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UNITED STATES ATOMIC ENERGY COMMISSION

Twentieth Semiannual Report

OF THE

ATOMIC ENERGY COMMISSION

July 1956

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LETTER OF SUBMITTAL

WASHINGTON, D. C.,
31 July 1956.

SIRS: We have the honor to submit herewith the Twentieth Semi-annual Report of the United States Atomic Energy Commission, as required by the Atomic Energy Act of 1954.

Respectfully,

UNITED STATES ATOMIC ENERGY COMMISSION,
WILLARD F. LIBBY.
THOMAS E. MURRAY.
HAROLD S. VANCE.
JOHN VON NEUMANN.
LEWIS L. STRAUSS, *Chairman*

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

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FOREWORD

Progress was made during the first half of 1956 in every principal aspect of the Nation's atomic energy program.

The most important step during this period toward development of peaceful uses of atomic energy was the President's announcement in February that he was approving the recommendation of the Atomic Energy Commission to make available 40,000 kilograms of special nuclear materials as required for fueling power and research reactors at home and abroad.

Development of nuclear power in the United States began to take shape. Basic regulations for the new industry were issued. Private concerns and public power bodies entered on a new planning for power reactors of different types. Three construction permits for power reactors were issued.

Under the Power Demonstration Reactor Program, a first contract was signed delineating the collaboration between Government and industry on design and construction of a power reactor.

The Atomic Energy Commission explored new reactor concepts for producing economic electric power and continued to encourage experimental work by industry.

Private participation was invited in a number of additional processes of atomic production. Applications for licenses to construct and operate atomic facilities continued to increase as did requests for access to classified information useful to industry.

An increasing volume of nonclassified and classified technical information was made available to private individuals and companies through published reports and compilations and through seminars and visits by holders of access permits to Commission installations.

The Commission continued its scrutiny of classification policy and classified material in its continuing program to make all possible information on peaceful applications available in unclassified form while tightly guarding the security of information related to military uses.

To help alleviate the shortage of technical manpower, more aid in education and training was scheduled.

The President's Atoms for Peace program received enthusiastic and widening support abroad and at home. New activities were reported almost daily.

The establishment of an International Atomic Energy Agency moved nearer with acceptance of a draft charter by a 12-nation sponsoring group and formulation of plans for a meeting of 87 nations to consider the charter.

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Additional countries entered into or negotiated for agreements for cooperation with the United States in peaceful atomic energy projects.

The exchanges of scientific and technical information accelerated as more documentary materials were provided and the rate of visits by technical and governmental personnel rapidly increased.

Training and education programs for friendly foreign nationals were expanded.

Business concerns of the United States supplied equipment for atomic activities in friendly nations.

The Atomic Energy Commission's production of special nuclear materials reached new high levels. All plants authorized in the construction program of July 1952 were completed and are now in operation.

Total raw materials supply again increased. The Commission announced its future (1962–66) program for purchasing domestic raw materials.

Weapons tests, two of which were open to representatives of the U. S. public news media and civil defense organizations, were held at the Eniwetok Proving Ground in the Pacific.

Work continued on design and construction of a growing family of military reactors.

The broad programs of research, supporting and assisting all atomic development and promoting progress and improvements in the fields of industry, agriculture, and medicine, continued to make productive contributions.

Research on controlled thermonuclear reactions continued, looking toward eventual control and use of the fusion reaction to produce power.

Fuel For Power and Research Reactors

On February 22, 1956, at the recommendation of the Atomic Energy Commission and with the Departments of State and Defense concurring, President Eisenhower announced that the Government would make available 40,000 kilograms of uranium 235—an amount of a value of a billion dollars at the unit prices announced in 1955 at the International Conference on the Peaceful Uses of Atomic Energy—to assist industrial power development and research within the United States and to enable friendly countries to develop the peaceful uses of atomic energy. In making the announcement, the President said, "This action demonstrates the confidence of the United States in the possibilities of developing nuclear power for civilian uses. It is an earnest of our faith that the atom can be made a powerful instrument for the promotion of world peace." [1]

[1] Text of announcement in appendix 8.

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The Presidential statement pointed out that, as additional projects were undertaken by United States industry and by other nations, the Atomic Energy Commission would recommend that additional supplies of nuclear fuel be made available as became necessary.

Of the uranium 235 allocated, 20,000 kilograms will be for domestic use chiefly in power reactors, and 20,000 kilograms (in addition to 200 previously allocated) for research and power reactors in cooperating countries. The uranium will be distributed under conditions prescribed by the Commission.

The present allocation of 40 metric tons of the fissionable isotope, uranium 235—20 metric tons of it for use in other countries—means that the United States is potentially dedicating hundreds of metric tons of enriched reactor fuel for use in research and power reactors. The fissionable material allocated would support the start of nuclear power programs with a generating capacity of several millions of electrical kilowatts.

In a statement issued simultaneously with the President's announcement, Chairman Strauss described the action as "the most important step toward peaceful uses of atomic energy since the passage of the Atomic Energy Act of 1954." [2]

The statement noted that the Commission now was authorized to provide sufficient uranium 235 to meet the estimated requirements of the private and public power groups in the United States which have announced plans for constructing nuclear powerplants; and could answer in the affirmative the "top-priority question" being asked by friendly nations—whether the United States would make fuel available for their nuclear power programs. The research agreements for cooperation with other nations embody a clause stating "the hope and expectation that this initial agreement . . . will lead to the consideration of further cooperation extending to the design, construction, and operation of power-producing reactors."

The chairman's statement added: "We are now embarking on programs of aid in nuclear power development, extending beyond our previous programs of support of atomic energy research in the United States and abroad. Under these programs we will provide uranium 235 to support nuclear power development during the life of the licenses issued under our civilian applications program at home and the expected life of agreed power reactor projects abroad using our fuel."

The 40,000 kilograms will not be distributed in any single year, but made available over a period of years as needed. The terms and conditions under which the 20,000 kilograms of uranium 235 will be made

[2] Text of statement in appendix 8.

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available to other countries will be provided in the separate agreements for cooperation. Charges for sale or lease of uranium 235 will be announced.

Expanding Peaceful Uses of Atomic Energy

Development in the United States

The notable progress of the past 6 months toward designing, constructing and operating nuclear *power reactors* to generate economically competitive electricity in the United States included the following:

The Commission issued and put into effect basic regulations on industrial development of power.

The Commission issued the first construction permits for two large power reactors, those of the Consolidated Edison Co., of New York, and of the Commonwealth Edison Co. of Chicago. Both are to be built without financial assistance from the Government. Applications were received for licenses to construct 10 reactors of various types, including two for the generation of power.

A fifth industrial combination—General Electric Co. and Pacific Gas and Electric Co.—planned to build a small power reactor without Government assistance. It received a construction permit.

The Commission contracted with the Yankee Atomic Electric Co., of Boston, Mass., to assist in developing a 134,000-kilowatt power reactor. The company will bear the construction costs. The Commission will contribute to research and development costs and will lend certain other assistance. This is the first contract to be entered into under the Power Demonstration Reactor Program.

Six public and cooperative organizations and one university submitted proposals to the Commission to build small power reactors under the Power Demonstration Reactor Program.

The Commission undertook work on four additional concepts potentially useful in power reactor design, making nine in all that were under study or to be constructed.

Construction of the Shippingport, Pa., Pressurized Water Reactor, planned for operation in 1957, went ahead on schedule. This will be the first large nuclear electric generating station in this country.

The Commission worked with Congress to devise methods for providing adequate public liability insurance for concerns wishing to build power reactors.

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[5] See Civilian Ap
[6] See p. 91 Eight

The price that the Commission will pay to licensees for plutonium as metal, and for uranium 233 as metal or as uranyl nitrate, was announced to holders of permits for access to classified information.

Studies leading to improved and more economical methods of separating fission products from spent reactor fuel elements, of radioactive waste disposal, and of possible commercial applications of nuclear heat were carried on at several locations, and new findings were made.

Altogether, private and public organizations have indicated that they are prepared to expend $358 million on power reactors. This exceeds the $313 million which the Government, under plans existing at the end of June 1956, would invest in experimental reactors and in contributing to some privately built and operated demonstration reactors. Some $210 million is indicated as industry's investment in power reactors to which the Government will make no financial contribution. Estimates were for investment by industry of $20 million in the Government's experimental nuclear power reactor program and of $128 million in the Power Demonstration Reactor Program. The Government's outlay was estimated at $236 million in the experimental program and $77 million in the demonstration program. The total electrical capacity envisioned by the plans for civilian nuclear power development as they stood in late June came to 1,182,000 kilowatts. Those which the Government would only license, not help finance, could total 673,000 kilowatts.

It has been estimated that the use of *radioisotopes* for research and in various processes in industry and agriculture already is repaying the Nation a dividend of several hundred millions a year. This dollar figure does not take into account the value to mankind of these substances as scientific tools, diagnosis, treatment and scientific study of human diseases and their consequent alleviation of human misery. During this reporting period to further the use of radioisotopes the rules governing distribution were simplified.[3] Earlier, the Commission had reduced by 80 percent the prices of reactor-produced radioisotopes used domestically for biomedical and agricultural research.[4] In the 6 months, 304 additional users applied for radioisotopes raising the total to 3,279. There were 5,875 shipments, including 369 for export. Training courses in handling radioisotopes, from which 2,500 persons already have been graduated, continued to increase the benefits of radioisotopes at home and abroad.

The Commission moved ahead with the program for *broadening private participation* in developing peaceful uses of atomic energy, and

[3] See Civilian Application.
[4] See p. 91 Eighteenth Semiannual Report (July–December 1955).

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encouraging increased performance of basic atomic energy processes by private concerns.

A working group reviewed under terms of the latest Declassification Guide more than 30,000 technical reports, determined that nearly 11,000 could be removed from classification, and more than 8,000 could be reduced in classification. Another revision of the Declassification Guide was initiated.

To assure prompt publication and distribution of technical information, the Commission undertook special steps to compile, and issue additional summaries of knowledge in various fields, individual reports, data, and engineering drawings. The unclassified material will be generally available; the classified will be available to appropriate categories of private individuals and concerns authorized to have access to classified papers for industrial purposes. A series of seminars was held and visits to Commission facilities arranged to provide industry representatives with essential information.

An additional 310 permits were issued during this reporting period for private persons and companies to have access to classified information useful for industrial purposes, raising to 912 the total of permits issued.

The Commission invited private concerns to submit bids on magnesium fluoride scrap generated at feed materials plants, and provided industry with additional information on which to base proposals (due October 1956) for manufacturing uranium feed for production plants.

Private industry was invited to undertake chemical processing of spent fuel elements, to increase commercial production of light weight engineering materials for shielding, and to supply beryllium needs. A new expanded program for procurement of zirconium from commercial sources was announced.

The Commission announced that its facilities were open to cleared individuals and concerns for experimental work when private facilities were not available.

The Commission assigned high priority to constructing the Engineering Test Reactor at the National Testing Station in Idaho. The Westinghouse Electric Corp. announced plans to finance and build a testing reactor.

The Commission's requests to private concerns for proposals to provide supplies or services for the atomic energy program serve three main purposes (1) to avoid further expansion of some Government-owned facilities; (2) to increase the capacity of private industrial plants adapted to serving atomic energy programs; and (3) to help

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private enterprise to develop sources of supply for the expanding private and public atomic energy industry.

Vital to both the industrial and the Federal programs for maintaining the United States leadership in atomic energy development is the *education and training* of more and better equipped scientists and engineers. A general shortage of technical manpower is the most severely limiting factor in expanding scientific programs in the economy of the United States. While the attractions of careers in the various atomic energy fields may tend to minimize the effects of the shortage in this special area, the lack of scientific and engineering personnel is a considerably more serious obstacle for the future than lack of raw materials or money. Public attention has been drawn to these facts in recent months by Government officials, including members [5] and staff [6] of the Commission. The Commission has undertaken some measure of aid to teachers, schools and colleges. However, the main initiative here must be taken by the educational system itself. Prompt energetic action is essential.

The Commission's recent actions aim (1) to expand specialized training in nuclear energy technology for industrial and Government employees and a quota of foreign nationals, and (2) to assist colleges and universities in establishing curricula and acquiring scientific equipment for use in nuclear science and engineering instruction and to help educators interest high school students possessing the necessary talents in studying for careers in science and engineering.

Report of panel study. In January 1956, the Panel on the Impact of the Peaceful Uses of Atomic Energy, appointed by the Joint Committee on Atomic Energy, filed its report with the Committee. The Panel reported, among its findings, that the "Commissioners and the Commission organization have reason to be proud of the Commission's accomplishments."

The Commission aided the Panel in its studies and welcomed its observations and recommendations for further developing peaceful uses of atomic energy. The Commission's views on the findings and recommendations of the Panel were presented to the Joint Committee in hearings held late in February. The transcript of the hearings was printed and is available to the Congress and the public. Earlier in February at a series of hearings the Commission presented to the Joint Committee its report of the growth, progress, and prospects, for industrial development in various fields of atomic energy, particularly in the production of electrical power with nuclear reactors,

[5] Chairman Strauss, in an address before the Thomas Alva Edison Foundation Institute, November 21, 1955.

[6] Rear Adm. H. G. Rickover, Chief, Naval Reactors Branch, Reactor Development Division, in an address before the Thomas Alva Edison Foundation Institute, November 22, 1955.

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as required in Section 202 of the Atomic Energy Act of 1954. The transcript of these hearings also has been printed and is available to the Congress and the public.

International Activities

The nations of the world moved measurably closer to the wide cooperation in developing peaceful uses of atomic energy which President Eisenhower proposed in his historic address before the United Nations General Assembly on December 8, 1953. Representatives of 12 nations agreed in early 1956 on a draft for a statute for an International Atomic Energy Agency. The draft statute will be submitted in September 1956 to a conference to which 87 nations, members of the United Nations or its specialized agencies, are to be invited. The Atomic Energy Commission worked with the Department of State and other agencies in the discussions on the International Agency charter, in disarmament conferences, and in presentations of the United States on various technical matters before United Nations committees and organizations.

Among the major actions of the last 6 months in international cooperation were the following:

Agreements for cooperation were negotiated with 11 nations (two of these were power reactor agreements with nations which previously had research agreements). Existing agreements with 4 nations were amended to provide for additional cooperation. During the period 8 new agreements went into effect—five of them negotiated during the previous reporting period; at the end of the period 8 new agreements and 4 amendments to agreements were before the Joint Committee on Atomic Energy for the 30-day statutory waiting period. (Status of agreements for cooperation nation by nation is shown in tabulated form on p. 12 of this Report.)

A regulation was issued on United States industrial activity in atomic energy in other countries. Official reports to the Commission show that business concerns contracted to design and construct seven reactors in other countries; contracts with United States concerns for three reactors in other countries are being considered.

The first four commitments were made under the President's plan to provide financial aid to research reactor projects in other friendly countries. Brazil, Denmark, the Netherlands and Spain are to receive $350,000 each.

The first shipments of heavy water were made to other countries and 129 tons were committed for delivery in six different nations.

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The United States facilitated atomic energy development abroad through taking part in technical conferences, exchanges of information, establishment of special exchange and coordinating groups on technical subjects, and interchange of scientific visits.

The reactor training program at Argonne National Laboratory was expanded by the addition of training units also at Pennsylvania State University and North Carolina State College. This action almost doubles the number of engineers and scientists that could be enrolled, including nationals from cooperating countries.

The Commission acted to permit increased numbers of scientists from friendly nations to do nonclassified work in nonsecurity areas of Commission and certain contractor facilities.

The Commission assisted in development of the program for the Asian Nuclear Center, which it was announced in March 1956 would be located in the Philippine Islands.

Additional technical libraries were presented to 9 other countries, bringing to 42 the individual libraries contributed to nations, plus 3 to international organizations.

Procedures for foreign distribution of radioisotopes for research were simplified.

United States physicists took part in three international conferences held to discuss high energy physics, at Rochester, N. Y., at Moscow, USSR, and Geneva, Switzerland.

Operations and Other Major Developments

Commission operations showed further strong advances during the first half of 1956.

Raw Materials and Production of Special Nuclear Materials

Production of uranium ore and concentrates from all free-world sources continued to increase. The rise in domestic production was especially rapid. Construction of additional milling facilities, here and in other countries, will contribute to further increases. When all facilities under construction, or definitely planned, are completed, the free world production of U_3O_8 may exceed 30,000 tons a year. The total can be increased if required. The United States now is the free world's leading producer of uranium ore in the free world with a total output approaching 3 million tons a year.

The Commission announced in May a new 5-year program for guaranteed purchasing of raw materials, to take effect when the

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present program expires in 1962. After that date, the Commission no longer will buy ores, but will guarantee to purchase mill outputs of concentrates under contract. The announcement of the program was made in advance in order to enable uranium miners and mill operators to plan ahead. As industrial demand grows, a gradual change from a Government-controlled to a commercial market is anticipated by the Commission.

Production of special nuclear materials again increased as the Commission placed in operation all the new facilities built in the expansion program authorized by the Congress in July 1952. As of June 30, 1956, the Nation's total investment in all Federal facilities amounted to about $6.75 billion before depreciation reserves.

Military Development

The emphasis in the military applications program during the last 6 months was upon research and development related to expanding the categories of nuclear weapons, including those intended primarily for defense. Production continued in accordance with the President's directive. Production and ordnance facilities are being expanded.

A series of tests of atomic weapons—"Operation Redwing"—were carried on at the Eniwetok Proving Ground in the Pacific. Two detonations, one of which was in the megaton range, were witnessed by pooled representatives of U. S. news media—the only Pacific tests covered at first hand by newsmen in 10 years. Civil Defense official representatives also observed the tests.

The current tests involved weapons generally smaller in yield than those tested during the 1954 series. The energy yield of the largest test fell substantially below that of the maximum 1954 test.

The programs for design and construction of military nuclear reactors continued to expand. These reactors are an important influence in accelerating practical development of all nucelar powerplants, including those for civilian use.

The naval reactors program, a joint undertaking of the Commission and the Department of Defense, is aimed at developing a series of nuclear powerplants designed to propel many sizes of naval ships from submarines to aircraft carriers. Construction of a second nuclear-powered submarine, the USS *Seawolf*, neared completion. A radar picket submarine, the largest submarine ever to be built and the first powered by two nuclear reactors, was authorized by the Congress.

The Army program now includes three major projects: a package power reactor being constructed at Fort Belvoir, Va., a smaller low-power reactor, and a reactor to assist in experiments with radiation

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as a tool for food preservation. Other advanced reactor systems were under consideration, including a gas-cooled type.

Research and development activities on aircraft nuclear powerplants progressed satisfactorily, and new test facilities were programmed for the National Reactor Testing Station in Idaho.

Research and Development Programs

The Commission's various research and development programs continued to attack the many problems involved in expanding uses of atomic energy and to provide fundamental understanding and data on which scientific progress may be based.

High-energy physics continued to command much attention. Drs. Frederick Reines and Clyde Cowan, Jr., physicists attached to the Los Alamos Scientific Laboratory, supported by the Commission, reported the discovery of a small nuclear particle, long predicted but not previously identified, called the neutrino. Studies continued in the properties of another nuclear particle, the antiproton, discovered last year at the University of California Radiation Laboratory of the Commission by Drs. Owen Chamberlain, Emilio Segre, Clyde Wiegand, and Thomas Ypsilantis, with help and cooperation from Herbert Steiner and Dr. Edward Lofgren.

Inorganic materials were tested as substitutes for organic resins in ion exchange separators; metallurgists explored problems in the use of liquid metal fuels in reactors. The Commission's research on methods of controlling thermonuclear reactions so that they some day may be employed in power generation went forward in five laboratories.

New methods of using atomic energy products and techniques to locate and treat cancers, and studies of the effects of radiation upon living creatures, were among the areas in which the life sciences made progress. The Commission advanced its program of providing improved facilities to assist fundamental research. A contract was signed for construction of a new Medical Research Center at Brookhaven National Laboratory to include the first nuclear reactor specifically designed for medical research and therapy.

Design and construction of two high-energy accelerators which the Commission will largely finance was approved for two Eastern universities, and design of two more high-energy accelerators was authorized for Midwest locations.

Information

During the past 6 months, the Commission has maintained and enlarged its efforts to inform the public and interested industry about

activities of the atomic energy program, at the same time that it has vigorously enforced those restrictions which protect information as vital to the national security. Special programs have distributed classified information within the atomic energy project and to appropriate Government agencies, in addition to the program mentioned earlier for assisting those private individuals and business concerns that have been granted permits and security clearances to have access to classified information.

A greatly enlarged program for translating and publishing foreign technical materials is under way. Additional depository libraries of unclassified Commission-published materials are being opened throughout the United States; the total as of June 30, 1956, was 49 libraries. Broad programs for publications and distribution of both unclassified and classified material are under way. Special transportable exhibits on peaceful uses of atomic energy were prepared and the Commission will bear transportation charges for their tours.

Administration and Personnel Activities

Important among administrative actions of the Commission during the reporting period was its revision of criteria and review procedures for determining whether a person in, or entering, the atomic energy program, is eligible for security clearance. The revision was announced on May 10, 1956, effective that day.

The Administrator, Housing and Home Finance Agency, was assigned responsibility by the President under the Atomic Energy Community Act of 1955 for disposing to private ownership all Commission properties in the atomic energy communities of Oak Ridge, Tenn., and Richland, Wash. Rules for priorities for purchase of residential and commercial properties were issued by the Commission. At Los Alamos, N. Mex., plans were completed for construction of housing units to replace temporary housing erected during the war years, and studies were under way to determine the feasibility of selling land for private construction.

On January 27, 1956, the appointment of Atomic Energy Commissioner Harold S. Vance, who had served under a recess appointment since October 1955, was confirmed by the United States Senate.

On June 4, 1956, the President renominated Atomic Energy Commissioner Willard F. Libby for a 5-year term, and on June 19, 1956, the Senate confirmed Dr. Libby's reappointment. Dr. Libby was appointed first in 1954 to fill an unexpired term.

In the staff, J. L. Kelehan resigned as Assistant General Manager for Administration, and Robert E. Hollingsworth, formerly Assistant Director, Division of Production, was appointed his successor. Paul

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F. Foster, formerly Special Assistant to the General Manager (Liaison), was appointed Assistant General Manager for International Activities, with the Division of International Affairs and the new Office of Special Projects under him. He was succeeded by John L. McGruder. Bryan F. LaPlante, formerly Assistant Director for Washington Area Security Operations, Division of Security, was appointed Special Assistant to the General Manager (Congressional Relations) succeeding William C. Wampler, resigned; C. D. W. Thornton resigned as Chief, Office of Operations Analysis and Planning, and was succeeded by Paul C. Fine, Assistant to Commissioner John von Neumann, as Acting Chief; Allan E. Jones was appointed Manager, Grand Junction Operations Office, Grand Junction, Colo.

Effective May 31, 1956, an Office of Special Projects was established, with responsibility for Commission activities on disarmament and, as assigned, for certain other international activities. Edward R. Gardner, formerly Deputy Director, Division of International Affairs, was named Director of the new office.

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MAJOR ACTIVITIES IN ATOMIC ENERGY PROGRAMS, JANUARY–JUNE, 1956

Raw Materials

Production of uranium ore and concentrates from all free-world sources continued to increase during the first half of 1956. The rise in domestic production was especially rapid, and the United States is now the free world's leading producer. Construction of new facilities for ore processing in this and other countries, and expansion of existing facilities, will produce further increases. Upon completion of projects now under way, or definitely planned, production of the free world should exceed 30,000 tons of uranium oxide (U_3O_8) per year, and this production can be increased if larger demand develops.

In May the Atomic Energy Commission announced a new domestic uranium procurement program which will replace the present program when it expires in 1962. The announcement of this new program will assist uranium mining and milling firms in planning future operations.

Domestic Production

Production of uranium ore and concentrates in the United States attained record levels during the reporting period. Three new mills were under construction and a number of concentrate proposals have been received which would involve construction of additional mills.

Extension of Domestic Procurement Program

The new uranium procurement program will provide a guaranteed market for all uranium concentrates produced by domestic mills from domestic ores, subject to compliance with Commission specifications and also to a stipulation that the Commission reserves the right to limit its purchases from any one mining property or mining operation to 500 tons of U_3O_8 per year. No commitment was made for purchase of vanadium after March 31, 1962. The new program will go into effect April 1, 1962, and will continue through December 31, 1966. Details about the new program will be published at a later date.

Under the new program the Commission established a base price for uranium concentrates, rather than for ores as formerly. The base price will be $8 a pound for U_3O_8 contained in concentrates that comply with specifications and is applicable to the type of high-grade

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chemical concentrate now bought under negotiated unit price contracts with milling companies. If in excess of 500 tons U_3O_8 per year is purchased from any one mining property or mining operation the price paid for the excess may be less than $8 per pound of U_3O_8.

Uranium concentrate producers will be required to enter into contracts if they wish to sell to the Commission. Contracts negotiated before March 31, 1962 may provide for amortizing the cost of milling facilities over a period extending beyond that date. In this case, an amortization factor could be added to the $8 base price, but amortization must be on not less than a 5-year basis. With respect to plants that have been fully or partially amortized under Commission contracts, the Commission may require that a part of mill capacity be available for treatment of purchased or custom ores.

The period for payment of a bonus for initial deliveries of uranium ores from eligible mining properties was extended from its original expiration date of February 28, 1957, through March 31, 1960.

As industrial demand for uranium develops, a gradual change from a Government-controlled to a commercial market is expected to take place. Producers will be able to sell to licensed domestic commercial users as well as to the Commission.

Ore Production

The number of uranium mines in production during the first 6 months of 1956 remained about the same as for the last 6 months of 1955, but the output from existing mines continued to increase sharply. Uranium ore production in the United States has reached nearly 3 million tons a year, and is expected to reach 5 or 6 million tons a year. In 1948, only about 70,000 tons of ore was produced in the United States.

Although no new uranium producing area was discovered during the last 6 months, several areas under development have been expanded.

New leasing system. On December 21, 1955, the Commission announced that a system of competitive bidding would be instituted for leasing uranium deposits developed by the Commission on withdrawn public lands and certain other areas under Commission control. The new leasing method became effective July 14, 1956, with publication in the *Federal Register* of the regulation, "Uranium Leases on Land Controlled by the Commission" (10 C. F. R. Part 60, Section 60.8).

This system will replace the previous selecting of lessees on the basis of qualifications, including mining experience and financial status. Under the new method, leases will be awarded to the acceptable bidder offering the highest cash bonus by sealed bid. The royalty rate, work

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requirements, and other conditions will be stipulated in the invitation to bid. These conditions would be determined by the Commission, based on the estimated size and grade of the deposit and the cost of mining facilities and production. However, leases will continue to be negotiated, rather than offered for competitive bidding, if special circumstances indicate that negotiation is in the best interest of the Government.

Ore Processing

Ore production exceeded processing capacity, with ore being stockpiled at the locations of new mills. With the completion of new mills under construction or planned, stockpiles will be reduced to normal operating inventories. All new mills and expansions are privately financed.

In addition to the nine mills already in operation, including the one at Monticello owned by the Commission, three are under construction, one at Tuba City, Ariz., one at Edgemont, S. D., and the other at Moab, Utah. Contracts for the purchase of production from a number of new plants are being negotiated. The new mills are being considered for such widely scattered areas as northwestern New Mexico, southern and eastern Utah, east-central Colorado, central Wyoming, and eastern Washington.

The total number of mills may be doubled by 1958. They range in size from 200 to more than 2,000 tons daily ore capacity.

Uranium in lignites. Several groups have indicated an interest in producing uranium concentrates from uranium-bearing lignites but production plans will depend upon the success of further development and pilot plant testing.

Uranium from phosphates. Byproduct uranium concentrates from Florida phosphate rock continued to be produced in small tonnages. A new byproduct uranium recovery unit is now being completed at East Tampa, Fla. for operation this fall under contract with the Commission by the U. S. Phosphoric Products Division of the Tennessee Corp. Solvent extraction of uranium from phosphoric acid, a process developed under contract for the Commission, will be used.

Foreign Activities

Combined Development Agency

Except for its Canadian contracts, the United States has undertaken foreign procurement jointly with the United Kingdom. The Com-

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bined Development Agency (CDA) was established in 1944 as one of the United States-United Kingdom-Canada operations of wartime atomic development. CDA's principal function is to develop and procure uranium supplies. Since Canada is a uranium producer with limited requirements, it does not participate in the combined procurement program, and its uranium has been sold to the United States under direct Commission contracts. The CDA at present has production contracts with Belgium, the Union of South Africa, Australia, and Portugal.

Belgian Congo

The Shinkolobwe mine in the Belgian Congo continued as an important producer of uranium without significant change in the rate of produciton.

South Africa

South African production again increased over the previous 6-month period, and will continue to increase as new plants are completed. A total of 17 uranium processing plants has been authorized, of which 14 are in operation.

Australia

Low-grade mechanical concentrates produced at Radium Hill in South Australia continued to be treated at the Port Pirie chemical treatment plant at a normal rate. Rum Jungle operations in the Northern Territory of Australia are producing uranium concentrates as expected.

Portugal

Operations in Portugal during the past 6 months continued at the normal rate.

Canada

The Canadian Government in February extended from April 1, 1957, to September 30, 1957, the deadline for commencement of production by companies submitting applications for special price con-

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tracts. Applications for contracts were received up to March 31, 1956. During the 6-month reporting period, the Canadian Government, through Eldorado Mining and Refining, Ltd., made additional commitments to purchase uranium under its program as announced in August 1955, and modified in February 1956. Essentially all uranium now produced in Canada comes to the United States under contracts between the Commission and Eldorado.

Several new mills are being built in the Beaverlodge area of Saskatchewan and the Bancroft area of Eastern Ontario, but the major new production will come from the Blind River area, just north of Lake Huron in southern Ontario. Blind River is developing into probably the most important uranium field in the world.

After announcement by the United States Atomic Energy Commission of its new program for purchasing domestic ore, the Canadian Government stated that it did not intend at this time to extend the Canadian uranium-buying program. The statement pointed out, however, that purchasers have the option under present special purchase contracts to extend the contracts beyond the expiration date of March 31, 1962.

Domestic Exploration

Private exploration has resulted in substantial increases in domestic ore reserves, particularly in the major uranium field in the Ambrosia Lake area, McKinley County, N. Mex., and in central Wyoming. The potential reserves of the producing areas of the United States have been estimated at 30 million tons of uranium ore. In addition, geological experts place the reserves of "indicated" and "inferred" ores at another 30 million tons. There are large areas of this country geologically favorable to uranium deposits that are yet to be explored.

Government exploration activities, conducted by the Commission, the U.S. Geological Survey, and the Bureau of Mines, Department of Interior, continued to be concentrated on evaluation of ore reserves and the results of private activity, on basic geologic studies of uranium ore deposits, and on dissemination of information useful to private operators.

Government drilling amounted to about 40,000 feet in the first half of 1956, in comparison with about 5 times that much in the last half of 1955. It was limited to completing projects designed to support geologic investigations. Virtually all drilling activities for uranium exploration and development were carried out by private interests. Total private drilling during the first half of 1956 was estimated at more

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than 4,000,000 feet, which is nearly equal to total private drilling for the entire year of 1955. A major portion of this drilling was for development rather than exploration.

Process Development

Process development continued in the Commission-owned laboratory at Winchester, Mass., operated under contract by the National Lead Co., Inc.; in the Bureau of Mines Experimental Station at Salt Lake City; and in the laboratories of Arthur D. Little, Inc., San Francisco, Dow Chemical Co., Pittsburg, Calif., and Battelle Memorial Institute, Columbus, Ohio.

Pilot plant testing for projected mills was carried on at the Commission-owned facilities at Grand Junction, Colo., also operated under contract by National Lead.

At Columbia University, laboratory and bench-scale studies on uranium recovery from Chattanooga shales continued.

Production

Production of special nuclear materials continued to increase during the first half of 1956 as additional facilities were placed in operation. With completion during the reporting period of the last units of the gaseous diffusion plant at Portsmouth, Ohio, and initial operation of a new chemical separations plant at Hanford, Wash., the Atomic Energy Commission now has in production all additional facilities authorized in July 1952.

On March 13, 1956, the last of 11 generator units of the two Ohio Valley Electric Corp. power stations, generating electricity for the Portsmouth plant, was declared in commercial operation. The last of 5 units at the Kyger Creek station went into full operation on December 22, 1955, ahead of schedule by a total of 5 generator-unit months of electricity production. The Clifty Creek station went into complete operation March 13, a total of 3½ generator-unit months ahead of schedule. Early completion meant a saving in operating expenses for the Portsmouth plant which thus was able to fulfill base load requirements at firm power rates of less than 4 mills per kilowatt hour, replacing interim power rates of between 5 and 6 mills.

Facilities now in production for turning out enriched uranium include three gaseous diffusion installations, at Oak Ridge, Tenn., at Paducah, Ky., and at Portsmouth. Facilities for production of plu-

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nium consist of eight graphite-moderated reactors at Hanford, and e heavy water-moderated reactors at Savannah River, S. C. To pport major production facilities, auxiliary plants are located at e major sites. At reactor installations are plants for final prepara- n of fuel elements and for chemical separation of spent elements. diffusion sites are plants for manufacturing uranium hexafluoride d material.

As of June 30, 1956, expansion of the Paducah hexafluoride plant s 2 percent behind schedule; expansion of the Fernald, Ohio, plant r manufacturing reactor fuel elements was 8 percent behind dule.

The new plant at the Weldon Spring site in the St. Louis, Mo., Area s 9 percent behind schedule.

To provide private industries with additional information on which base proposals (due October 1, 1956) for manufacturing further ntities of uranium feed for production plants, the Commission anged a series of seminars with industry representatives. Follow- this series of meetings arrangements were made, at the request of ms active in this program, for visits by individuals to feed material s for further specialized discussions with contractor personnel. visits are expected to continue through the summer months.

As an additional step toward doing away with the Government nopoly in production of materials, and toward providing services the atomic industry, the Commission on January 17, 1956, invited vate concerns to figure on purchasing magnesium flouride scrap erated at feed materials plants. The Commission estimated that 00 to 8,000 tons of scrap will be available annually. The date when posals are to be submitted will be set after private concerns have e to make their studies. Interested firms were provided with scrap terial and technical data for their calculations. Other steps in the gram of promoting private participation in atomic energy activi- are described in the section of this report on Reactor Development.

Military Application

phasis during the last 6 months was placed on research and elopment related to expanding the United States family of nuclear pons, including those primarily designed for defensive purposes. work was advanced by the results of the full scale tests conducted arly 1955 at the Nevada Test Site (Operation Teapot).

During this reporting period production of atomic weapons con- d in accordance with the President's directive.

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Operation Redwing

Early in May 1956, a full-scale series of tests began at the Eniwetok Proving Ground, in the Marshallese Islands of the Pacific. This series, designated "Operation Redwing," incorporated further testing of devices leading toward development of defensive weapons, as well as testing of thermonuclear devices to verify the state of understanding of these weapons.

In order to broaden public knowledge of the effects of thermonuclear weapons, and to provide nongovernmental reporting of the conduct of a test at the Eniwetok Proving Ground, a selected group of 15 news media representatives was invited to witness a detonation of a device with a yield in a range equivalent to millions of tons of TNT (see Information Services). Also included in this special group were 17 observers selected by the Federal Civil Defense Administration. It is believed that this first hand experience provided the observers, and through them the public, with information which will greatly enhance the civil defense effort.

The meticulous safety precautions surrounding the tests, which included a danger area many times larger than the initial area used in the 1954 series, resulted in a 13-day postponement of the shot viewed by public media and civil defense observers due to unfavorable weather conditions (see Biology and Medicine).

The explosive force of the detonation on May 20 of a device dropped from an airplane was, as predicted, substantially lower than the largest yield of the 1954 series. The tests involve weapons generally smaller in yield than those tested during the 1954 series. The energy yield of the largest test falls substantially below that of the maximum 1954 test.

Additions to the Weapons Production Complex

With the two weapons research laboratories, the Los Alamos Scientific Laboratory, Los Alamos, N. Mex., and the University of California Radiation Laboratory at Livermore, Calif., working on new principles, the United States family of weapons in various stages of research, development, and production engineering, is increasing rapidly.

In order to facilitate early production of the weapons conceived in the Livermore Laboratory, it has become necessary to increase weapons production facilities, and to provide ordnance engineering facilities at Livermore, in addition to those currently provided at Albuquerque, N. Mex., by the Sandia Corp., a subsidiary of Western Electric Co.

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It has been determined that the expanded ordnance engineering function should be carried out under the current contract with the Sandia Corp. which, since 1949, has been administered by the Albuquerque Operations Office (formerly the Santa Fe Operations Office),[7] and will continue to be administered by that office. The Livermore laboratory itself is operated by the University of California under a contract administered by the San Francisco Operations Office. The expansion is expected to result in a significant increase in employment at the Livermore laboratory, as well as at the Livermore branch of the Sandia Corp.

Construction has begun on an $18.4 million addition to the weapon production facility at Rocky Flats northwest of Denver, Colo. This expansion includes two new process buildings and additions to three existing structures. The project is on schedule and employs a construction force of about 700.

Corresponding necessary expansion of other weapon production facilities is planned.

Some 1,000 personnel of Los Alamos Scientific Laboratory have moved into the new, 4-story General Laboratory and Administration building which was completed recently. This new $6 million structure replaces most of the remaining temporary laboratory buildings built in 1943 and 1945. The new building which provides some 560 offices and contains 210,000 square feet of usable space, stands in the modern technical area on the South Mesa. Plans call for further construction on the South Mesa to replace the remainder of the technical operations buildings in the townsite area on Los Alamos Mesa.

International Affairs

Outstanding among the events related to the international program for development of the peaceful atom was the agreement of twelve sponsoring countries of the United Nations, including the United States and the Soviet Union, on an acceptable basic charter for establishment of an International Atomic Energy Agency. Representatives of 87 nations will be invited to participate in a conference to consider this basic charter at United Nations headquarters in New York during September 1956. This accomplishment grew out of the proposal for international cooperation to advance the peaceful uses of atomic energy which the President made in his historic address before the United Nations General Assembly on December 8, 1953.

[7] See Organization and Personnel.

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Another major development during the first half of 1956 was the allocation of 40,000 kilograms of contained uranium 235, one-half of which will be earmarked for use in foreign nations for peaceful purposes. This will be principally used for fuel in research and power reactors and is in addition to the 200 kilograms of uranium 235 previously allocated (see Foreword for details).

As the United States continued during this reporting period its negotiations of agreements for cooperation, a total of 38 agreements had been completed with 36 nations. Agreements with 30 nations were in effect as of June 30, 1956, eight more than at the close of the previous reporting period. The remaining eight agreements have been placed before the Joint Committee on Atomic Energy of the Congress to lie for the required 30 days. They were scheduled to complete the United States requirements for going into effect during July.

Other developments in international cooperation included actions which: enabled United States industry to work with other nations with the result that, as of June 30, 1956, business concerns had been selected to build seven reactors in other countries; pledged the United States to contribute financial support to research reactor projects in Brazil, Denmark, the Netherlands, and Spain, the first commitments under the President's plan for research assistance; resulted in sales of reactor materials abroad; gave assistance to the Department of State in various United Nations activities, including disarmament discussions; facilitated exchanges of information with scientists of other nations; increased to 42 the number of technical libraries approved for presentation to other countries plus three to international agencies; expanded technical and scientific training programs; and assisted in developing plans for the Asian Nuclear Center to be established in the Philippine Islands. United States scientists also participated in three international conferences on high energy physics, and the Commission broadened the opportunities for alien scientists to participate in nonclassified research in Commission and certain contractor facilities. The Commission also assisted in United Nations plans to establish an international system for collection of data on radioactive fall-out.

International Atomic Energy Agency

The early establishment of an international agency is one of the major objectives to which considerable effort has been directed during this reporting period. Conferences were held in Washington from

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February through April by the 12-nation working groups to consider the text of a draft statute for establishing the agency. Representatives at the conference included those from the original eight countries sponsoring the agency—Australia, Belgium, Canada, France, Portugal, the Union of South Africa, the United Kingdom, and the United States; and the four nations later invited to participate—Brazil, Czechoslovakia, India, and the Soviet Union.

Substantial agreement was reached on the draft statute, and 87 nations are to be invited to send representatives to a conference on the final text of the statute to be held in New York in September 1956.

The draft statute adopted by the 12-nation group at Washington provided for an agency empowered to perform significant services in aiding the atomic energy programs of member countries. The agency would be required to apply minimum prudent safeguards to atomic energy projects supported by the agency. It could handle and store significant amounts of special nuclear materials, and serve as a pool to distribute materials for major contributors.

Under the draft statute, the agency's general administrative expenses, including the costs of safeguards for agency projects, would be financed by apportionment among the members in accordance with a scale to be determined by the agency's general conference. The costs of materials, services, equipment, and facilities furnished to members by the agency would be recovered through charges made to recipients.

Agreements for Cooperation

Negotiations of agreements for cooperation in developing the peaceful uses of atomic energy had been completed with 36 nations as of June 30, 1956. New agreements covering power reactors also had been negotiated with two countries formerly having research agreements with the United States. Of the total, 30 agreements had become effective. Eight agreements, including five negotiated before Dec. 31, 1955, became effective during this reporting period. Before June 30, the remaining eight had been signed and filed with the Joint Committee on Atomic Energy of the Congress where they must lie for days while the Congress is in session before they can come into effect. Four of these pending agreements deal with power reactor projects. In addition to these new agreements, amendments had been negotiated on four existing agreements and these also were forwarded to the Joint Committee.

The following table lists all agreements on which negotiations have been completed as of June 30, 1956, by type of agreement and by status of agreement.

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AGREEMENTS FOR COOPERATION IN EFFECT AND PENDING

Research reactor agreements	Power reactor agreements	Pending—date placed before Congress	Effective date January-June 1956 [1]
Argentina [1]			
	Australia	June 18, 1956	
Austria		June 8, 1956	
	Belgium		
Brazil			
	Canada [2]	June 26, 1956	
Chile			
Colombia			
Costa Rica			June 21, 1956
Cuba		June 22, 1956	
Denmark [4]		June 28, 1956	
Dominican Republic		June 15, 1956	
Federal Republic of Germany [4]		June 28, 1956 [4]	Apr. 23, 1956
France	France [3]	June 19, 1956	
Greece			
Ireland [5]			May 14, 1956
Israel			
Italy			
Japan			
Lebanon			
Netherlands	Netherlands [6]	June 21, 1956	
New Zealand		June 14, 1956	
Pakistan			
Peru			Jan. 25, 1956
Philippines			
Portugal			
Republic of China			
Republic of Korea			Feb. 3, 1956
Spain			
Sweden			Jan. 18, 1956
Switzerland	Switzerland [6]	June 20, 1956	
Thailand			Mar. 13, 1956
Turkey			
	United Kingdom [2]	June 13, 1956	
Uruguay			Jan. 13, 1956
Venezuela			

[1] Where no date is given, agreement was in effect during previous reporting period ended Dec. 31, 1955.
[2] Agreements expanded by amendment, see text.
[3] Agreement with France includes only nonclassified information.
[4] Agreement amended to increase amounts of uranium 235 available.
[5] Exchange note from Ireland not received as of June 30, 1956.
[6] New agreements negotiated; earlier agreements did not include power reactors.

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As of June 30, the United States was negotiating *research reactor agreements*[8] with Ceylon, Ecuador, Guatemala, Haiti, Union of South Africa, and Yugoslavia. Special ceremonies were held on the signing of the Thai agreement on March 13, 1956, in Bangkok. The Secretary of State signed on behalf of the United States. The Thai Foreign Minister, on behalf of the Government of Thailand, expressed deep interest in the Atoms for Peace Program.

As a result of the President's allocation of uranium 235, partly for use in power reactors abroad, it is expected that cooperating countries will be increasingly interested in *power reactor agreements*. Negotiations of power reactor agreements were completed as of June 30 with Australia, France, the Netherlands and Switzerland. Discussions were continuing with Brazil, India, Italy, and Norway. The power reactor agreements generally are to provide for exchange of information on experimental and power reactors, and for transfer of uranium enriched in uranium 235 up to a maximum of 20 percent for use as fuel in reactors. During June, the Commission approved amendments negotiated on power reactor agreements with Canada and the United Kingdom, to broaden the permissible areas of exchange. The amendment of the United Kingdom agreement was signed June 13, that with Canada on June 26, and both were placed before the Joint Committee.

Activities in International Cooperation

Contracts with United States Industry

Commercial transactions under way within the framework of the international agreements are listed below:

Belgium. The Westinghouse International Electric Co. under contract to the Syndicat d'Etude de l'Energie Nucleaire, a group of private Belgian firms, has designed and will construct a pressurized water reactor to operate at 11,500 kilowatts. It is anticipated that the reactor will be in operation some time in 1958.

Westinghouse has been authorized to exchange classified information with authorized Belgian nationals on the construction and design of the reactor. The Mallinckrodt Co. will convert uranium hexafluoride (UF_6), obtained from the Commission, into uranium dioxide (UO_2) to be fabricated into fuel elements by Westinghouse. The special nuclear materials needed will be provided under terms of the agreement for cooperation. To assist early development of this pro-

[8] For general content of research reactor agreements, see pp. 6–7, Eighteenth Semiannual Report (January–June 1955).

gram, Belgian nationals have been placed in various Commission facilities and universities throughout the country and others will be accepted for advanced training and research in nuclear technology.

Brazil. The National Research Council of Brazil has awarded a contract for construction of a 5,000-kilowatt pool research reactor to The Babcock & Wilcox Co. It will be located at the Atomic Energy Institute at the University of Sao Paulo. A pool reactor uses water as moderator, coolant, and shield.

Denmark. The Foster Wheeler Corp., of New York received a contract to build a 5,000-kilowatt pool reactor for the Government of Denmark.

Greece. Information has been received by the Commission that specifications for the construction of research reactors were forwarded by Greece to American firms with requests for bids. The specifications called for a 200-300 kilowatt pool reactor.

Israel. Bids were requested by Israel for designing and constructing two reactors: a 10,000-kilowatt natural uranium-heavy water reactor, and a pool reactor.

Italy. The Italian Government has awarded a contract to American Car and Foundry Industries for design of a 5,000-kilowatt heavy water research reactor (similar to the CP–5 of Argonne National Laboratory) to be located in Milan.

Japan. A nuclear reactor will be constructed by Atomics International, a division of North American Aviation, Inc., for the Atomic Energy Research Institute of Japan. The reactor, a 50-kilowatt water-boiler, will be used for general research studies in atomic energy and for student training.

Netherlands. The American Car and Foundry Industries was selected to construct a 20,000-kilowatt high flux pool research reactor for the Netherlands Government.

Spain. The General Electric Co. has been selected by the government of Spain to build the first reactor in that country. This will be a 3,000-kilowatt pool research reactor to be located in the Moncloa area near Madrid.

Financial aid on research reactors. Four countries received commitments from the United States to provide financial assistance on reactor

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projects within the framework of their agreements for cooperation and under the terms of the President's offer of June 11, 1955, to assist foreign nations on research reactor projects.[9] Under this offer, on completion of the project, the United States will pay half the cost up to a maximum for the United States of $350,000.

The first commitment was made to Brazil on May 22 in connection with the construction of a 5,000-kilowatt pool research reactor. On May 29, Spain received a commitment from the United States for construction of a 3,000-kilowatt pool research reactor. On June 28, Denmark and the Netherlands received commitments, Denmark for assistance on a 5,000-kilowatt pool reactor, the Netherlands on a 20,000-kilowatt pool reactor. Each nation will receive a contribution in the amount of $350,000 to be payable upon completion of the agreed projects.

First Heavy Water Shipped Overseas

As of this reporting period, the Commission had approved sale of 129 tons of heavy water, at $28 a pound, to Australia, France, India, Italy, Switzerland, and the United Kingdom, to assist those nations in developing peacetime uses of atomic energy. Initial consignments of 16 tons of the material, used as a moderator in reactors, have been shipped abroad—11 tons to the United Kingdom and 5 tons to France.

Included in the 129-ton total was an additional 11 tons for India. An original order of 10 tons for India—announced on February 12, 1955—was the first approved under the Atoms for Peace Program. The 21 tons will be used by India in a research reactor which Canada plans to provide under the Colombo Plan.[10]

The United Kingdom will use the heavy water in several research reactors. The Swiss order is to go to Reactor, Ltd., a private group carrying on nuclear research in Switzerland and operating the research reactor which the United States exhibited last August at the International Conference on the Peaceful Uses of Atomic Energy in Geneva, and which was sold to Switzerland under an agreement for cooperation.

Total amounts approved in the sale of heavy water are: to Australia, 11 tons; to France, 30 tons; India, 21 tons; Italy, 10 tons; Switzerland, up to 7 tons, with 2 tons to be delivered by August 1957; and the United Kingdom, 50 tons.

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[9] See pp. 12–13, Eighteenth Semiannual Report, (January–June, 1955.)

[10] The Colombo Powers include Australia, Burma, Canada, Ceylon, India, Indonesia, Japan, Laos, Malaya, Nepal, New Zealand, Pakistan, the Philippines, Singapore, South Vietnam, the United Kingdom, and the United States.

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United Nations Activities

There was a marked increase in activities related to atomic energy under consideration among committees and organizations of the United Nations during this period. The Atomic Energy Commission worked with the Department of State in these activities and provided technical advisors and staff assistance.

Disarmament

Commission representatives acted as advisors on the United States Delegation at meetings of the Five-Nation Subcommittee of the United Nations' Disarmament Commission, held in London from March 19 through May 4, 1956. The five nations represented on the Subcommittee were Canada, France, the Union of Soviet Socialist Republics, the United Kingdom, and the United States.

Scientific Committee on Radiation

The Scientific Committee on the Effects of Atomic Radiation, established by the United Nations Tenth General Assembly, began its first series of meetings on March 14, 1956, at New York. Members were Argentina, Australia, Belgium, Brazil, Canada, Czhechoslovakia, Egypt, France, India, Japan, Mexico, Sweden, the Union of Soviet Socialist Republics, the United Kingdom and the United States.

The Committee surveyed in detail the scientific problems related to its mandate to receive, examine and disseminate information on radiation levels and "effects of radiation on man and his environment." The Committee adopted a United States proposal recommending uniform standards in the submission of fall-out measurements, and noted a technical procedure that might be adopted in collecting fall-out data.

The United States offered assistance to members of the United Nations and of the specialized agencies in establishing collection stations, in processing the fall-out samples collected, and in exchanging such unclassified data from samples as would be useful in preparing national reports to the Committee.

The United States representative on the Committee was Dr. Shields Warren, New England Deaconess Hospital, Boston, Mass. Dr. Austin Brues, Argonne National Laboratory, and Merrill Eisenbud, New York Operations Office, were alternate representatives. The next meeting of the Committee was scheduled for October 1956 in New York.

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United Nations Trusteeship Council, Weapons Tests

After the Trusteeship Council of the United Nations received petitions protesting against testing nuclear devices in and near the Trust Territory of the Pacific Islands, Commission staff assisted the Department of State in preparing a reply.

In reply to the petitions, the United States stated that only after careful, serious and comprehensive studies was a decision reached to carry out the tests in the Marshall Islands; that the United States had earnestly sought a fully safeguarded international agreement that would make further tests unnecessary, but that until an agreement had been reached "elementary prudence required the United States to continue its tests"; but that every precaution would be taken to assure that fall-out would occur only in the danger area surrounding the Eniwetok Proving Ground which includes no islands inhabited by the Marshallese; that there was no need to evacuate the Marshallese from their home islands, that emergency evacuation plans had been formulated should such action become necessary; and that Marshallese were being trained in emergency health measures.

The United Nation Trusteeship Council on March 29 approved by a 9 to 4 vote a resolution approving the tests in the Marshall Islands, provided all necessary safeguards were taken.

Other International Cooperation Activities

Exchanges with Other Nations

The Commission has broadened its participation in exchange of technical knowledge and skills during the first half of 1956 through government-to-government action, and government-to-industry action, and through conferences, visits, and other programs for exchange of information.

Unclassified exchanges of information between foreign personnel included, during the 6 months' period, 326 visits of foreign nationals from 47 countries to United States installations, and also 447 visits of foreign nationals or embassy personnel from 36 countries to Washington headquarters.

From July 23, 1955, the date on which the agreements for cooperation between Belgium, Canada, and the United Kingdom became effective, to May 23, 1956, arrangements have been made for 167 individuals from all three countries to visit United States facilities, and for 263 United States representatives to visit their facilities for observations of atomic energy programs and classified discussions.

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Significant activities in programs for exchanges of information follow:

Two United States groups visited the *United Kingdom* in January and February, 1956. The first group reviewed and observed reactor development projects, especially power reactors. The second group exchanged information on fast reactor technology. This exchange was supplemented during a visit in May of a corresponding group from the United Kingdom to the United States to discuss information on certain experimental fast breeder reactors in the United States and in Great Britain. On May 14, the United States sent a technical group to visit the United Kingdom for inspections and classified discussions on homogeneous reactors and their potentialities in the power reactors field.

In May, Sir Edwin Plowden, Chairman of the United Kingdom Atomic Energy Authority, visited Commission installations with Chairman Strauss for general discussions and inspection of projects related primarily to power reactor development.

A technical conference on reactor hazards was held with United Kingdom representatives June 12–15, 1956 in Chicago to evaluate the present status of activities in the reactor hazards field. Discussions were based on 34 United States and 36 United Kingdom technical papers.

In January, three members of the same United States groups visited atomic energy installations at Brussels, *Belgium;* Stockholm, *Sweden;* Oslo, *Norway;* Paris, *France;* and Zurich, *Switzerland.* The technical group from the United States that went to the United Kingdom in May made a trip to the *Netherlands* to observe that nation's reactor program.

Visits to Washington headquarters and Commission installations were arranged for Franz Josef Strauss, Minister of Atomic Affairs of the *Federal Republic of Germany* and two representatives of the German Atomic Energy Commission. The Minister and his party toured facilities at the Argonne National Laboratory, the University of California Radiation Laboratory, at Berkeley, and several contractor installations in the Detroit and Los Angeles areas.

United States, United Kingdom and Canadian representatives held a Tripartite Conference in Chalk River, Canada, during January to discuss nuclear constants used in reactor core design, reactor core physics (both experimental and theoretical), reactor core computations, long-term irradiation reactivity effects, and reconciliation of differences between experiments and calculations using basic cross section data.

As a result of proposals made at the Tripartite Conference, a Reactor Physics Constants Center was established at Argonne National Laboratory to perform the function of a secretariat for North America.

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The Center will assist the exchange and coordination of reactor physics data and information. A second will be established at Harwell to process United Kingdom data. It is hoped that these Centers will promote improved understanding of reactor theory and experimentation.

A Tripartite Nuclear Cross Sections Committee also was established to provide a formal means for collaborating on research in these fields. In all three countries, committees and advisory groups are responsible for coordinating work on determining nuclear cross sections and constants. However, until the new tripartite committee was established there was no organized or formal means of coordinating the work among the three countries.

The new committee consists of 12 members, five from the United States, four from the United Kingdom and three from Canada. Its primary concern will be with measurements of nuclear cross sections and basic nuclear constants, with related techniques and with development and procurement of laboratory instruments.

Liaison or program participation activities are financed partly by the Commission, partly by the Department of State, or the International Cooperation Administration. These activities are described below:

Thailand, Pakistan and Turkey were visited in March by Commission technical personnel to discuss atomic energy programs.

The symposium held in *Israel* in April on macromolecular chemistry was attended by a staff scientist, who later visited several European countries to discuss research developments in atomic energy.

A series of unclassified lectures was given in April by a United States scientist on the uses of radioisotopes in marine biological research at a session of European scientists in Naples, *Italy*. The lectures were followed by visits to atomic energy laboratories in *France*, *Switzerland*, and the *Federal Republic of Germany*.

In May the opening of the United States Information Agency Exhibit on Atomic Energy at Osaka, *Japan*, was attended by a United States scientist.

At the Radiation Research Society Meeting in Chicago during May, a *British* scientist presented the principal lecture.

In June, an eight-man team of atomic energy specialists from the Commission, the Department of State, the International Cooperation Administration, and educational institutions, visited *Argentina*, *Brazil*, *Uruguay*, and *Venezuela* to discuss atomic energy applications in biology, medicine, agriculture and industry. This trip was jointly sponsored by the United States Government and the Fund for Peaceful Atomic Development, a private nonprofit foundation. Additional trips of this type to other areas are being planned.

From July through December 1956, a Commission scientist will be in *Chile*, South America. In response to a request of the Chilean Atomic Energy Commission, a series of lectures will be given on atomic energy and engineering to a group of graduate students and to the general public in Santiago, Antofagasta, Concepcion, and Valparaiso. Discussions will also be held with the Chilean atomic energy group regarding implementation of that country's agreement for cooperation.

Technical Libraries

The Commission up to June 30, 1956, had approved presentation of libraries to 42 countries and 3 international organizations. During this reporting period, the following nine nations were notified they would receive libraries: Ceylon, Costa Rica, Federal Republic of Germany, Guatemala, Iceland, Iraq, Luxembourg, Republic of Korea, and Venezuela.

Training and Education

Training of foreign nationals. The Argonne National Laboratory, in cooperation with North Carolina State College and Pennsylvania State University on April 16, 1956 initiated a third course in the International School of Nuclear Science and Engineering. The total of 62 students included 47 selected from 23 foreign countries[11] and 15 from the United States. The new arrangements with the universities will permit increasing the number of students (see Education and Training).

Asian Nuclear Center. The United States proposed to the Consultative Assembly of the Colombo Powers in Singapore in October 1955 that there be established an Asian Nuclear Training and Research Center, and stated that, if this were done, the United States through the International Cooperation Administration, would provide funds to support the center, and to provide equipment including a research reactor. In March the Republic of the Philippines was chosen as the site for the center.

The Commission assisted the Department of State and the International Cooperation Administration in planning for the Center. Its major function will be to train instructors and teachers in nuclear energy technology and sciences for other Asian educational institu-

[11] Students were selected from: Argentina, Brazil, Burma, Ceylon, Chile, Denmark, Egypt, Federal Republic of Germany, Finland, France, Greece, Italy, Japan, Norway, Pakistan, Philippines, Republic of China, Republic of Korea, Spain, Switzerland, Turkey, Venezuela, and Yugoslavia.

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tions. In addition, it may serve as a convenient site for international conferences or meetings related to peaceful uses of atomic energy.

In February, the Commission agreed to a contract under which Brookhaven National Laboratory would develop preliminary plans for the Center for the International Cooperation Administration. Preliminary plans will be submitted to interested United States agencies and will deal with the personnel, equipment, and organization of the Center based on the needs and interests of the Asian members of the Colombo Plan.

A survey group of technical and administrative personnel, largely from Brookhaven, made a 9-week visit to Burma, Cambodia, Ceylon, India, Indonesia, Japan, Laos, Malaya, Nepal, Pakistan, the Philippines, Thailand, and Vietnam, to study the problems. Following this group's report, the responsible United States agencies will prepare tentative plans which will be submitted to the Colombo Powers, at an October 1956 meeting in Wellington, New Zealand.

The Center will be financed through the President's Fund for Asian Economic Development established under the Mutual Security Act.

International Conferences on High Energy Physics

The Commission, in cooperation with the National Science Foundation, the Office of Naval Research, the University of Rochester and Rochester industries sponsored the *Sixth Annual University of Rochester Conference on High-Energy Nuclear Physics*, April 3–7, 1956, Rochester, N. Y. Like the preceding meetings, it was devoted to unclassified experimental and theoretical developments in the field of fundamental high-energy nuclear physics.

Approximately 200 of the world's leading physicists attended the conference. Three scientists from the Union of Soviet Socialist Republics discussed the results of recent Soviet investigations. At the close of the conference the Soviet group which included a member of the Soviet delegation to the negotiations on an international atomic energy agency, visited the University of California Radiation Laboratory, Berkeley, Calif., and Brookhaven National Laboratory, Upton, Long Island, N. Y. for unclassified discussions and toured nonsecurity areas. They also visited a number of universities while in this country.

A second international conference, the *CERN Symposium on High-Energy Accelerators and Pion Physics*, was held in Geneva, Switzerland, on June 11–23, 1956, attended by approximately 200 of the world's leading scientists in this field, including 50 from the United States. At a similar 1953 conference arranged by CERN (European Organization for Nuclear Research), the principles of the cosmotron

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at Brookhaven Laboratory and the bevatron at University of California, Berkeley, were discussed fully.

Since then, various groups have been working on other ideas for accelerating high-energy particles, and new machines are now approaching the project stage. The first week of this year's conference was devoted to a discussion of these new ideas and machines. During the second week, most recent developments in particle detection and pion physics were discussed.

A number of individual scientists from the United States, as well as from other countries was invited and 14 from the United States, including a number from Commission installations, attended the *Academy of Sciences of the Soviet Union Conference on Physics of High-Energy Nuclear Particles* in Moscow, May 14–20, 1956. The conference was devoted to the physics of high-energy particles, and the results of experiments in the Institutes of the Soviet Union concerning the properties and interactions of elementary particles of high-energy matter. Theoretical implications of the experiments and relevant work about interactions of particles in cosmic rays were discussed.

After the conference, scientists visited several scientific installations within the Union of Soviet Socialist Republics, such as the Lebedev Institute of Physics, the Institute of Nuclear Problems, the USSR Atomic Power Station, and the Moscow State University.

Participation of Alien Scientists in Nonclassified Research

The Commission has revised its policy on participation of alien scientists as employees, or guests working without pay, in nonclassified research in nonsecurity areas of Government laboratories and integrated contractor installations. Prior to this revision, alien scientists could be employed on nonclassified research only at University of California Radiation Laboratory, Berkeley, Calif., and at Brookhaven National Laboratory, Upton, Long Island, N. Y., under assigned quotas. For guest alien scientists no quotas were fixed.

With the postwar recovery of scientific research in European countries, the institution of agreements for cooperation, the launching of the President's Atoms for Peace program, and the impending shortage of qualified scientists and engineers within the United States, the Commission decided to broaden use of alien scientists. It removed the quota restrictions on employment of alien scientists, and permitted all laboratories and contractor installations to employ aliens, or appoint guest aliens, subject to the same security arrangements as under previous policy deemed necessary for the protection of classified information. They will work on nonclassified projects only and in nonsecurity areas. In addition to security requirements,

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two other stipulations are made: laboratory space must be available, and equally qualified United States citizens must be given priority. The manager of operations for the field office affected will be responsible for authorizing employment or appointment by laboratories or contractors.

This policy on alien employment and appointment does not apply to individuals from countries listed as Subgroup A countries in Section 371.3 of the comprehensive export schedule of the Department of Commerce. Nor does it apply to aliens employed or appointed as guests on nonclassified research contracts reviewed originally by Washington headquarters. Alien employment or appointment under these contracts will be in accordance with each contractor's employment policy.

Civilian Application

Taking major steps to assist development of the private atomic energy industry, the Atomic Energy Commission put into effect nine basic regulations during the first half of 1956. The regulations deal with licensing, access to restricted data, unclassified activities in foreign atomic energy programs, and rules of practice. Eight were new regulations while the ninth was a revision of the existing regulation on distribution of byproduct material (radioisotopes).

The first construction permits authorizing construction of two large nuclear power reactors were issued to Consolidated Edison Co. of New York and to Commonwealth Edison Co. of Chicago.

During the period 10 applications were received for licenses to construct nuclear reactors of various types, including two for the generation of electric power.

Continued growth in the use of radioisotopes in medicine, industry, and agriculture was evidenced by the entry into the program of some 204 new users.

The Commission testified on legislation designed to help meet the liability insurance problems of reactor licensees.

A total of about 300 private individuals and organizations applied for permits for access to restricted data during the reporting period, and 912 were in effect as of June 30, 1956.

A public document room was opened making documents related to the licensing program available for examination.

Regulations

Eight new regulations were published in effective form. In addi- the regulation on byproduct material (radioisotope) licensing

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was revised to conform with the 1954 Atomic Energy Act, and to liberalize and simplify domestic and foreign distribution procedures. In drawing these regulations, a primary objective was to impose the minimum of control consistent with the protection of the common defense and security and the health and safety of the public.

Briefly, the regulations and their scope are as follows (see Appendix 7 for texts):

"Licensing of Production and Utilization Facilities," 10 C. F. R. (Code of Federal Regulations) Part 50, effective February 18, 1956, applicable to the licensing of nuclear reactors, plants for the separation of isotopes of uranium, and plants for processing irradiated materials containing special nuclear material.

"Operators' Licenses," 10 C. F. R. Part 55, effective February 3, 1956, established procedures and minimum criteria for the issuance of licenses to individuals having responsibility for operating the controls of production and utilization facilities.

"Licensing of Special Nuclear Material," 10 C. F. R. Part 70, effective March 4, 1956, established procedures and criteria for the issuance of licenses to possess, use, and transfer special nuclear material.

"Licensing of Byproduct Material," 10 C. F. R. Part 30, effective February 10, 1956, is a revision of a former regulation applicable to the licenses governing the procurement, delivery, possession, use, transfer, export, and disposal of certain radioisotopes.

"Rules of Practice," 10 C. F. R. Part 2, effective March 5, 1956, establishes the Commission's administrative procedures in connection with the issuance, renewal, amendment, suspension, or revocation of licenses, and commission rules for conducting formal hearings.

"Access to Restricted Data," 10 C. F. R. Part 25, effective February 4, 1956, establishes the procedures and criteria for obtaining access to confidential or secret restricted data relating to the civilian uses of atomic energy.

"Safeguarding of Restricted Data," 10 C. F. R. Part 95, effective February 2, 1956, imposes requirements for the protection of confidential and secret restricted data and applies to all persons who receive access to such data under an Access Permit.

"Unclassified Activities in Foreign Atomic Energy Programs," 10 C. F. R. Part 110, effective January 20, 1956, prescribes procedures governing applications by individuals and organizations in the United States for specific authorizations to engage directly or indirectly in the production of special nuclear material outside the United States and generally authorizes certain nonclassified foreign activities. The regulation also establishes reporting requirements applicable to persons who engage in certain unclassified activities in foreign atomic energy programs.

"Standard Specifications for the Granting of Patent Licenses," 10 C. F. R. Part 81, effective February 25, 1956, establishes standard specifications for the issuance of licenses on patents owned by the Commission, patents declared affected with the public interest pursuant to Section 153.a. of the Atomic Energy Act of 1954, and other patents useful in the production or utilization

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of special nuclear material or atomic energy licensed pursuant to Section 153.e. of the Act. The regulation contains a general authorization, subject to certain restrictions, under Section 57.a. (3) of the Atomic Energy Act of 1954.

A new draft of the proposed regulation prescribing standards for protection against radiation hazards was submitted to the Advisory Committee of State Officials during the February meeting of the Committee. Further revisions in the regulation are being made in the light of comments and suggestions received.

Program for Private Access to Restricted Data

An average of 50 permits was granted each month during the period to private individuals and concerns interested in obtaining access to restricted data on the civilian applications of atomic energy. As of June 30, 1956, a total of 912 permits was in effect.

The increasing use made of the permits was evidenced by the growing number of personnel clearances requested, reports purchased, and visits made to Commission facilities by permittees as indicated by the following tables.

CUMULATIVE REQUESTS FOR NEW CLEARANCES

	"L"s [12]	"Q"s [12]
Total, December 31, 1955	2, 109	632
Total, June 30, 1956	4, 244	2, 533

NOTE.—This does not include clearances originally granted for Commission program work and transferred or extended to the Access Permit program.

CUMULATIVE CLASSIFIED REPORTS PURCHASED

	Confidential Reports	*Secret Reports*
Total, December 31, 1955	2, 188	437
Total, June 30, 1956	11, 329	1, 984

CUMULATIVE CLASSIFIED VISITS TO COMMISSION FACILITIES

Total, December 31, 1955	838
Total, June 30, 1956	1, 351

Requests for amendments to access permits, principally to enlarge the scope of access provided, stood at about 35 per month compared to 10 per month during the last half of last year. This also indicates increased activity by the holders of permits.

The distribution of permits by geographic area, industry, and field of interest is given in the following tables along with comparative data for the permits in force as of December 31, 1955:

[12] P. xiii, Seventeenth Semiannual Report (July–December 1954), and p. 102, Eighteenth Semiannual Report (January–June 1955).

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DATA ON ACCESS PERMITS

Geographic Distribution

	December 31, 1955	June 30, 1956
New England	57	82
Middle Atlantic	225	336
East North Central	118	186
West North Central	41	56
South Atlantic	60	82
East South Central	9	27
West South Central	23	31
Mountain	16	33
Pacific	50	76
Hawaii, Alaska, and Puerto Rico	3	3
Total	602	912

Business or Occupation

	December 31, 1955	June 30, 1956
Metal Mining and Refining	21	44
Metal Products Manufacturing	107	151
Chemical and Petroleum Manufacturing	56	82
Instrument Manufacturing	42	60
Engineering and Construction	57	77
Utilities and Associated Companies	132	160
Research Organizations	30	44
Consultants	56	128
Banks and Investing Companies	17	21
Insurance Organizations	25	48
Educational Institutions	11	15
Others not Elsewhere Classified	48	82
Total	602	912

Field of Interest

Operating Atomic Facilities	December 31, 1955	June 30, 1956
Reactors for production of electric power	133	158
Reactors for other purposes such as research, propulsion of ships, etc	28	35
Plants to refine uranium and thorium ore and process feed materials	39	62
Chemical plants for reprocessing spent fuel elements	21	31
Manufacture of Atomic Energy Products		
Entire reactors	40	72
Components such as fuel elements, instruments and pumps for reactors and related facilities	123	193
Materials for atomic energy applications such as zirconium, carbon, and special alloys	49	94

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Related Activities	*December 31, 1955*	*June 30, 1956*
Utilizing radioactive isotopes for sterilization of food, radiochemistry research, etc	38	49
Design and construction of atomic energy facilities	56	71
General nuclear research	28	41
Consulting on atomic energy problems	54	132
Investing and lending capital	16	19
Evaluating insurance risks	27	47
Others not elsewhere classified	63	102

NOTE.—These figures include permit holders with more than one field of interest, resulting in a total greater than the number of permittees.

The Commission continued a program of meetings with industry on subjects of interest to permit holders. In January, a meeting on Power Reactor Fuel Processing was held at Idaho Falls, in March, on the Homogeneous Reactor Program in Oak Ridge (see Reactor Development).

Materials and Services

The President's announcement on February 22, 1956, that 40,000 kilograms of uranium 235 would be made available for peaceful uses—half for domestic industries (see Foreword and Appendix 8)—authorized the Commission to provide enough of this special nuclear material to meet the estimated needs of United States public and private power groups which had announced plans for nuclear plants.

The Commission prepared and distributed to access permittees the classified specifications, and prices which the Government will pay, for licensee-produced plutonium metal, uranium 233 as metal, and uranium 233 as uranyl nitrate. A charge of $43 per kilogram for thorium metal and related specifications was announced (see Reactor Development).

In another step to further private participation in developing atomic energy for peaceful uses, the Commission announced on February 9, 1956, that organizations or individuals would be permitted use of Government facilities or equipment for their own purposes provided the user had appropriate security clearance, the work did not interfere with Commission programs, and private facilities or equipment were not reasonably available. If necessary, the Commission will establish priority for the use of facilities and equipment. Arrangements under which the facilities and equipment will be made available include: (1) the assessment of charges based on either full recovery of costs of the work to the Commission or based on going commercial rates; (2) applicable patent provisions; (3) compliance

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with Commission regulations concerning health and safety, and security; (4) appropriate indemnifications of the Government from claims arising out of the performance of the private work.

Licensing Activities

Production and utilization facilities. Applications for licenses for production and/or utilization facilities were received from the following:

Power Reactor Development Co., Detroit, Mich., for construction and operation of a developmental fast neutron breeder reactor to produce heat for 100,000 kilowatts of electrical energy to be generated by Detroit Edison, Inc.

Aerojet-General Nucleonics, Walnut Creek, Calif., for construction and operation of a 100 milliwatt boiling water research reactor. The application filed by Aerojet-General Nucleonics supersedes that previously submitted by Applied Nucleonics Corp. which is being liquidated. Also for a license to receive and possess uranium 235 contained in 20 percent enriched uranium dioxide for the fabrication of core assemblies for AGN's 201 nuclear reactor which the company proposes to build for sale to universities and industry. AGN's 1956 special nuclear material requirements consist of 2 kilograms of uranium 235. Their 1957 requirements consist of 1 kilogram of uranium 235 per month.

AMF Atomics, Inc., New York, N. Y., for construction and operation of a 5,000 kilowatt pool reactor for applied research by a group of industrial firms. The proposed site of the reactor is to be near Plainsboro, N. J.

Dow Chemical Co., Midland, Mich., for construction and operation of a liquid metal fuel test reactor for research and development, with a maximum heat output of 10,000 kilowatts. The proposed location is at Midland, Mich.

Ford Motor Co., Dearborn, Mich., for construction and operation of a public demonstration research reactor similar to the Geneva Conference pool reactor to be located in the Rotunda Building in Dearborn.

General Electric Co., Schenectady, N. Y., for construction and operation of a developmental boiling water reactor at its Alameda County, Calif., laboratory site. The company also applied for licenses to construct and operate a critical experiment facility at this same location. Both facilities will be utilized initially for developing design details for the Commonwealth Edison power reactor. A construction permit for the reactor was issued May 14, 1956. A construction permit authorizing construction of the developmental boiling water

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reactor was issued on May 14, 1956. A construction permit authorizing construction of the critical experiment facility was issued on June 29, 1956.

Lockheed Aircraft Corp., Van Nuys, Calif., for construction and operation of a critical experiment facility on the campus of Stanford University, Palo Alto, Calif. The initial experiments to be conducted will develop data for a small power reactor which Lockheed is currently designing.

Massachusetts Institute of Technology, Cambridge, Mass., for construction and operation of an 1,000-kilowatt reactor, heavy water moderated and cooled, to be used for medical therapy and research activities on the campus in Cambridge. A construction permit was issued May 7, 1956.

Nuclear Development Corp. of America, White Plains, N. Y., for construction and operation of a critical experiment facility near White Plains, N. Y. A construction permit was issued June 11, 1956.

State College of Washington, Pullman, Wash., for construction and operation of a 100-kilowatt pool research reactor to be located on the University campus.

The Prosperity Co., Syracuse, N. Y., for construction and operation of an 100-kilowatt research reactor, similar to the Geneva reactor, to be built on the campus of the University of Miami, Coral Gables, Fla.

Westinghouse Electric Corp., Pittsburgh, Pa., for construction and operation of an engineering test reactor at a site in Westmoreland County, Pa. Westinghouse also applied for a license to construct and operate at the same site a critical experiment facility to develop experimental data for the Belgian Thermal Reactor.

Construction permits were issued on May 4, 1956 to:

Commonwealth Edison Co., Chicago, Ill., for construction of an 180,000-kilowatt dual cycle boiling water reactor in Grundy County, Ill. The earliest completion date specified in the permit is March 1, 1959, and the latest completion date is September 30, 1960.

Consolidated Edison Co., New York, N. Y., for construction of an 140,000-kilowatt pressurized water converter reactor in Westchester County, New York. The earliest completion date specified in the permit is October 1, 1959, and the latest date is October 1, 1960.

Operator Licenses

During this period 25 applications were received for operators' licenses for production and utilization facilities, and 16 operators'

licenses were issued to operate a particular, designated research reactor at Armour Research Foundation, Chicago, Ill., Battelle Memorial Institute, Columbus, Ohio, Naval Research Laboratory, Washington, D. C., North Carolina State College, Raleigh, N. C., and Pennsylvania State University, University Park, Pa., and critical experiment facilities at The Babcock & Wilcox Co. and Nuclear Development Corp. of America. In four instances, applicants were informed that operators' licenses were not required for reactors operated for the Commission.

Special Nuclear Material Licenses

As of June 30, 1956 a total of 24 special nuclear material licenses had been issued since the passage of the Atomic Energy Act of 1954, not including those incorporated in production and utilization facility licenses. New applications received and licenses issued, included:

Atomic Power Development Associates, Detroit, Mich., was issued a license authorizing the use of 15 kilograms of uranium enriched to 30 percent in uranium 235 for use in its research and development activities relating to nuclear power reactors. Deliveries to APDA from the Commission are to be spread over a 4-year period. The materials will be used by APDA contractors appropriately licensed by the Commission.

Atomics International (a division of North American Aviation, Inc.) applied for and was granted a license to receive 3.5 grams of uranium 235 contained in fission chambers required as part of the control system in the research reactor constructed by this firm for Armour Research Foundation. Atomics International also applied for a license to receive uranium 235 contained in two fission counters to be incorporated in the control system of a research reactor being built for export to Japan.

Bailey Meter Co., Cleveland, Ohio, applied for a license to receive approximately 2 grams of uranium 235 contained in a fission chamber to be incorporated in the control system being constructed by the firm for The Babcock & Wilcox Co. critical assembly facility at Lynchburg, Va.

Battelle Memorial Institute, Columbus, Ohio, requested an amendment to its license and allocation to provide for an additional 5 kilograms of uranium 235 for use in fuel element research and development for its industrial sponsors. Battelle also requested an amendment to its license to receive 1.71 grams of uranium 235 contained in a fission chamber to be used in its critical experiment laboratory.

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Carnegie Institution of Washington applied for a license to authorize its possession and use of 500 milligrams of uranium 235 in coulomb excitation studies and mineral age investigations.

Department of the Navy (Bureau of Ships) applied for a license to receive and possess a plutonium-beryllium source to be used by the Material Laboratory of the New York Naval Shipyard at Brooklyn, N. Y., to measure the neutron absorption characteristics of various overlays of fiberglass and resinous materials.

Hercules Powder Co., Wilmington, Del., applied for a license to receive and possess 25 grams of uranium (20 percent enrichment in uranium 235) in the form of uranyl nitrate, for radiation chemistry experiments.

Mallinckrodt Chemical Works, St. Louis, Mo., applied for a license to receive and possess up to fully enriched uranium hexafluoride for conversion to uranium oxide for various customers.

Glenn L. Martin Co., Baltimore, Md., was issued a license authorizing the firm to receive 50 grams of uranium oxide, the uranium content of which is enriched to not more than 90 percent in uranium 235, for use in research and development work. The company later requested an amendment to its license authorizing receipt of 1 kilogram of uranium oxide, of not more than 90 percent enrichment, for fuel element research.

Metals and Controls Corp., Attleboro, Mass., applied for and was issued a license authorizing the firm to receive 11.3 kilograms of uranium enriched to about 90 percent in the isotope uranium 235 for use in the fabrication of fuel elements for the Battelle Research Reactor.

Norton Co., Worcester, Mass., applied for and was issued a license to receive from Atomic Energy of Canada Ltd. 25 pounds of uranium dioxide containing uranium enriched to 7.1 percent in uranium 235 for fabrication into a ceramic of type fuel elements and return to the Canadian organization. The license provides that the material will be received and returned by Norton Co. via the Commission's Schenectady Operations Office.

Nuclear Development Corp. of America, White Plains, N. Y., was issued a license authorizing receipt from other licensees of 500 grams of uranium enriched to 30 percent in uranium 235 for use in studies of the effects of reactor-produced radiation on simulated fuel elements.

Nuclear Metals, Inc., Cambridge, Mass., applied for and was granted a license to receive from Atomic Energy of Canada Ltd. 1.41 kilograms of uranium 235 for fabrication of prototype fuel elements and return

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to the Canadian organization. The application states that the material will be received and returned by Nuclear Metals, Inc. via the Commission's New York Operations Office. Nuclear Metals later requested an amendment to its license to authorize receipt of an additional 60 grams of uranium 235 for fabrication of fuel element test specimens for Atomic Power Development Associates.

Nuclear Science and Engineering Corp., Pittsburgh, Pa., requested and was granted an amendment to its license to increase from 10 to 25 grams the contained uranium 235 the firm is licensed to receive and use in its research and development work. The additional 15 grams will be received from other licensees.

Owens-Corning Fiberglas Corp., Newark, Ohio, was issued a license authorizing receipt of 50 grams of uranium oxide containing uranium enriched to 90 percent in the isotope uranium 235 for incorporation in glass fibers which will be used by Rensselaer Polytechnic Institute for experimental work under a Commission contract.

Sinclair Research Laboratories, Inc., Harvey, Ill., applied for a license to authorize the firm to receive and use spent Materials Testing Reactor fuel elements as a source of radiation for petroleum research.

Sylvania Electric Products, Inc., Bayside, N. Y., applied for a license authorizing its receipt from other licensees of uranium enriched in uranium 235 for fabrication into fuel elements. The firm requested that its license authorize its possession of up to 50 kilograms of contained uranium 235 at any given time.

The Babcock & Wilcox Co., Lynchburg, Va., was issued a license authorizing its receipt of 50 grams of uranium enriched to about 90 percent in uranium 235 for use in research upon effects of reactor-produced radiation on simulated nuclear fuel elements. This company also applied for a license to authorize its receipt at its Alliance, Ohio, Research and Development Center of 900 grams of uranium 235 contained in uranium enriched to 22 percent in uranium 235. This material is to be used in a fuel pin fabrication project for Atomic Power Development Associates.

The University of Chicago applied for and was issued a license authorizing the university to receive trace quantities of plutonium which will result from irradiation of small quantities of uranyl nitrate hexahydrate in the CP–5 reactor at Argonne National Laboratory.

The University of Michigan, Ann Arbor, Mich., was issued a license authorizing receipt for use as a gamma ray source at its Phoenix Memorial Laboratory of up to 800 grams of uranium 235 contained in four irradiated fuel elements, and such byproduct material as may be contained in these fuel elements.

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Tracerlab, Inc. was issued a license authorizing its receipt of small quantities of special nuclear, source, and byproduct materials for use in work the firm is performing at its Boston, Mass. and Richmond, Calif. laboratories for the U. S. Air Force.

U. S. Geological Survey, Department of the Interior, Washington, D. C., applied for a license to receive and possess 10 milligrams of uranyl nitrate, the uranium content of which is enriched to 99.9 percent in the isotope uranium 235, for use in research and development work to be conducted by the Survey at the Naval Gun Factory and Carnegie Institution of Washington.

U. S. Naval Radiological Defense Laboratory, San Francisco, Calif., applied for an allocation of and a license to possess small quantities of special nuclear materials for use in its research and development program.

Westinghouse Electric Corp. applied for licenses to receive and possess at its Blairsville and Forest Hills, Pa., plants uranium metal and uranium dioxide enriched in uranium 235 for use in the manufacture of various types of fuel elements.

Source Material Licenses

Source material licenses were issued or renewed for 1,050 organizations or individuals between January 1 and June 30, 1956. These included 386 to producers, 13 to processors, 66 to distributors, 153 to consumers, and 432 to exporters.

Byproduct Material Licensing

The use of radioisotopes in medicine, industry, and agriculture continue to grow. At May 31, 1956, there were 3,279 licensed users in the United States representing an increase of 304 licensees since November 30, 1955. Total shipments of radioistopes during this period amounted to 5,875 including 369 shipments for export. Appendix 4 lists the types of radioisotopes for which licenses were issued and also shows the numbers of users by class and location. New developments in the field are reported in the sections on Physical Research and Biology and Medicine.

New regulations simplifying procedures for domestic distribution of radioisotopes and removing certain restrictions on sales abroad were issued January 11 and became effective February 10, 1956 (see Appendix 7). Coupled with the reduction in prices for isotopes to be used in biomedical and agricultural research within the United States,

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effective July 1, 1955,[13] the regulations are expected to increase the use, and the consequent benefits, of this atomic tool in research.

The procedures established February 10 assist radioisotope users in other countries to obtain isotopes of the elements 3 through 83 in the atomic table by dealing directly with Commission or commercial suppliers, rather than going through their nation's representative here. The requirement that foreign scientists report on request about the results of their work has been eliminated. The new procedures do not apply to exports to countries listed as Subgroup A in Section 371.3 of the comprehensive export schedule of the Department of Commerce.

Domestically, researchers and other radioisotope users are permitted under the new regulation to possess larger quantities of radioactive materials under general license. A list of 65 byproduct atomic materials is included in the regulations, giving the quantity of each which a user may possess and use under general license. The regulation provides that a purchaser may possess up to 10 of these quantities at any one time. The old regulation did not list specific byproducts, but provided generally the total level of radioactivity which might be possessed at any one time without a specific license.

Insurance on Nuclear Facilities

In January 1956 the insurance industry announced formation of three syndicates to provide insurance protection on reactor plants and equipment, and to cover public liability for radiation damage or injury arising from operation of such plants. This was confirmed by a report dated March 1, 1956, of the group of insurance executives which has been studying the problem of insurance of private atomic energy installations, which stated:

1. Public liability coverage in excess of $65 million per installation is expected to be available.
2. Coverage of all physical damage to reactor installations and property incidental thereto in excess of $50 million is expected to be available.
3. Efforts are under way to complete organization of the syndicates as rapidly as possible.
4. Premium rates will be established separately for each installation.
5. The group will continue to study and report on remaining aspects of the problem.

The public liability coverage expected to become available, as indicated above, is unprecedented, being estimated at over four times the amount hitherto available to industry for any one operation. How-

[13] See p. 91, Eighteenth Semiannual Report (July–December 1955).

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ever, many representatives of the atomic energy industry believed that greater insurance coverage would be necessary, since a major accident, however remote its possibility, might result in claims far exceeding the level of insurance proposed. The Atomic Energy Commission, after studying the problem, made proposals for legislation to provide for indemnification against liability of facility operators and those supplying them with materials, equipment or services for the facility. The Commission testified on this and other proposed legislation during this reporting period.

Public Document Room

On February 6, 1956, the Commission announced the opening of a Public Document Room where records relating to its licensing program are available for public examination. Except for classified material and material for which "business confidential" treatment has been asked and granted, the Document Room files contain records of license and access permit applications and issuances, comments from interested persons on proposed regulations, and records of licensing hearings. The room is located in the reception lobby at 1717 H Street NW., Washington, D. C., outside the security area.

Reactor Development*

The Nation's program for development of nuclear reactors to generate electricity for civilian use went forward on a broad front during the last 6 months. A fifth industrial combination announced its intention of building a power reactor without financial assistance from Government. The Atomic Energy Commission signed its first contract under the Power Demonstration Reactor Program with the Yankee Atomic Electric Co., of Boston, Mass. Seven organizations made proposals for building small-scale reactors under this same program making a total of 11 proposals received in response to the Commission's invitations.

As the table (Developing Civilian Atomic Power) shows, private and public organizations in the United States have announced they are prepared to expend $358 million on power reactors, exceeding the $313 million, which the Government would invest—$236 million in its own experimental reactors, and $77 million in contributing to some reactors which private and public industry will build and operate. The electrical capacity of civilian power projects to date totals a potential 1,182,000 kilowatts.

*Commissioner Thomas E. Murray does not subscribe to this section of the report.

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DEVELOPING CIVILIAN ATOMIC POWER

Type of reactor	Government's experimental program	Power demonstration program	Independent industrial program
Pressurized water	Shippingport, Pa., Duquesne Light Co and Westinghouse Electric Corp. for AEC, 60,000 kw—1957.	Rowe, Mass., Yankee Atomic Electric Co., 134,000 kw—1960. University of Florida (Gainesville) 500 kw—1959.	Indian Point, N. Y., Consolidated Edison Co. of N. Y., 14,000 kw—1960.
Boiling water	Lemont, Ill., Experimental Boiling Water Reactor, Argonne National Laboratory, 5,000 kw—1957.	Elk River, Minn., Rural Cooperative Power Association, 22,000 kw—1960.	Dresden, Ill., Nuclear Power Group (Commonwealth Edison Co. and others), 180,000 kw—1960. Livermore, Calif., General Electric Co. and Pacific Gas & Electric Co., 3,000 kw—1957.
Sodium cooled: Thermal	Santa Susana, Calif., Sodium Reactor Experiment, North American Aviation for AEC and Southern California Edison Co.,[1] 7,500 kw—1957.	Consumers Public Power District (Nebraska), 75,000 kw—1959. Anchorage, Alaska, Chugach Electrical Association, Inc. and Nuclear Development Corp. of America, 10,000 kw—1962.	
Fast	National Reactor Testing Station, Experimental Breeder Reactor No. 2, Argonne National Laboratory, 17,500 kw—1959. Los Alamos Scientific Laboratory, Molten Plutonium Reactor Experiment. No electricity—1959.	Monroe, Mich., Power Reactor Development Co., Inc. (Detroit Edison Co. and others), 100,000 kw—1960.	
Fluidized: Aqueous Homogeneous.	Oak Ridge National Laboratory, Homogeneous Reactor Exp. No. 2, no electricity—1956. Los Alamos Scientific Laboratory, Power Reactor Experiment Nos. 1 and 2, no electricity—1956.	Hersey, Mich., Wolverine Electrical Cooperative, 10,000 kw—1959.	Eastern Pa., Pennsylvania, Power & Light Co., 150,000 kw—1962.
Liquid metal	Liquid Metal Fueled Reactor, The Babcock & Wilcox Co.—1959.	City of Orlando, Fla., 25,000—40,000 kw—1961.	
Organic moderated	National Reactor Testing Station, Organic Moderated Reactor Experiment, North American Aviation for AEC, no electricity—1957.	City of Piqua, Ohio, 12,500 kw—1961.	
Gas cooled	Gas Cooled Reactor (contractor not selected).	City of Holyoke, Mass., 15,000 kw—1961.	
Unspecified			Florida (Florida Power Corp.) (Florida Power & Light Co.) (Tampa Electric Co.), 200,000 kw—1962.

NOTE: Dates shown are for start of operation.

[1] Turbogenerator and other conventional electric transmission equipment.

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ESTIMATED PROGRAM TOTALS

Costs	Government $236,000,000 Industry 20,000,000	Government $77,000,000 Industry 128,000,000	Government 0 Industry $210,000,000
	Estimated cost of all work from July 1, 1953, through completion of projects listed. Includes cost of core fabrication but excludes cost of special nuclear materials. Excludes EBR-1, HRE-1, and Borax-1, 2 and 3.	Based on proposals submitted to AEC. Excludes cost of core fabrication and of special nuclear materials.	Based in part on statements made by sponsoring utilities and in part on AEC estimates.

	Kilowatts
Total electrical capacity	1,182,000
Government's Experimental Program	90,000
Power Demonstration Program	419,000
Independent Industrial Program	673,000

Total estimated cost	$671,000,000
Government	$313,000,000
Industry	358,000,000

The Commission undertook contracts and experimental work on four additional concepts in its Experimental Power Reactor Program, besides work already under way on five other concepts. Construction of the Pressurized Water Reactor at Shippingport, Pa., which comes under this program, made good progress.

During this reporting period, the Commission made further moves to bring private industry more strongly into the atomic energy program. It signed long-range contracts for an expanded program of commercial production of zirconium metal. The Commission proposed that private industries undertake chemical processing of spent fuel elements and manufacture additional reactor materials. It also established licensing and other necessary regulations, as reported in the section on Civilian Application.

The program of developing reactors for military power and for naval and aircraft propulsion also made significant progress. Preliminary steps were taken toward eventual development of gas-cooled power reactors for special military and civilian applications. The USS *Seawolf*, the second nuclear-powered submarine, neared completion at Groton, Conn., and the Congress authorized construction of an atomic-powered radar picket submarine in the Navy's shipbuilding program. The picket submarine—the largest submarine ever built by the Navy—will be the first powered by two reactors. Research and development activities on aircraft nuclear powerplants progressed satisfactorily.

Construction of the Engineering Test Reactor (ETR) at the National Reactor Testing Station in Idaho proceeded on a top priority basis. Plans for a privately financed testing reactor were announced by Westinghouse Electric Corp. In Commission laboratories, supporting research and development studies were undertaken and a

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multiple attack was made upon the problems of improving methods of processing spent fuel elements.

Civilian Power Reactor Program*

Privately Financed Reactors

In addition to the four large power reactors—each to produce between 140,000 and 200,000 kilowatts of electricity—which private industry was previously reported as planning to build entirely with private funds,[14] the Commission received notification in March 1956 that private concerns intend to build a fifth, smaller reactor. The General Electric Co. and the Pacific Gas and Electric Co. plan to construct and operate a boiling water reactor to help supply electricity for the San Francisco Bay area.

The plant, to be located at the new General Electric Co. laboratory in the Livermore-Pleasanton area of Alameda County, Calif., is planned for completion during 1957 at a cost of between $3 and $4 million. Initially, it would have a maximum generating capacity of 3,000 kilowatts of electricity; ultimately of 10,000 kilowatts or more.

The total electrical capacity announced as planned from privately financed reactors is 673,000 kilowatts; the total announced expenditure $210 million. Following are the individual projects:

	Type of reactor	*Electrical generating capacity (kilowatts)*
Commonwealth Edison Co.	Dual-cycle boiling water	180,000
Consolidated Edison Co.	Pressurized water	140,000
Florida Power & Light Co. (Florida Power & Light Co., Tampa Electric Co., and Florida Power Corp.)	Large atomic plant (type not yet determined)	200,000
General Electric Co. and Pacific Gas & Electric Co.	Boiling water	3,000
Pennsylvania Power & Light Co.	Aqueous homogeneous	150,000

Power Demonstration Reactor Program

The Commission on June 6, 1956, signed its first contract with an industrial group proposing to build a power reactor under the Power Demonstration Reactor Program by which the Commission agrees to make contributions to the project. During this same reporting period.

*Commissioner Thomas E. Murray does not subscribe to this section of the report.

[14] See pp. 41–43, Eighteenth Semiannual Report (January–June, 1955).

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the Commission received seven proposals to build small power reactors. They were submitted in response to its second invitation (issued September 1955 with a deadline of February 1, 1956) which specified reactors with capacities between 5,000 and 40,000 kilowatts of electricity. The purpose of the Power Demonstration Program is to demonstrate on a commercial basis the technical and economic feasibility of power reactors in a wide range of capacities and design concepts.

In response to the Commission's first invitation, issued in January 1955, with an April 1, 1955 deadline and specifying no particular size of reactor, four proposals were received.[15] It was in connection with one of these proposals, that of the Yankee Atomic Electric Co., of Boston, Mass., that the contract has been signed. Contracts are being negotiated in connection with two others—those of the Power Reactor Development Co., Inc., of Detroit, Mich., and the Consumers Public Power District, of Columbus, Nebr. The fourth proposal, from the Commonwealth Edison Co., of Chicago, Ill., was later considered not as an application under the Power Demonstration Program, but solely a request for a license to build a reactor, since no Government assistance was sought.

The details of the three proposals first received (exclusive of that from Commonwealth Edison) are as follows:

Company and Location of Reactor	*Type of Reactor*	*Electrical Generating Capacity (Kilowatts)*
Yankee Atomic Electric Co., Rowe, Mass.	Pressurized water	134,000
Consumers Public Power District of Columbus, Nebr., Hellum, Nebr.	Sodium graphite	75,000
Power Reactor Development Co., Inc. (Detroit Edison and others), Dresden, Ill.	Boiling water	100,000

Contract with Yankee. The contract with the Yankee Atomic Electric Co. provides that the company will bear all construction costs, estimated at $34.5 million, of which $18.5 million is expected to be for the reactor. Research and development costs are estimated at $5 million. The Commission will perform up to $1 million of the research and development work in its own facilities, and will underwrite up to $4 million of this work in private facilities; research and development costs above $5 million will be borne by the company.

The Commission agreed further to waive its normal charge for use of special nuclear material needed to fuel the reactor for a period beginning with the contract date, June 6, 1956, and ending five years after the date of issuance of a license to operate the facility.

[15] See pp. 41–42, Eighteenth Semiannual Report (January–June, 1955).

The contract provides that the company will report fully to the Commission on technical and economic information obtained in the development, design, construction and operation phases of the project. Patent rights in connection with work done with Commission assistance will be established by the Commission. The Company will receive, as a minimum, a nonexclusive, irrevocable, royalty-free license. In connection with inventions or discoveries made by the company or its employees without Government assistance, the company will grant the Commission a nonexclusive, irrevocable, royalty-free license for governmental purposes.

The contract also provides that spent fuel elements from the project will be processed in accordance with policies and prices in effect at the time processing is necessary.

The company has selected Westinghouse Electric Corp. to develop and design the project, and Stone and Webster Co. to construct the plant. The Commission contract was assigned to the Schenectady (N. Y.) Operations Office to administer.

Seven new proposals. In response to the Commission's second invitation under the Power Demonstration Reactor Program the following seven proposals, each involving a different design concept, were received:

	Type of Reactor	*Electrical Generating Capacity (Kilowatts)*
Chugach Electric Association, Inc., Anchorage, Alaska, jointly with Nuclear Development Corp. of America, White Plains, N. Y.	Liquid sodium-cooled, heavy water-moderated.	10,000
City of Holyoke Gas & Electric Dept., Holyoke, Mass.	Gas-cooled (nitrogen)	15,000
City of Piqua, Ohio	Organic-moderated	12,500
Orlando Utilities Commission, Orlando, Fla.	Liquid metal fuel	25,000 to 40,000
Rural Cooperative Power Association, Elk River, Minn.	Boiling water	22,000
University of Florida, Gainesville, Fla.	Pressurized light water	500
Wolverine Electric Cooperative, Big Rapids, Mich.	Aqueous homogeneous	10,000

In April, the Commission approved the proposals of the Rural Cooperative Power Association and the Wolverine Electric Cooperative as bases for contract negotiations. The other five proposals are being evaluated by the Commission on a competitive basis contingent upon availability of Government funds.

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Experimental Power Reactor Program

During the last 6 months, in addition to the work already being done in Government laboratories and under contract on five types of power reactors, the Commission pushed ahead with contracts and experimental work to advance four additional concepts.

A contract was signed for work on a reactor using an organic fluid as a moderator and coolant. Contract negotiations were begun for developing and constructing a reactor to use a liquid metal fuel. Outlines for research and development programs were undertaken for reactors operating on a mixture of uranium and plutonium, and for gas-cooled reactors to operate in combination with gas-turbine powerplants.

Organic-moderated reactor experiment. In March 1956, the Commission signed a contract with Atomics International, a division of North American Aviation, Inc., to construct and operate an experimental reactor, moderated and cooled with an organic fluid, at the National Reactor Testing Station, Idaho. Estimated cost of the initial phase of the Organic-Moderated Reactor Experiment (OMRE) is $1.8 million of which approximately $750,000 will be borne by Atomics International.

The experiment is designed to establish the technical feasibility of using the hydrocarbon, diphenyl, as a moderating and cooling material. The use of organic compounds such as diphenyl has several potential advantages: a low level of induced radioactivity, low corrosion of fuel elements, and a high boiling point, which would make possible systems operating at reasonably high temperature at low pressures.

The experiment, carrying forward research previously done by North American Aviation, will simulate conditions of heat transfer, temperature, and coolant flow, which would exist in a practical power reactor.

The OMRE will be designed to generate 5 to 15 megawatts of heat and will use fuel elements highly enriched in uranium 235. Construction will begin this year with reactor operation scheduled early in 1957.

A further phase in the development of organic-moderated reactors is being undertaken as part of the naval reactor program.

Liquid metal fuel reactor experiment. The Commission began negotiations during this reporting period with The Babcock & Wilcox Co. for development, design, fabrication, and operation of a Liquid Metal Fuel Reactor Experiment (LMFRE). Babcock and Wilcox became a major new research and development contractor for the Commission when its proposal was selected as the best of 11 submitted. The

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Union Carbide Nuclear Co. will be a subcontractor primarily in the chemical processing of fuel.

The Liquid Metal Fuel Reactor Experiment will carry forward research work done by the Brookhaven National Laboratory on the concept of a reactor using uranium fuel dissolved in molten bismuth. The laboratory will continue to contribute to general development, while Babcock and Wilcox will concentrate on engineering aspects.

The liquid metal fuel concept seems to offer considerable promise as an economic source of heat for central station powerplants. In addition, its nuclear flexibility appears sufficiently great to permit its use in a thermal, intermediate, or fast, reactor in a variety of sizes. The present experiment will be designed to establish basic technical feasibility of the concept, rather than to serve as a pilot plant demonstration of a particular liquid metal design concept.

Experimental plutonium fuel reactor. The Commission has requested the General Electric Co. at the Hanford Works, Richland, Wash., to outline for the Commission's use a research and development program covering the use of plutonium in power reactors. Combining plutonium with natural uranium as a reactor fuel would be of particular value to most foreign countries by freeing them from a dependence on importing uranium 235. Some domestic reactor designs also include plutonium as a fuel, although very little research and development work on its use has been done. A practical, low-cost plutonium fuel element is needed as well as basic data for design of reactors using both uranium and plutonium. Development of uranium fuel elements and other advanced reactor technology will be additional objectives of this Hanford program.

Construction of a small experimental reactor is planned as the focal point of the program, which would utilize the extensive development facilities at Hanford and the skills and experience of scientists and engineers who have worked on the Hanford production reactors.

Gas-cooled reactors. Gas-cooled reactors that use the heated gas to drive turbine powerplants are considered a possible answer to the problem of economic power reactors of small size. Among the advantages of this concept may be simplicity of design, high efficiency, and independence from such environmental factors as a continuous supply of cooling water. In small sizes, gas turbines are less expensive than steam turbines. The principal problem to be overcome in achieving an economically competitive reactor would be designing fuel elements that would have a reasonable life expectancy at the high temperatures needed for good thermal efficiency.

During this reporting period, study contracts were negotiated with Ford Instruments Co., a division of the Sperry Rand Corp., and with

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Studebaker-Packard Corp., to provide a better understanding of the potential economics of this concept, and to delineate the research and development remaining to be accomplished. Some actions on research and development concerning suitable materials are described in the report section on the Army Reactors Program, under which another gas-cooled reactor experiment will be designed.

Pressurized Water Reactor. During the first 6 months of 1956 construction of the Pressurized Water Reactor (PWR) at Shippingport, Pa., continued. Construction of steel structures to house the reactor neared completion by the Pittsburgh-Des Moines Steel Co. Erection of structural steel for service and turbogenerator buildings was begun in March by the American Bridge Division, United States Steel. Placing of all plant concrete was about 75 percent completed.

The Dravo Corp. of Pittsburgh, Pa. was selected by the Westinghouse Electric Corp., designer and developer of the plant, as subcontractor for installing the reactor. Dravo completed shops and warehouses and began putting in equipment foundations and some components. Construction of the reactor vessel, to contain the core of uranium fuel, continued in the Chattanooga shops of Combustion Engineering, Inc. The heat exchangers, being built by The Babcock & Wilcox Co. and by Foster-Wheeler Corp., are approaching completion.

The Duquesne Light Co. of Pittsburgh is building the conventional portion of the plant and will operate the entire plant. Duquesne will also contribute $5 million toward the cost of reactor plant design, development, and construction.

The PWR plant will be the first large nuclear power generating station in the Nation, with a capacity of at least 60,000 kilowatts of electricity. The Shippingport plant, estimated to be completed in 1957, is not expected to produce economic power but rather to provide information that can be obtained only from the construction and operation of a prototype plant. The pressurized water concept has been developed further than any other in the power field. Experience with the Hanford reactors, the Materials Testing Reactor, and the Submarine Thermal Reactor (S1W), developed technical knowledge which is being applied in the PWR.

Boiling Water Reactors. Boiling Reactor Experiment No. 3 (Borax-3) was shut down in April after operating at the National Reactor Testing Station for about 6 months at design temperature and power levels up to that necessary to produce about 2,000 kilowatts of electricity. A second core of oxide fuel elements is being fabricated and will be used in continuing the experiment as Borax-4. Initial operation of Borax-4 is expected this summer. This type of reactor

differs from the pressurized water reactor in that steam generation is allowed to take place in the reactor core itself.

Borax-3, one of a series of similar plants designed by Argonne National Laboratory, became critical on June 9, 1955. It was the first reactor to be used in this country to supply experimentally the power and light for an entire city (July 17, 1955).[16]

The phase in the boiling water reactor program following Borax-3 and Borax-4 experiment will be construction and operation of the Experimental Boiling Water Reactor (EBWR) at Argonne National Laboratory, Lemont, Ill. During this reporting period fabrication and erection of the containment shell to house the reactor and generating equipment was completed by the Graver Tank and Manufacturing Co. The pressure vessel, designed jointly by Argonne Laboratory and The Babcock & Wilcox Co. engineers, has been installed. The facility is expected to be generating power early in 1957.

The EBWR powerplant—designed to produce 20 megawatts of heat and 5,000 kilowatts of electricity—will have the minimum capacity considered necessary to permit sound extrapolation to large-size central station plants. Architect-engineer for the project is the Sargent & Lundy Co. of Chicago; the Sumner Sollitt Co. will construct the reactor building under a lump-sum contract; and the turbine-generator, condenser, circulating water pumps, and associated equipment will be fabricated by the Allis-Chalmers Co.

In addition to eliminating an external heat exchanger, a boiling water reactor has the advantage that the steam pressure and temperature can be as high as those in the reactor vessel, thus improving the total thermal efficiency of the plant. Conversely, a cheaper reactor vessel can be designed for a given steam pressure. For example, if a steam pressure of 600 pounds per square inch gauge (psig) is desired, a boiling reactor need only withstand this pressure, whereas a pressurized water reactor may have to be designed as high as 2,000 psig.

One important feature of this type is that an increase in demand leads to a lower reactor pressure, an increase in the steam volume, and a reduction in the reactivity and power level. The reactor thus has good nuclear stability. This feature, although contributing to the safety of the reactor, tends to lower, rather than to increase power to meet rising demand. External control methods which add to the cost are necessary. Other problems include incomplete knowledge of boiling heat transfer phenomena and the need to develop long-lived fuel elements. The latter is a major problem common in all reactors using solid fuel elements.

[16] See pp. 41–42, Nineteenth Semiannual Report to Congress (July–December 1955).

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Sodium Reactor Experiment. Although considerable progress was made on certain phases of the Sodium Reactor Experiment (SRE) during the reporting period, some other phases were delayed. As a result, fabrication of the reactor by Atomics International, a division of North American Aviation, Inc., at Santa Susana, Calif., now is expected to be completed about October 1956.

This reactor, of 20 megawatts heat capacity, will use liquid sodium as coolant and graphite as moderator, since sodium makes possible high temperatures without a high pressure reactor vessel. Thus high thermal efficiency is expected to be achieved without a large increase in construction costs. The design is complicated by the necessity of guarding against the explosive sodium-water reation, and of protecting the uranium and graphite from the sodium. Sodium also becomes highly radioactive when irradiated, requiring extra shielding around the heat exchanger.

The reactor building was being completed at the site 30 miles northwest of Los Angeles. Work progressed on the installation of electric generating facilities by the Southern California Edison Co. The turbogenerator, electrical switch gear, transformers, and large water cooling tower were being installed. The steam generator is being fabricated by The Babcock & Wilcox Co., and other sodium piping is being fabricated by Atomics International at the site.

The delay arose from four different factors. After the reactor core tank was installed, it was discovered that the wrong type of welding rod had been used in fabricating the tank and other reactor components. This was due to an error in the plant of the welding rod manufacturer. It was necessary to repair or replace all questionable welded items. A second factor was that small cracks developed in the end plates of zirconium cans used for cladding graphite, and can components had to be remanufactured. Some equipment was delayed because of a strike in the vendor's plant, and delivery of the air blast heat exchanger was slowed by fabrication difficulties.

Reactor engineers and physicists were planning improved methods of reactor operation and start-up procedures in anticipation that criticality tests would start in January 1957.

Fast Breeder Reactors. On November 29, 1955, a power surge occurred which resulted in damage to the *Experimental Breeder Reactor No. 1* (EBR–1), which has been operated by Argonne National Laboratory at the National Reactor Testing Station. The incident occurred in the course of experiments intended to determine the cause of certain nuclear instabilities noted during operation of the reactor at low power. It was known in advance that there existed a real possibility that the experiment could result in a melt-down of the fuel. The

results of the experiments were considered sufficiently valuable to the fast breeder reactor program to warrant the degree of risk involved.

The particular experiment that resulted in damage required allowing reactor temperature to rise without coolant flow until the fuel temperature increased by a large amount. It had been anticipated that the reactor period to be reached in this experiment would be so short that period meters installed in the reactor control system could not be set without rewiring the meter circuits. (The reactor period is that length of time in which a reactor increases its generation of neutrons 2.7 times.) Accordingly, the pile period meter had been disconnected from the "scram" circuit which shuts down the reactor instantaneously in emergency, and it was left for the operator, or for automatic power level circuits, to shut the reactor off when this became necessary.

Excess reactivity was introduced into the reactor, so that its initial period was 60 seconds at a power level of a few watts. As the power and temperature increased, the reactor's period shortened. At a power level of about 150 to 200 kilowatts, a period of less than 5 seconds, much shorter than usual, was reached. At this point the scientist in charge called to the reactor operator to press a button which would have cut off reactivity very rapidly. The operator misunderstood and began to move the control rods at their normal speed, reducing reactivity slowly. When the scientist noticed this, he pressed the "reactor scram" button. At the same time the automatic power level controls were triggered, and shut down the reactor. They were set to operate when the power level reached 1,500 kilowatts. This whole operation took place within 2 seconds.

Shortly after the excursion occurred, radioactivity was detected in the building and personnel were promptly evacuated. There was no overexposure to radiation or other injury. Monitoring instruments recorded no release of radioactivity to other portions of the testing station, or to the surrounding area.

Information on the incident at first remained incomplete and speculative, as the reactor was too radioactive to permit proper inspection. It was not until May 17 that it became possible to remove the core from the reactor vessel. Since then it has been feasible to disassemble and examine limited portions of the reactor core. Further disassembly has been prevented by the consequences of the extreme heat reached in the reactor during the experiment, now known to have exceeded the melting point of uranium, 1,130 degrees centigrade. It was not known during the experiment that temperatures had reached this level because three thermocouples which measured core temperatures were not operating properly. The heat caused fusing together of some of the fuel rods and of various other parts of the core, and they cannot be separated by disassembly methods previously in use

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without danger of ignition and breakage. The balance of the core will therefore be removed as a unit and disassembled under the more controlled conditions of a "hot" laboratory.

Significant observations which can already be made as a result of the experiment are that, in this case, substantial melting of the fuel did not produce a violent nuclear reaction, and the radioactive products of the melt-down were readily contained. Disassembly of this highly radioactive system is providing valuable experience in remote handling of large radioactive objects. It is believed that the instability displayed by the EBR–1 is not characteristic of fast breeder reactors in general and that it can be corrected by modifications of the core and fuel elements. Work to establish this conclusion more firmly is proceeding.

At Argonne National Laboratory, conceptual design of the *Experimental Breeder Reactor No. 2* (EBR–2) was completed during the reporting period and the architectural-engineering phase begun. The new reactor will be sodium-cooled, will generate 62.5 megawatts of heat, and produce 15,000 kilowatts or more of electricity. It is hoped that the reactor can be in operation in late 1958, although there has been a delay in the schedule.

The Zero Power Fast Critical Assembly (ZPR–3) was operated successfully at the Idaho Testing Station during this reporting period. This facility began operation in October 1955 and will be used to provide accurate data necessary for detailed design of the EBR–2 core. Critical experiments for the EBR–2 core with uranium 235 are continuing and a plutonium loading for EBR–2 criticality tests will be completed soon.

Because of the heavy workload imposed on Zero Power Fast Critical Assembly No. 3 (ZPR–3), consideration is being given to the construction at Argonne of a second ZPR–3 to use for calibration purposes.

The *molten plutonium* fast reactor experiment at Los Alamos Scientific Laboratory is still in the phase of preliminary research and development. Because of health precautions required in experimenting with plutonium, progress is not expected to be rapid. Problems of containing molten plutonium are under investigation and samples are being prepared for irradiation in the Materials Testing Reactor at the Idaho Testing Station.

Homogeneous reactors. Construction of *Homogeneous Reactor Experiment No. 2* was completed at Oak Ridge National Laboratory, Oak Ridge, Tenn., early in May 1956 along with associated concurrent work on reactor component development. This included testing of a redesigned pressurizer, and a modified pump to circulate the fuel solution. Breaking-in tests are being conducted, and the reactor is expected to become critical this fall. The power output of HRE–2

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probably will not exceed 10 megawatts of heat. Work on the associated chemical processing plant is progressing.

HRE-2, like its predecessor HRE-1, is designed to test the economic feasibility, and work out the problems, of power generation with a reactor in which the fuel is dissolved in a liquid moderator which is circulated as a coolant. HRE-1, which embodied a concept proposed by the Oak Ridge National Laboratory, was dismantled in 1954 after operating successfully for two years at the laboratory.

HRE-2 uses for fuel a dilute solution in heavy water of uranyl sulfate, highly enriched in uranium 235.

One important advantage of this type of reactor is that the core design is mechanically simple. The reactor has a high degree of nuclear stability which makes for safety. Stability of fuel elements over long periods is not a problem, as in reactors using solid fuel rods. The possibility of continuous removal of fission products, many of which act as neutron absorbers, makes the reactor attractive as a breeder operating on the thorium-uranium 233 cycle.

The problem of fuel element stability has been solved however, at the expense of difficulty in containing the highly radioactive and corrosive solution in a high pressure plumbing system.

Further homogeneous reactor experiments are being conducted at Los Alamos Scientific Laboratory, Los Alamos, N. Mex., where development work continues on aqueous homogeneous reactors using an uranyl phosphate solution and a novel mechanical arrangement.

Construction of the *Los Alamos Power Reactor Experiment No. 1* (LAPRE-1) was completed.[17] Tests were initiated, but because of mechanical damage occurring to plating and cladding in the bottom portion of the reactor, apparently during final assembly, it was necessary to shut down for repairs. LAPRE-1 is equipped with a fuel circulating pump, is designed to generate fairly high pressure steam, and to have a thermal output of 2 megawatts.

The other experimental power reactor in the Los Alamos program, LAPRE-2, depends upon natural convection to circulate the fuel and is designed to produce a lower pressure steam with a heat output of 1.3 megawatts. Fabrication of components was completed during the reporting period, and the experimental reactor is being assembled.

Naval Reactors Program

The naval reactors program, a joint undertaking of the Commission and the Department of Defense, is aimed at developing and evaluating a group of nuclear powerplants designed to propel many sizes of

[17] See pp. 45–46, Nineteenth Semiannual Report to Congress (July–December 1955), for description of LAPR experiments.

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naval ships from small submarines to the largest aircraft carriers. The program continues to be an important accelerating influence in practical development of all nuclear powerplants.

Submarine Thermal Reactors (S1W and S2W)

The S1W (formerly STR, Mark I) plant at the National Reactor Testing Station in Idaho is being gradually modified to convert it from a land prototype for the USS *Nautilus* nuclear propulsion plant into a flexible testing facility where new developments in technology, design, and operation of improved naval water-cooled nuclear powerplants will be investigated, and improved design cores can be tested. The S1W has been redesignated the Naval Reactor Test Facility.

The second phase of the modification program was completed during the winter of 1955–1956. This included installation of a carbon-steel steam generator in the primary coolant system, and of improved reactor and primary system control equipment. It also included partial accomplishment of a change to make the plant capable of operating at higher powers and temperatures. The reactor core and fuel were renewed during that period for the first time, after some 30 months of operation and testing. Plant operation and scheduled testing were resumed during April 1956.

The USS *Nautilus*, powered by the S2W nuclear propulsion plant formerly the Submarine Thermal Reactor Mark II, now has operated for a year and a half.

Submarine Intermediate Reactors (S1G and S2G)

Operation of S1G (formerly SIR Mark A), land prototype of a nuclear propulsion plant for the U. S. submarine *Seawolf*, continued at West Milton, N. Y. It is being used for prototype testing and training of naval personnel.

The USS *Seawolf*, which will be powered by the Submarine Intermediate Reactor, Mark B (S2G), neared completion at Electric Boat Division, General Dynamics Corp., in Groton, Conn.

On April 3 the Commission announced that contracts were entered into with the City of Holyoke, Mass., and the Village of Ilion, N. Y., for sale of the output of any excess electric power produced by the prototype plant. The two municipalities were given until May 1 to complete arrangements for transmission of the power from West Milton to their own systems. Each was to receive one-half of any excess power.

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On May 16, 1956, the two municipalities reported that they had been unable to make arrangements to transmit the power. They did not request any extension of time in which to complete their arrangements.

These contracts—based on firm purchase proposals made prior to February 1 by the municipalities in response to the Commission's invitation—provide for delivery of power, as available at the West Milton bus bar, at 3 mills per kilowatt hour. Due to the experimental nature of the nuclear powerplant, no guarantee has been or can be given as to amount and timing of available power.

Submarine Advanced Reactor (S3G)

Design and development of the Submarine Advanced Reactor continued at Knolls Atomic Power Laboratory, Schenectady, N. Y. Preliminary grading was completed and construction of the test site facilities for the S3G land prototype powerplant was put under way. This prototype is being constructed on land adjacent to the S1G land prototype plant at West Milton, N. Y.

Congress authorized the construction of a nuclear-powered radar picket submarine in the Navy's shipbuilding program for fiscal year 1956. This submarine, to be powered by two S3G-type nuclear reactors, will be the largest submarine ever built, and the first powered by two reactors.

Submarine Reactor Small (S1C)

Design and development of a nuclear propulsion plant for a small submarine has been undertaken by the Commission to fulfill a requirement of the Department of Defense. In July 1955 a contract was awarded to Combustion Engineering, Inc., of New York City, to design and develop the reactor and related equipment.

Combustion Engineering—the third major contractor to enter the naval reactor development program—will carry out this work in its facilities being constructed near Windsor, Conn.

Large Ship Reactor (A1W)

Design and development of the Large Ship Reactor prototype propulsion plant by Westinghouse Electric Corp. continued at the Bettis Plant in Pittsburgh, Pa. Construction of test site facilities by the Arrington Construction Co. began at the Reactor Testing Station in April. Arthur G. McKee & Co. of Cleveland is architect-engineer for

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the site facilities; Newport News Shipbuilding and Dry Dock Co. will design the special shipboard features of the prototype plant.

Naval Reactor Organic Experiment

The Commission, during this reporting period, assigned to Knolls Atomic Power Laboratory, Schenectady, N. Y., operated by the General Electric Co., the design of an organic reactor experiment. The proposed experiment is planned in connection with a Department of Defense requirement for developing a nuclear powerplant of small size and weight suitable for light naval vessels. The experiment is expected to provide information on specific engineering problems involved in the use of organic compounds as a coolant for naval reactors.

Army Reactors Program

The Army reactors program, intended to develop reactor systems for special military needs, now includes three major projects—the Army Package Power Reactor, the Argonne Low Power Reactor, and the Food Irradiation Reactor. Preliminary steps also are being taken toward eventual development of gas-cooled power reactors for special military and civilian applications.

Army Package Power Reactor (APPR-1)

Construction of the APPR-1 continued during the past 6 months at Fort Belvoir, Va. The major portion of the building and the vapor container were finished, and some nonreactor equipment was installed under supervision of the prime contractor, Alco Products, Inc. The plant, scheduled for operation early in 1957, is intended to produce 1.825 kilowatts of electricity.

Development work supporting military pressurized-water systems continued with completion of critical experiments by Oak Ridge National Laboratory. Heat transfer tests at Columbia University, and fuel element development projects under contracts with the Nuclear Development Corp. of America and Sylvania Electric Products, Inc., are still in progress.

Argonne Low Power Reactor (ALPR)

The Pioneer Service and Engineering Co. was selected as architect-engineer, under subcontract with the Argonne National Laboratory, for design of the non-nuclear portions of the Argonne Low Power

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Reactor. The project, established in November 1955, calls for development of a boiling water heterogeneous reactor powerplant for military use. The net power output would be 200 kilowatts, about one-tenth that of the APPR-1. The reactor will be constructed at the National Reactor Testing Station.

Experiments on materials and control systems for military boiling reactors continued at Argonne and at Battelle Memorial Institute.

Food Irradiation Reactor (FIR)

At the request of the Department of Defense, the Commission initiated a project to provide a food irradiation source for the Army Quartermaster Corps. During this reporting period, Army experiments were continued to demonstrate whether foods sterilized by this process would be nontoxic, acceptable to consumers, adaptable to efficient handling techniques, and economically competitive with foods preserved by other processes.

Joint studies by the Commission and the Department of Defense concluded that a reactor optimized for gamma ray production should meet the Army's food irradiation requirements. Conceptual design studies were made of various reactor types to form a basis for selecting the best system.

Gas-Cooled Reactor Development

In connection with designing gas-cooled power reactors to meet military needs for compact, water-free power systems, and civilian requirements for an economic small central station powerplant, Battelle Memorial Institute has begun testing materials applicable to this reactor concept. Preliminary design of gas-cooled test loops has been initiated. A contractor is being selected to design, construct, and operate a gas-cooled reactor experiment.

Advanced Reactor Systems

The Commission and the Department of Defense continued studies on conceptual design and feasibility of advanced reactor systems for eventual military use.

The Army Transportation Corps, under contract with the Nuclear Development Corp. of America, began studies on applying nuclear power to meet Army transportation requirements. Navy's Bureau of Yards and Docks continued design studies on a barge-mounted nuclear powerplant through the Naval Research Laboratory and the

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Shipbuilding Division, Bethlehem Steel Co. The Army's Engineer Research and Development Laboratories, complementing the Commission's gas-cooled reactor program, continued to work toward the development of closed-cycle, gas turbine power-generating equipment suitable for use with a nuclear reactor.

Aircraft Reactors Program

During this reporting period research and development activities on aircraft nuclear powerplants progressed satisfactorily.

Close coordination of Commission programs in this field with those of the Air Force, the Navy Bureau of Aeronautics, and the National Advisory Committee on Aeronautics continued.

Flight Engine Test Facilities at NRTS

In April the Commission entered into a contract with the Ralph M. Parsons Co. of Los Angeles, for architect-engineering of new test facilities to be built in the Aircraft Nuclear Propulsion area of the National Reactor Testing Station. The contract calls for designing a test building, a shielded control and equipment building, and supporting facilities. Design work under the contract is expected to be completed in about 10 months, with construction expected to start in the spring of 1957. Construction is estimated to cost approximately $12 million, and as many as 600 workers may be employed on construction. The contract with the company was negotiated on a lump-sum basis.

The Parsons Co. has been architect-engineer of other facilities at the Aircraft Nuclear Propulsion site in the assembly and maintenance area, the administration service area, and the initial test area.

Runway and Auxiliary Facilities at Testing Station

As the design and construction agent of the Air Force at the Idaho Station, the Commission entered into a contract in February 1956 with Porter, Urquhart, McCreary, and O'Brien, of San Francisco, Calif., for the design of a runway and auxiliary facilities to be constructed at the testing station.

General Engineering and Development

During the last 6 months, the Atomic Energy Commission has asked private industry to undertake chemical processing, has signed con-

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tracts for increased commercial production of zirconium, and invited proposals on reactor materials currently produced in Government-owned facilities. In addition to these moves to encourage wider participation in the atomic energy industry, the Commission has set prices and begun to market certain basic reactor materials; has held a conference on homogeneous reactor design and building; has undertaken studies on pressure vessel stresses and proposed study of safety codes governing pressure vessels; has moved ahead with possible commercial applications of nuclear heat; and has assigned top priority to construction of the Engineering Test Reactor urgently needed to carry on irradiation tests of power reactor components. Research has been conducted on various methods of separating fission products and reprocessing spent fuel elements, on waste disposal, and on reactor safety.

Encouraging Commercial Chemical Processing

A policy aimed at having commercial chemical plants ready to process spent fuel elements from the first privately owned power reactors was announced by the Commission on January 5, 1956. It was discussed later in the month at a chemical processing meeting at Idaho Falls, Idaho, attended by 183 representatives of business firms. The talks centered on the effect of cost factors in chemical processing on economical operation of reactors.

It was announced that proposals would be invited some 12 to 18 months later for the design, construction, and operation of the chemical processing plants. The Commission would permit use of its laboratories on a reimbursable basis for developmental work by those whose proposals were accepted, and would supply the plants with an initial base load of spent fuel from one or more of perhaps 20 reactors. Meanwhile, interested firms will be furnished with samples of spent fuel elements and information on technology, fuels available, costs, etc., to help them prepare proposals.

Lightweight Shielding Being Produced Commercially

The Commission has urged private companies to take over production of lightweight engineering materials for use in reactor and accelerator shielding. The decision was prompted by an increasing interest by business concerns in the manufacture of boral—a solidified mixture of boron carbide and aluminum originally produced at Oak Ridge National Laboratory.

During this reporting period, the Brooks and Perkins Co., Inc., accepted two orders for boral from private firms.

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Zirconium Production

In May the Commission announced an expanded program for procurement of high purity zirconium metal and hafnium oxide to meet increasing short- and long-range reactor development requirements. A major portion of the procurement is for scheduled projects of the Navy, the remainder for the Commission.

To provide an assured future supply of the materials, long-range contracts have been signed with three new commercial suppliers who were among 10 firms which submitted proposals. These three contracts, covering a 5-year period, call for annual delivery of 2,200,000 pounds of zirconium, subject to availability of funds, at an average cost of about $14 million a year.

The new long-range suppliers are: National Distillers Products Corp., which will supply 1 million pounds annually from new facilities to be constructed at Ashtabula, Ohio; NRC Metals Corp., a subsidiary of the National Research Corp., Cambridge, Mass., which will supply 700,000 pounds annually from a plant to be constructed near Pensacola, Fla.; and Carborundum Metals Co., which will supply 500,000 pounds annually from a plant to be constructed at Parkersburg, W. Va.

Contracts are for fixed unit prices subject to revision within established ceilings at specified periods during the contract terms. Production is expected to begin late in 1957 from new plants to be financed entirely by the suppliers.

Requirements for zirconium and hafnium which must be met before the new plants go into production are expected to exceed present stockpile and production. These requirements will be met (1) by Carborundum Metals Co., Inc., of Akron, N. Y., current Commission supplier, increasing its annual production from 200,000 pounds to 325,000 pounds; (2) by reactivating the plant at Albany, Oreg., of the Bureau of Mines, Department of the Interior, which was the pilot zirconium production plant in this country, to produce about 300,000 pounds annually beginning in August 1956 (The plant will be operated under a contract which will expire June 30, 1958, by the Wah Chang Corp. of New York which was among seven firms responding to a Commission invitation for proposals to operate the plant.); and (3) by importing from Japan 200,000 pounds of zirconium, meeting the Commission's specifications, under an arrangement made on behalf of the Commission by this Government's Commodity Credit Corp. Deliveries are expected to begin this year and will be completed in 1957.

Each new arrangement includes procurement of all byproduct hafnium oxide which is obtained from the zirconium-bearing ores processed by the suppliers.

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Industry Offers to Meet Beryllium Needs

Three proposals were received in May in response to the Commission's January invitation to private industry to submit proposals for supplying up to 100,000 pounds a year of reactor-grade beryllium metal over a 5-year period. The proposals came from Brush Beryllium Co., Beryllium Corp. of America, and Riverside Metals Co., a division of H. K. Porter, Co., Inc. The three proposals will be evaluated technically, and the plants inspected before a decision is made.

Beryllium requirements now are met from the production of a Government-owned plant at Luckey, Ohio, which is operated for the Commission by the Brush Beryllium Co. If proposals prove acceptable, the Luckey plant would be placed on a standby basis.

In addition to the metal required by the Federal program, quantities of beryllium may be required for privately financed projects which the Commission does not intend to supply.

Price Set for Thorium

A revised basic price of $43 a kilogram for sale or lease of thorium metal was established by the Commission in January. The price will apply to licensees planning to use the metal in nuclear reactors and for other enterprises in peaceful uses of atomic energy. The Fernald (Ohio) Feed Materials Production Center was designated as the f. o. b. point. Thorium metal will be leased or sold in limited quantities only until industry is prepared to meet commercial requirements.

Conference on Homogeneous Reactor Program

A civilian power reactor conference to enable private holders of permits for access to classified information to review the homogeneous reactor programs at Oak Ridge National Laboratory and at Los Alamos Scientific Laboratory was held at Oak Ridge, Tenn., March 21–22, 1956, with the Oak Ridge Laboratory as host. The conference—including tours of the homogeneous reactor site and engineering development laboratory, and sessions with key laboratory personnel—was attended by about 225 persons.

Pressure Vessel Studies

An unclassified feasibility study of pressure vessels for nuclear power reactors [18] was published in December 1955 by the Commission and is presently available to industry.

[18] *Feasibility Study of Pressure Vessels for Nuclear Power Generating Reactors* (AECU-3062), December 1955, available from the Office of Technical Service, U. S. Department of Commerce, Washington 25, D. C. Price $1.75.

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Through the Pressure Vessel Research Committee of the Engineering Foundation, the Commission is sponsoring an investigation of the stresses at nozzles and openings of pressure vessels in order to provide the facts on stress concentrations in those areas. The results of the study may justify use of lower safety factors in pressure vessel design with resultant savings in materials.

Pennsylvania State University is conducting this study under contract. The Engineering Foundation's Welding Research Council will inform industry of the results through publications of the Council.

Codes for boilers and pressure vessels. The Boiler and Pressure Vessel Code of the American Society of Mechanical Engineers, or a local version of that code, constitutes the legal basis for the design of boilers and pressure vessels in the key industrial states. This code, developed by the Society's Boiler and Pressure Vessel Committee, is under continual review by that group. The National Board of Boiler and Pressure Vessel Inspectors, consisting of the chief inspectors from the various states and cities, is charged with the administration of the code.

While this code has proved adequate in providing safe construction for conventional boilers and pressure vessels, additional provisions will be necessary in designing vessels for reactor service. In addition, certain of the code's present provisions would introduce unnecessary hazards if imposed on reactor vessels.

In view of these facts, the Commission has been instrumental in organizing a special subcommittee of the Boiler and Pressure Code Committee on Nuclear Power. This special subcommittee will cooperate in modifying the code to provide for nuclear requirements, and will eventually prepare an additional section to the code applying specifically to nuclear installations. In addition, the membership of the Nonferrous Subcommittee has been enlarged to include engineers qualified to prepare industrial standard specifications and develop allowable design data for certain newer structural materials useful in nuclear installations.

Engineering Test Reactor.

Construction of the Engineering Test Reactor (ETR) went ahead on a top priority basis during this reporting period at the National Reactor Testing Station, Idaho. The ETR will provide irradiation facilities urgently needed in developing reactor components for military and civilian power reactors. Completion and initial operation of the facility is scheduled for March 1957.

Architect-engineering and construction were undertaken by the Kaiser Engineers Division of the Henry J. Kaiser Co. Nuclear design

of the reactor core and facilities within the tank is being performed by the Atomic Power Equipment Department of the General Electric Co. under contract to Kaiser. Fuel elements are being designed by Oak Ridge National Laboratory.

To make the reactor available for experimentation as early as possible, some facilities designed to handle first experiments are being constructed and installed at the same time as the reactor structure itself.

Private Test Reactor

The Westinghouse Electric Corp. will begin construction in September of the first large testing reactor to be built by private industry. Completion is scheduled for August 1957. The $6.5 million plant, to be known as the Westinghouse Testing Reactor, (WTR), will be located on an 800-acre site near Waltz Mill, Pa., 29 miles southeast of downtown Pittsburgh.

The WTR will be used for evaluation of full-size fuel specimens and other components of atomic powerplants under actual operating conditions. Using highly enriched uranium with light water as a moderator and coolant, the reactor will operate in the range of 20 megawatts or above.

Nuclear Heat for Coal Gasification Studied

During this reporting period initial tests to determine the feasibility of using nuclear heat to produce gas from coal were begun at the Appalachian Experiment Station, Morgantown, W. Va., Bureau of Mines, Department of the Interior. The tests, which do not use actual nuclear heat, resulted from discussions between the Bureau and the Commission regarding the applicability of nuclear heat to high-temperature chemical processes.

The Bureau undertook to build two experimental units, heated electrically, as models of possible future nuclear units. The first model has been built and is being used in current tests at Morgantown; the second is scheduled for early completion.

In cooperation with the Bureau of Mines, the Commission initiated a preliminary engineering study to determine the feasibility of a process heat reactor. It is expected that this reactor would operate in a temperature range around 1,370 degrees centigrade. It is anticipated that this study will point up the need for work aimed at developing components which will operate satisfactorily at high temperatures. This reactor concept has been followed with great interest by industry, since it has potential application to other high temperature chemical processes.

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Chemical Engineering

During the reporting period, Commission laboratories and contractors continued with research and development programs dealing with the separation of fission products from spent fuel elements. Separation methods under study included: gasification of fuel elements combined with fractional distillation; liquid metal extraction; evaporation of fission products from molten metal, from solids, and by flash distillation in arc zones. Solid scavenging techniques have been tested as has fused salt extraction. In addition, work in pure metallurgical processing was stepped up to implement the process data needed for reactors such as sodium graphite reactors and fast breeder reactors. Other research on chemical processing is described in the section on Physical Research.

Volatility separation. A new separation process being developed at Argonne National Laboratory is based on fluorination of reactor fuel elements, followed by fractional distillation of the fluoride products. Successful tests of the process have been carried out on a pilot plant scale.

Oak Ridge National Laboratory has also done research on the fluoride volatility process, dissolving uranium in molten fluorides and then generating uranium hexafluoride which volatilizes readily. Fewer steps are required than in conventional solvent extraction processing methods and the equipment is less expensive.

High temperature chemical separation. Another new processing concept—called pyrometallurgical processing—being developed by Argonne, by Ames Laboratory in Iowa, and by Atomics International, a division of North American Aviation—has as its objective, not complete purification, but sufficient purification to permit reuse of fuel in a reactor.

The Argonne effort is directed toward a specific type of nuclear reactor—the fast reactor. At the high neutron energies existing in these machines, the effect of fission products on neutron economy is much less than in thermal reactors. Repurification is therefore needed primarily to maintain the radiation stability of the fuel. Sufficient purification may be effected by simple chemical and metallurgical techniques similar to those now employed with such metals as steel, copper, zinc, and lead. When a satisfactory process is developed, it will be tried out as part of the operation of Experimental Breeder Reactor No. 2, presently under design at Argonne.

The molten metal extraction method of reprocessing reactor fuel, as studied at Ames, keeps the metal in its metallic state and so does away with dissolving the fuel metal in acid and using aqueous solution chemistry for purification. This procedure involves melting uranium

and uranium alloy with another metal. The separation of uranium takes place with a concurrent separation of fission products. The uranium then can be recast into fuel elements and put back into the reactor until another reprocessing is necessary.

A similar process being investigated by Atomics International places the uranium melt in contact with a molten metal, such as magnesium, at a temperature above the melting points of both metallic phases. Magnesium has successfully separated plutonium and some fission products from irradiated uranium metal by direct solvent action at 1150 degrees centigrade.

Three other high temperature chemical processing methods have been under investigation at Atomics International. Direct distillation of plutonium and of many fission products from irradiated uranium metal can be achieved at temperatures of 1600 to 1700 degrees centigrade. The more volatile fission products and some uranium have been separated from irradiated thorium-uranium metal by (1) evaporation from molten metal, (2) vaporizing from solid samples, and (3) flash distillation in the arc zone of an arc-melting apparatus.

Solid scavenging techniques have also been used by Atomics International on irradiated uranium metal and have resulted in removal of many fission products by both adsorption and chemical exchange. Refractory salts and graphite have been used in the scavenging phase. Due to the high oxidation potential of thorium, irradiated thorium-uranium melts become seriously contaminated by container materials at elevated temperatures.

Finally, fused salt extraction of plutonium and some fission products from irradiated uranium metal has been demonstrated, using uranium tetrafluoride as the salt phase, at 1300 degrees centigrade. The resulting plutonium-rich salt phase subsequently was reduced to yield a uranium-plutonium alloy containing a small fraction of the original fission products.

Processing waste materials in fluidized beds. When a gas stream is passed up through a bed of finely divided solids, the solids can be suspended in the gas by varying the velocity of the stream so that the solids are held in equilibrium within the pipe or container. In this fluidized form, heat can be transferred to or from the material much more easily than when the same material is in solid form. Fluidized material also presents a large area for interaction between solids and gases.

Scientists at Argonne National Laboratory are applying fluidization to radioactive waste treatment. Radioactive waste solutions of

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aluminum nitrate are sprayed into a heated, air-fluidized bed of aluminum oxide, where the water is evaporated and the aluminum nitrate is converted into aluminum oxide. The nonvolatile radioactive materials remain in the oxide. The oxide has a much smaller volume than the original solution, and it can be stored without concern about its corroding through a container. These characteristics are expected to reduce the cost of treating wastes.

Another promising method has been developed at Oak Ridge National Laboratory for inexpensive disposal of radioactive wastes containing aluminum nitrate. Following heat treatment to convert the aluminum compound to a form that does not adsorb on ion exchange resins, the fission products are removed by ion exchange and concentrated to a small volume. These are the only components of the waste requiring expensive storage facilities.

Reactor Safety

SPERT and KEWB. More than 200 "transient" tests have been made at the Special Power Excursion Reactor Test Facility (SPERT–I) of a heterogeneous reactor concept, operated by Phillips Petroleum Co., at the National Reactor Testing Station in Idaho. During a typical test, the reactor power reached 510 megawatts in 0.75 second and then dropped equally rapidly under the self-regulation of temperature rise and void formation. Data on SPERT experiments were released in June, as part of the Commission's program to provide information to industry for the evaluation of reactor hazards.

The design work on SPERT–II and III progressed satisfactorily and construction of central control facilities and the SPERT–III reactor was scheduled to start this summer.

At Santa Susana, Calif., Atomics International's construction of the Kinetic Experiment on Water Boilers facility (KEWB), a homogeneous reactor concept, is nearing completion. Instrumentation difficulties prevented this reactor from going critical as scheduled during this reporting period. These difficulties have been largely overcome and data on transient tests in this facility are expected by mid-summer.

Kinetics of metal ignition. Many metals will burn or even cause explosions under certain conditions, particularly if they are finely divided as in machining operations.

Argonne National Laboratory has initiated an investigation of such pyrophoric behavior of metals used in nuclear reactors (e. g., uranium, plutonium, thorium, zirconium) by studying factors affecting the

kinetics of ignition in the metals. This investigation is designed to lead to more effective measures for the control and prevention of the serious hazard of metal fires or explosions.

Sanitary Engineering

Research and development in the disposal of highly radioactive wastes, followed three major approaches.

The first of these was the *fixation of the waste fission products* in an inert solid carrier so that the possibility of release and subsequent migration of the radioactivity into environment is eliminated or reduced to acceptable limits. This would allow the carrier containing the radioactive material to be permanently stored or buried in special locations without harmful effect on the environment.

Work along these lines was carried out at Brookhaven National Laboratory on the conversion to the oxide form of the inert salt and fission product constituents of high-level waste. Subsequent leaching and fixation in clays are further steps involved in complete disposal. A preliminary engineering evaluation of this system is planned.

Studies at Johns Hopkins University on the fixation of cesium 137 and strontium 90 in hydrated alumino-silicates showed considerable promise. It appeared that formation of highly stable feldspars at relatively low temperature (300 degrees centigrade) is the dominant factor in success of this method. Other work is described in the section of this report on Biology and Medicine research.

The second approach to the problem of disposal of highly radioactive wastes involves the *selective removal of specific nuclides* such as cesium 137 and strontium 90. Because of the severe radiotoxicity and long half-lives of these materials, their removal from wastes and fixation would substantially reduce the effective radioactive life of the remaining material, and increase the possibilities of safe disposal into the environment under controlled conditions. It is important, however, that the removal of these nuclides be essentially complete because of the very low concentration of these isotopes allowable in the environment.

Such selective removal studies were initiated at Oak Ridge using ion-exchange techniques.

The third approach contemplates the direct *discharge of highly radioactive wastes to specially selected geologic formations.* Through the Earth Sciences Division, National Academy of Sciences, a group of experts in the fields of geophysics and geology is preparing an initial report to indicate existing information pertinent to the problem, and in a preliminary way, the technical possibilities; delineate areas where information is lacking and recommend research and development to obtain pertinent data.

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[19] See pp. 98–9

Declassification and Classification Program

The Atomic Energy Commission maintains a continuing two-part program to make available to the public all possible information about atomic energy without imperiling national security, and to provide access to classified technical information to private enterprise so as to assist industrial development of peaceful uses of atomic energy. First, the Commission maintains a current, realistic Declassification Guide to assist technical experts throughout the atomic energy program in determining that information which can be published and the classification which must be placed on other information to protect essential security. Second, the Commission conducts a continuous review of classified material developed in prior years. To step up this part of the program the Commission completed in February 1956, a special accelerated review of much of the classified material accumulated throughout the life of the atomic energy program to determine the material which could be published or downgraded to a lesser category of classification.

Declassification Guide

The Declassification Guide which provides current classification policy was revised following each of the seven international consultations with the United Kingdom and Canada in earlier years. The eighth Declassification Conference was held in April and the Commission is currently considering the possibility of revisions involving declassification and also of downgrading a large body of material which will aid in the development of peaceful uses of atomic energy and in fundamental research in this field.

The last revision of the Declassification Guide was put into effect in July 1955. That version recognized that a great many reports about civilian power reactors no longer required the maximum protection of high classification. It has greatly facilitated industrial access to essential information.[19]

Accelerated Declassification

In the Commission's accelerated review of classified material 30,773 research and development reports and informal memoranda were surveyed. The review was aimed at declassifying or downgrading the classification of a large accumulation of classified reports of potential use in the development of the atomic energy industry in the light

[19] See pp. 98–99. Nineteenth Semiannual Report (July–December 1955).

of the current Declassification Guide. The review was done at the Oak Ridge, Tenn., Operations Office by a team of 35 scientists and engineers from major installations, under supervision by Commission staff.

It was a special stepped-up program within the larger program for continuous review of all currently produced technical reports carried on as normal procedure.

Of the 30,773 classified reports reviewed, 10,916 were declassified and are available to the general public, 8,574 were classified "Confidential", and are available to private individuals and concerns with "L" or limited clearance as well as those with "Q" or full clearances (see Civilian Application), and 11,283 remained in the "Secret" classification. Approximately half of those in the last category are available to access permit holders with "Q" clearance who demonstrate a need for the information. The balance, or 4,700 reports, are not currently available to access permit holders because the reports are primarily concerned with military programs. However, these reports are being re-edited when possible so as to dissociate useful technology from its military application.

Continuing Program

Since the special review team was disbanded, Commission staff has reviewed an additional 3,019 technical reports as part of its continuing program to declassify material for industrial use where this is possible without compromise to national security.

Information Services

During the last 6 months, the Atomic Energy Commission has maintained and enlarged its efforts to inform the public and interested industry about all nonclassified activities of the atomic energy program, at the same time that it has vigorously enforced those restrictions which protect such information as is considered essential to national security. In addition, special programs have distributed classified information within the atomic energy project, to appropriate Government agencies and to those private individuals and concerns that have been granted access permits and security clearances to aid their participation in atomic energy development.

The public has been informed chiefly through the news media—the press, television, radio, trade and professional journals—but also public groups have heard talks and addresses by many Commission and contractor officials. Reports and press releases have been issued, and interviews encouraged and given. Representatives of news media

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and of industry have been invited to assist this effort by their suggestions.

The distribution of technical information to private individuals and concerns interested in the peaceful uses of atomic energy has steadily increased. Much more unclassified and declassified material is available under the policy of declassification adopted in 1955, and the accelerated program of declassification in 1955–56 (see Declassification and Classification Program). Many more individuals and concerns have been granted access permits, personnel security clearances, and approval of storage facilities for use of appropriate classified material (see Civilian Application). A greatly enlarged program for translating and publishing foreign material has started. Additional depository libraries of unclassified, Commission-published, materials are being opened; each metropolitan center of 500,000 or more population is to be supplied with at least one such library. Broad programs for publication and distribution of material are under way.

A major technical exhibit demonstrating United States atomic equipment, instruments, and accomplishments, prepared for the International Conference on the Peaceful Uses of Atomic Energy held last August in Switzerland, has been placed on display twice in this country—in Oklahoma City, Okla., and in New York City. It will be on view to the public in Chicago, Ill., for 2 years. Mobile exhibits on peaceful uses of atomic energy were prepared in this reporting period and soon will start on schedules of almost continuous showing. These exhibits will tour at Government expense under a new policy adopted by the Commission in January 1956.

Public Information

In addition to its increased emphasis on making information available to the public through the customary channels, the Commission during the last 6 months arranged for the first time since 1946 for uncleared observers to attend a weapons test in the Marshall Islands. The Commission further has broadened its assistance to educators (see Education and Training), has arranged for a semipermanent display of the Geneva exhibit, and has prepared mobile exhibits depicting the peaceful uses of atomic energy.

Reporting "Operation Redwing"

The Commission's invitation to 15 selected representatives of news media and to 17 Federal Civil Defense Administration observers to attend "Operation Redwing" had two principal purposes: (1) to broaden public understanding of the effects of thermonuclear weapons,

and (2) to provide for public nongovernmental coverage and reporting of activities at the Eniwetok Proving Ground.

Applying the same techniques used in events involving public reporting at continental tests in Nevada, it was possible to permit this uncleared observer group to witness a weapons detonation at the Eniwetok Proving Ground without their having access to any classified information.

Extensive unclassified background material supplied to the observer [20] was supplemented by briefing talks by Commissioner Harold S. Vance and the Joint Task Force Commander, Rear Admiral B. Hall Hanlon, and his principal staff. The observers were taken on tours of portions of the installations on Bikini and Eniwetok atolls.

The observers witnessed the LaCrosse shot, a kiloton-range detonation on May 4, and the Cherokee detonation of a thermonuclear experimental bomb in the range of several megatons, on May 20 after a 13-day wait for favorable weather. The Cherokee bomb was dropped from an Air Force B–52 plane.

The output of reporting by the small, pooled group of newsmen was heavy. During the 19 days in the Proving Ground, the wire service, newspaper, photo syndicate and United States Information Agency representatives filed 172,400 words and 56 radio photos over U. S. Navy facilities on the USS *Mt. McKinley;* the radio–TV pool broadcaster was on the air by direct circuit to the United States for a total of 3 hours; the pool television unit made 3,600 feet of film and 1,200 feet of official film was supplied to the theatrical newsreel and to television. In addition, a large amount of news material, sound tapes, and still pictures was flown to the Continent.

The Redwing Observer Program was supervised by a special organization—known as the Joint Office of Test Information—comprising public information, classification, and security, specialists from the Commission and the Department of Defense. The office issued 52 pieces of background and briefing material totaling 254 pages and 94 news and informational communiques.

Evaluation of this information project involves many intangibles but it is the consensus of the interested government agencies that the public reporting by media representatives disseminated facts capable of clarifying confused understanding that have been evident since 1954, both in the United States and abroad, about the high-energy nuclear weapons tests.

U. S. Technical Exhibit from Geneva

At the conclusion of its showing in Geneva, Switzerland, the United States Technical Exhibit, except for the research reactor which was

[20] See Appendix 9.

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sold to the Swiss Government, was displayed in New York City October 19 to November 3, 1955. It was installed at the Carnegie Endowment International Center, United Nations Plaza, under the auspices of the Atomic Industrial Forum, the Carnegie Endowment for International Peace, and the Fund for Peaceful Atomic Development. An exhibit believed to be of such a highly technical nature that it would not particularly interest nonprofessional people was visited by 50,000 persons including large numbers of school children.

The State of Oklahoma's Department of Commerce and Industry contracted with the Commission to show the exhibit in connection with the Southwest American Exposition in Oklahoma City, April 15–29, 1956, which was attended by several hundred thousand visitors. At the conclusion of the Oklahoma City showing, the exhibit was shipped to Chicago, Ill., where under the sponsorship of the Museum of Science and Industry, it is scheduled to be displayed for a period of at least 2 years.

Smaller Exhibits Prepared

Recognizing the need and the desire of the public for fuller information on progress and development of the peaceful uses of atomic energy, the Commission in January 1956 decided to provide several new exhibits which can tour the country. Two types of these exhibits are being prepared, a larger one requiring about 5,000 square feet of floor space for display, and a smaller mobile exhibit that is to be set up and toured in truck trailers. The exhibits are to be available to qualified exhibitors free of rental and transportation charges.

The Commission defines a qualified exhibitor as "one who, in the judgment of the Commission, would show the exhibit for the purpose of informing the public and not for any commercial exploitation, and who would make no charge to the public for the showing."

The Oak Ridge Institute of Nuclear Studies, through its American Museum of Atomic Energy, undertook to develop and prepare the exhibits, three of the larger type, and five of the truck-trailer exhibits. The three larger exhibits each consisted of 82 panels with suitable model displays, pieces of equipment and other visual and auditory devices. The first of the larger exhibits was scheduled to be put on display for an exhibition of several months at the Smithsonian Institution in Washington, D. C. The other two exhibits of this type were by June 30 booked several months in advance. The general fields covered by the exhibit include raw materials; reactors; nuclear power in the United States; production of radioisotopes; radioisotopes in industry, medicine and agriculture; the United States world-wide Atoms for Peace Program; encouraging United States private enterprise in

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atomic energy; health, safety, and industrial uses of atomic energy; research; and Commission programs for training technical manpower.

The five exhibits set up in truck trailers are designed for display in rural and small urban areas. These mobile units, 35 feet in length, display exhibit material covering all areas of peacetime atomic energy development. Arrangements are being worked out with the National University Extension Association to sponsor the exhibits nationally and arrange for their scheduling and public showings. It is anticipated that the National Organization of the Junior Chamber of Commerce will cooperate locally in putting on the exhibits. The first of these units was expected to be ready for touring by mid-summer of 1956.

Technical Information

Distribution

Including the reports declassified by the accelerated review program (see Declassification and Classification), approximately 26,000 nonclassified technical reports were available to science and industry as of the end of this reporting period. This included some 500 papers which United States scientists and engineers prepared for last August's International Conference on the Peaceful Uses of Atomic Energy in Switzerland. Professional and technical journals have published about 6,000 of the total; the remainder are for sale by the Office of Technical Services, U. S. Department of Commerce. Besides these reports, some 200 summaries and compilations are being sold, chiefly through the Government Printing Office.

The nonclassified reports are available to all purchasers. Each applicant for a permit for access to classified material is sent immediately a price list of the nonclassified reports, bibliographies, and lists of other technical material. When a permit is granted, this first shipment is supplemented by appropriate publications and lists of classified material. Classified documents are sold to access permit holders by the Technical Information Service Extension at Oak Ridge, Tenn.

Sales of nonclassified reports for the year ended April 30, 1956, by Commerce's Office of Technical Services were estimated at approximately 112,000 copies. The Office of Technical Services also is prepared to supply photostat or microfilm reproductions of all the Commission's nonclassified reports not available in full-size printed copies. Other sources for microcopy reproductions are Hitchock Publishing Co., 1115 Seventeenth St., N. W., Washington; The Microcard Foundation, Box 2145, Madison 5, Wis.; and Readex Microprint Corp., 100 Fifth Ave., New York 11, N. Y.

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Forty-nine depository libraries have been established throughout the country (see map) to provide reference and photoduplication service covering their collections of nonclassified atomic energy reports, special publications and bibliographies. The Commission has authorized establishment of 15 additional depositories. When completed, this library system is intended to make available at least one collection of nonclassified documents in each metropolitan area of 500,000 or more persons. The Commission also plans to establish several classified depositories for service to access permit holders at various locations throughout the United States.

Engineering Drawings

Some 4,000 nonclassified and classified engineering drawings of industrial interest have been assembled to distribute through the Technical Information Service Extension at Oak Ridge, Tenn. The drawings include sets of selected nonclassified engineering drawings for the following reactors: Oak Ridge Research Reactor (X–10), Materials Testing Reactor, Los Alamos Supo Water Boiler Reactor, Tower Shielding Reactor Facility, Bulk Shielding Reactor Facility, Argonne CP-5, ORNL Low Intensity Training Reactor (LITR), Geneva Conference Pool Reactor, and Los Alamos Test Power Reactor Experiment No. 1.

Industrial Exhibits

Small technical exhibits on single aspects of industrial possibilities of atomic energy were shown during the last 6 months at such meetings as the New England New Products, New Methods Exhibits, Boston, Mass., March 1956; the Swiss Atom Show sponsored by the Swiss Society of Engineers and Architects and the Swiss Electrical Association and Power Engineers Exhibit, both in Neuchatel, Switzerland, in April 1956; and the Conference on Industrial and Social Implications of Atomic Energy sponsored by the American Labor Education Service, Cleveland, Ohio, January 1956. An exhibit also was presented at the Nuclear Engineering and Science Congress and International Atomic Exposition, Cleveland, Ohio, in December 1955.

Publication

The Commission has initiated programs to compile and publish handbooks and summaries in selected technical fields (see Appendix 6). Those printed or released during 1956, nonclassified, and available

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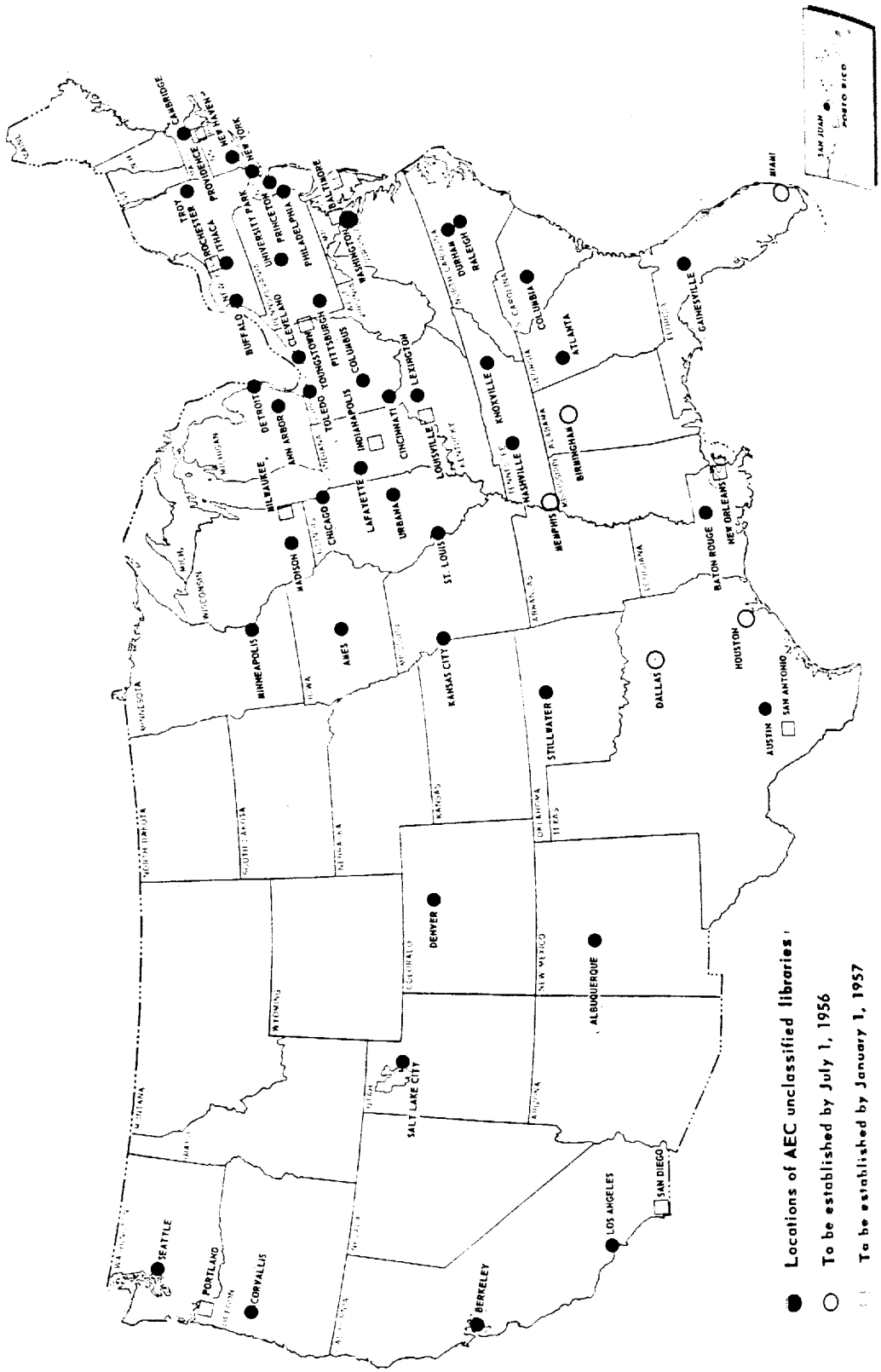

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from the Superintendent of Documents, Government Printing Office, Washington 25, D. C. are: "Radioisotopes in Medicine;" "Conference on Radioactive Isotopes in Agriculture" (in press); and "Nuclear Level Schemes."

Major nonclassified publications printed or released during 1956 and available from the Office of Technical Services, Department of Commerce, Washington 25, D. C. are: "USAEC Industrial Participation Group Program—History and Accomplishments," May 1951-April 1955; "Materials Testing Reactor Project Handbook;" "Reactor Shielding Design Manual;" "Raw Materials Conference on Solvent Extraction;" "Feasibility Study of Pressure Vessels for Nuclear Power Generating Reactors;" "The Chemistry and Metallurgy of Miscellaneous Materials;" "Determination of the Isotopic Composition of Uranium;" "Electrical Equipment for Tanks and Magnets;" "Magnets and Magnetic Measuring Techniques;" "Electrical Circuits for Calutrons;" "Electromagnetic Separation of Isotopes in Commercial Quantities;" "Sources and Collectors for Use in Calutrons;" "Problems of Physics in the Ion Source."

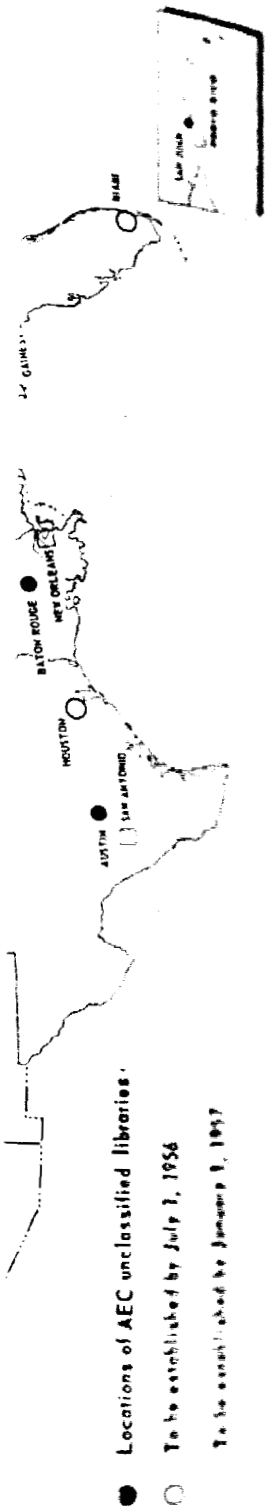
One additional volume of the National Nuclear Energy Series entitled, "Medical Effects of the Atomic Bomb in Japan," became available from the McGraw-Hill Book Co., New York, N. Y.

Other manuscripts, some of which may be classified, are now in preparation under contracts. They are: "Atomic Energy Fact Book," "Handbook on Waste Disposal;" "Nuclear Radiations in Industry and Science;" "Production of Uranium Metal;" "Production of Thorium Metal;" "Recovery and Processing of Uranium Ores;" "Neutron and Gamma Irradiation Facilities;" "Handbook of Reactor Control and Safety;" "Trilinear Chart of Nuclides;" "Radiation Shielding;" "Corrosion and Wear Handbook for Water-Cooled Reactors;" "Hot Laboratory Catalog;" and the four-volume revised "Reactor Handbook."

"The Industrial Atom" series of nonclassified monographs presenting articles of current industrial interest now numbers 12 issues, for sale at the Office of Technical Services.

The Commission has maintained a continuing review of technical reports as they are created to determine whether they contain industrial information which should be published. Recently, a special program was undertaken to survey information accumulated in the hands of its contractors, much of it as informal notes, with the intention of selecting and publishing such material as might be useful to industry, either nonclassified or with appropriate classification.

Other publication programs designed to assist industry include a classified monthly abstract journal for those with access permits, bibliographies, proceedings of seminars, and a classified bimonthly jour-



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nal which collates scattered material. In addition, a new series of compilations has been started to pull together research in various fields. These compilations and the handbooks and summaries mentioned earlier are to be issued in a nonclassified version and, to the extent necessary, also a classified version.

Seminars

Seminars and consultations on various technical and industrial activities are arranged with representatives of private concerns. Proceedings of seminars are published as rapidly as possible. Last year, eight technical briefings were held with a combined total attendance of 1,470 persons. During the first half of 1956, ten meetings were held, eight on feed materials technology. Two meetings were at Oak Ridge, one each at Cincinnati, Fernald, Ohio, Lemont, Ill., Paducah, Ky., New Brunswick, N. J., and St. Louis, Mo. (see Production). "Chemical Processing of Fuel Elements" was discussed in a meeting at Idaho Falls, Idaho and the "Homogeneous Reactor Experiment No. 2" at Oak Ridge (see Reactor Development).

Translations

During the last two reporting periods, the Commission has expanded its program for producing translations of foreign scientific literature of value to the national atomic energy program. A wider selection of foreign scientific journals is scanned regularly, and English-language abstracts are prepared covering articles of interest for inclusion in the Commission's nonclassified abstract journal *Nuclear Science Abstracts*. Translations of widespread interest are published and sold through the U. S. Government Printing Office. Among those issued during the last 6 months was a four-volume translation of the papers presented at the scientific conference in Moscow in July 1955—"Conference of the Academy of Sciences of the USSR on the Peaceful Uses of Atomic Energy."

In addition, the Commission has joined with the National Science Foundation in promoting a broad program to make foreign scientific literature increasingly available, including assistance in financing a translation center in the Library of Congress.

Exchange of Information with Other Government Agencies

The Commission has carried on a comprehensive program of scanning the reported results of research and development activities of other Government agencies and their contractors in order to acquire

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technical information of use and interest to the program. Technical reports and publications are distributed as appropriate to Commission laboratories.

Technical information developed within Commission programs has been similarly made available to other interested agencies. (See also the Civil Defense Section of this Report.)

In this manner, the continuing large-scale interchange of information on research results and research in progress helps the interchange of scientific ideas and also the avoiding of duplication in areas of common interest.

Education and Training

A general shortage of scientists and engineers is a severely limiting factor in expanding scientific programs in the economy of the United States. While the many attractions of a career in the atomic energy development may tend to lessen the impact of the shortage in this special field, the lack of scientific and technical personnel is a considerably more serious obstacle for the future than either money or raw materials. Public attention has been drawn to these facts in recent months by Government officials in the fields of science and technology, including Commissioners of the Atomic Energy Commission.

Two committees appointed by the President are at work on needs for technical manpower. The Committee on Education Beyond High School was appointed in March 1956 to make recommendations, among other topics, on how to meet any shortage in scientific, engineering, or other professions. The National Committee for the Development of Scientists and Engineers, appointed in April, provided a mechanism for common effort among major interested groups in the United States toward meeting the technical manpower shortages. Later, the Subcommittee on Research and Development of the Joint Committee on Atomic Energy held hearings on the effects the general shortage might have upon atomic energy development.

Basic atomic energy programs have not yet been seriously hampered by lack of qualified scientists and engineers, but the pressure of expanding activities in peaceful uses of atomic energy, within the United States and abroad, has not yet exerted its full impact. Large growth in electric powerplants using nuclear energy, increasing use of radioisotopes in industry as well as in research and medicine, and the development of nuclear propulsion systems, to cite a few of the broadening areas, are expected soon to begin putting heavy demands on manpower resources for atomic energy development. All national

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needs for technical manpower will expand, but requirements for atomic activities are expected to grow more rapidly than most, and represent an increasing percentage of total needs.

In support of the national effort to increase the supply of scientists and engineers, the Atomic Energy Commission has expanded its previous programs, and undertaken new ones, aimed at helping to staff Federal and industrial activities in the field of atomic energy. In addition training assistance is provided to other nations cooperating with the United States in developing the peaceful uses of atomic energy.

Since 1948, the Commission has offered training courses in use of radioisotopes, and since 1950 has conducted and assisted graduate work in reactor technology. Its program of fellowships and scholarships has continued since 1950. The new and expanded programs are designed, (1) for the immediate future, to expand specialized training in nuclear energy technology for industrial and Government employees and a quota of foreign nationals; and (2) for the longer range, to assist colleges and universities in establishing curricula and acquiring scientific equipment for use in nuclear science and engineering instruction, and to interest high school students who might have a bent for study of technical subjects.

The Commission also is planning a series of surveys in an attempt (1) to pinpoint needs in the United States as well as in connection with international commitments, over the next 20 years for individuals trained in nuclear science and engineering and (2) to determine whether or not the planned facilities of Commission installations, industry, colleges and universities, will meet the needs.

The Commission's program, although only a small part of the national effort, is directed toward meeting immediate needs by special training for engineering and science graduates, and meeting future needs by seeking to increase the number of colleges and universities that offer curricula in nuclear energy technology, and by attempting to interest high school teachers and students in nuclear subjects. Some projects are sponsored jointly with the National Science Foundation and the American Society for Engineering Education. During the first half of 1956, the Commission took the following steps:

1. Arranged two summer institutes in nuclear energy technology for college and university faculty members;
2. Offered to assist two more universities which have made proposals to build research reactors, and considered other similar projects; demonstrated the subcritical assembly as a training tool, and supplied some materials to universities for assemblies; developed a new reactor useful for university laboratory courses;

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3. Planned a conference for deans of engineering and presidents of colleges and universities interested in curricula in nuclear sciences and engineering;
4. Arranged institutes for high school teachers and continued to provide study kits to high school teachers and pupils; and
5. Placed on the Commission staff a scientific manpower specialist with responsibility for working with, and stimulating, all the various Commission educational and training programs, for compiling and analyzing basic statistical information, and for recommending appropriate policy.

A brief summary of some of the important programs of education and training supported by the Commission is given below.

Meeting Current Manpower Needs

Graduate schools. To help meet the need for graduate training in nuclear sciences, the Commission supports graduate schools on a limited basis, and operates two special graduate schools—the Oak Ridge School of Reactor Technology, Oak Ridge, Tenn., and the International School of Nuclear Science and Engineering of Argonne National Laboratory, Lemont, Ill.

The Oak Ridge School, operated for the Commission by Oak Ridge National Laboratory, provides a one-year graduate program in reactor technology. In operation since 1950–1951, it has graduated 374 students. The school now has 95 students in residence and 120 students are expected for this fall's session. Beginning with the September 1956 class, all students will be employees of industry or of Government agencies. Previously recent graduates of colleges and universities also were included.

The International School of Nuclear Science and Engineering was established at Argonne in March 1955 primarily to fulfill commitments under the President's Atoms for Peace program. As of September 1956, the school will have graduated 101 students and 62 others will go in residence at that time. Of the 101 graduates, 70 are from 29 other countries and 31 from the United States. In April 1956 the school program was changed to provide for participation of Pennsylvania State University and North Carolina State College, both of which have nuclear reactors. Under this plan, students take a semester of work at Pennsylvania State or North Carolina State, then take a second advanced semester at Argonne. Because of physical limitations, Argonne can have only about 60 students in residence at one time. The cooperative plan will enable Argonne to accept 120 students each year.

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The Oak Ridge Institute of Nuclear Studies (ORINS), an association of 34 southern colleges under Commission contract[21] also provides experimental medical and radiological residencies and training in the safe and efficient use of radioisotopes. Since its formation in 1948, ORINS has instructed about 2,500 scientists from every state in the United States, from Puerto Rico, Hawaii, and the District of Columbia, and from 37 other countries. Four-week courses in basic techniques are offered approximately 6 times each year (some exclusively for foreign nationals). Two-week courses in veterinary radiological health are conducted primarily for Armed Forces veterinary personnel. Under its medical research program, ORINS offers one-year post-residencies in radiology and experimental medicine and three summer residencies for medical school staff.

On-the-job participation. University people and industrial employees are gaining special experience through temporary work at a number of Commission installations. Such arrangements benefit the Commission programs by bringing into them some specialized talent not otherwise available. The individuals concerned also have opportunities for training.

At the Commission's laboratories, opportunities exist for outstanding students to do research which becomes the basis for master's and doctor's degrees. Applications are made by universities and colleges for students who have completed formal courses in chemistry, biology, mathematics, and other sciences.

The Massachusetts Institute of Technology has assigned graduate students for on-the-job participation at Oak Ridge. Current plant problems are submitted for solution by the students under an MIT resident staff, consisting of an assistant professor and an instructor. Two or more students are assigned to a problem, and a Commission plant consultant assists them. Ordinarily, each problem lasts two weeks, and a student in one semester would be assigned eight or nine different problems, and thus acquire actual engineering experience.

Commission facilities have increased their summer employment of graduate and undergraduate students, and of faculty members.

Industry personnel have been participating in increasing numbers in programs of Commission contractors. The period of participation averages approximately one year. During last year, 38 industrial engineers and scientists completed participation of this type, and this year 65 were taking part. So far, some 53 different industrial firms have benefited.

Fellowship programs. Fellowships are offered by the Commission in radiological physics, industrial hygiene, and industrial medicine.

[21] See Appendix 3.

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Fellowships in *radiological physics*, covering health problems associated with handling radioactive material and with the release of nuclear energy, provide for 9 months of formal graduate work at universities and 3 months of specialized study and field work at Commission facilities. There are 3 cooperative programs: Vanderbilt University with Oak Ridge National Laboratory, Oak Ridge, Tenn.; University of Rochester with the Brookhaven National Laboratory, Upton, Long Island, N. Y.; and University of Washington with the Hanford Works, Richland, Wash. The program, begun in 1951, has had 208 participants and 71 appointments have been made for the 1956–1957 school year. The Oak Ridge Institute of Nuclear Studies administers these fellowships.

Fellowships in *industrial hygiene* permit graduate study at Harvard University School of Public Health or the University of Pittsburgh Graduate School of Public Health. The program, started in 1953, has had 21 participants and 10 appointments have been made for the 1956–1957 school year. The Oak Ridge Institute of Nuclear Studies administers this program.

Fellowships in *industrial medicine* provide advance training and on-the-job experience. These fellows, about seven each year, may study at Harvard University, the University of Pittsburgh, the University of Cincinnati, or the University of Rochester. After one year of academic training, the fellow may take another year of in-plant work at a major Commission facility. Some 32 physicians have accepted fellowships under this program since 1950. The program is administered by the Atomic Energy Project, University of Rochester.

International programs. In addition to the plans of the United States to share the costs of research reactor projects in cooperating countries, the Commission assists in providing training designed to increase the knowledge in foreign countries in the peaceful use of atomic energy. They may request training in the United States for scientists and engineers, or the services of United States personnel to go to their countries and provide instruction and information there (see International Affairs).

Assisting Educational Institutions

Faculty training. A major problem of colleges and universities in conducting atomic energy curricula is a shortage of faculty with experience in nuclear energy fields.

In the summer of 1956 two institutes of 2 months each will be conducted—one at the Argonne National Laboratory, and one at the

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Brookhaven National Laboratory—for college and university faculty members. This program, undertaken by the Commission with the American Society for Engineering Education and the National Science Foundation, will provide material for engineering faculty members to use in teaching nuclear energy technology. In all, 90 individuals may enter these courses, 60 at Argonne and 30 at Brookhaven.

For several years university faculty members have participated in research program at national laboratories during the summer months and on sabbatical leave. They now average about 75 a year. The experience gained by the research participants has been responsible for initiation of university research projects directly and indirectly related to atomic energy programs. The experience gained also has assisted faculty members in presentation of scientific courses.

Providing facilities and equipment. Facilities and equipment are another need of colleges and universities in undertaking nuclear science and engineering curricula.

The Commission has furnished fuel elements, or solutions, for research reactors to North Carolina State College, Pennsylvania State University, and the University of Michigan, and has made specific offers of similar assistance to the Massachusetts Institute of Technology and the State College of Washington. Six additional projects of this type are under study.

To demonstrate the value of subcritical assemblies for training purposes, an assembly has been prepared for display at scientific and educational meetings. Uranium and neutron sources for assemblies have been furnished to New York University, Virginia Polytechnic Institute, and the University of Florida during the last 6 months. Twenty additional schools have indicated interest in the use of subcritical assemblies as a training tool.

A low power reactor of wide flexibility was developed by Argonne National Laboratory for use in teaching courses in reactor theory and nuclear physics and in engineering laboratory experiments. The reactor, called the *Argonaut*, is designed to operate at a power of 1 to 10 kilowatts and has special safety features which make it particularly suitable for campus use.

Teaching and libraries. Scientists from Commission facilities have lectured, conducted seminars, taken part in colloquia, and carried on related activities at universities. During the last 6 months more requests for this kind of activity have been received.

The Commission has contributed nonclassified depository libraries on nuclear technical information to a number of universities and colleges (see Information Services).

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Research contracts. Through Commission support of research in the physical and biological sciences at colleges, universities, and other nonprofit institutions, more than 2,000 students annually receive assistance and training. The schools gain in experience for faculty and often acquire additional facilities for postgraduate programs.

College conference. A conference of some 300 deans of colleges of engineering and presidents of colleges and universities is being planned for September 1956 at Gatlinburg, Tenn. At this meeting the Commission will stress the need for engineers and scientists trained in nuclear specialties, present its program of education and training, and summarize its program of assistance to nonprofit organizations. Officials of all colleges and universities that have interest in nuclear science curricula or research will learn of the assistance available, and have an opportunity to exchange views on their activities in the atomic energy field.

High School Programs

An important consideration in increasing the total supply of engineers and scientists is interesting high school students in careers in these fields. The Commission has a number of programs directed to this end.

Symposia and institutes have been supported to attract students, either directly or through their teachers. In the summer of 1956 the Commission and the National Science Foundation will jointly sponsor summer institutes for high school science teachers. The institutes, at Duke University, Harvard University, the University of New Mexico, and the Oak Ridge Institute of Nuclear Studies will run from 1 to 2 months with 20 to 50 high school science teachers in each. After the ORINS institute, a small number of the teachers will visit high schools during the fall, spending about 1 week at each and presenting material related to atomic energy so as to stimulate interest in scientific matters among students and teachers. This is an experimental program.

Up-to-date kits of published materials are provided to high school students and teachers upon their requests to show the opportunities and information available in the atomic energy field. As an indication of increasing interest in this kind of help, the Commission distributed 2,814 student kits in the first 6 months of 1956, compared with 430 in a similar period of 1950, and 783 teacher kits in 1956 compared with 227 in the first quarter of 1950.

The standard kits distributed contain general information on use of atomic energy in agriculture, medicine, power and other industry,

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basic scientific background, and such material, useful in school science projects, as instructions on building a low-cost Geiger counter. Special kits also are prepared on the request of teachers or pupils working on science fair or similar projects. Photographs and charts are lent for exhibition or instruction purposes.

The Commission was considering a program to assist science teaching in high schools by preparing for distribution to high school science teachers on request, some 300 "Radioisotope Kits" that would include radioisotopes, a neutron source, and detection and counting equipment. A further study was being made of the scope of such a program and its costs.

Physical Research

Highlights of the last 6 months of research in physical, chemical, and metallurgical problems related to nuclear energy and to the Atomic Energy Commission's programs, and to the industry built about them, included:

Approval of design and construction of two high-energy accelerators by Eastern universities, and authorization of design of two accelerators in the Midwest.

In radioisotopes, offering for sale of 29 new short half-life products, and completion of a cell for handling multikilocurie quantities of powerful radiators such as cobalt 60.

In the international field, participation of United States scientists in three international conferences on high-energy physics; establishment of tripartite nuclear cross sections committee and reactor physics constant centers with the United Kingdom and Canada; and revision of Commission policy to allow employment, or guest participation, of aliens scientists in unclassified work in nonsecurity areas at all Commission laboratories and all contractors (see International Affairs).

High-energy physics continued to command much attention in physical research. Investigators announced the discovery of a nuclear particle, the neutrino, which was extremely difficult to detect, and studied the properties of another newly discovered nuclear particle, the antiproton. Research on controlled thermonuclear reactions continued.

In chemistry, improvements in processes for separating fission products from irradiated fuel elements were tried, and inorganic materials were tested in ion exchange separations, among other valuable studies.

Metallurgists continued interesting work on metal defects caused by irradiation and proposed explanations for the solution of a key problem in the use of liquid metal fuels in reactors.

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Commission Actions in Field of Physical Research

Particle Accelerator Program

The Commission approved construction of two high-energy particle accelerators at two Eastern university sites during this reporting period, and authorized a group of Midwestern universities and Argonne National Laboratory, Lemont, Ill., to undertake design and development of high-energy particle accelerators of advanced nature.

The accelerators which were approved for construction are (1) a joint Harvard University-Massachusetts Institute of Technology machine to be placed on the Harvard campus, and (2) a joint Princeton University-University of Pennsylvania machine to be placed on the Princeton campus.

The Midwestern University Research Association, authorized to undertake design and development of an accelerator, comprises the University of Chicago, University of Illinois, University of Indiana, University of Iowa, Iowa State College, University of Michigan, Michigan State University, University of Minnesota, Northwestern University, Notre Dame University, Ohio State University, Purdue University, Washington University (St. Louis, Mo.), and University of Wisconsin.

The two Eastern university proposals were accepted after the Commission had canvassed all universities that did substantial work in high-energy physics in order to determine their interest and capabilities in designing, constructing, and operating a high-energy accelerator.

The Harvard-MIT machine will be a circular alternating gradient electron synchrotron, with an 118-foot radius. It will be a 6 billion electron volt (Bev) machine and is estimated to cost the Government [illegible] million. Construction will require about 42 months.

The Princeton-University of Pennsylvania accelerator will be a uniform gradient proton synchrotron that will require about 44 months to construct. This machine will have an energy of 3 Bev and will be built at an estimated cost to the Government of $5.8 million.

The accelerators will be operated by the institutions under contract with the Commission, and will be available to scientists from other institutions.

Radioisotope Production and Process Development

For the calendar year 1955, the number of radioisotope shipments from Oak Ridge, Tenn., increased slightly over calendar year 1954 and the total amount of radioactivity shipped rose from 48,879 curies in

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1954 to 49,383 curies in 1955. There were also considerable increases in shipments of cobalt 60 and cesium 137 for large irradiation units.

A new 177-page loose-leaf radioisotope catalog was compiled, printed and distributed.

Twenty-nine new short half-life products, ranging from antimony 122 to yttrium 90, were offered for sale as a result of increased manipulator cell facilities and faster processing techniques. Most of these products were irradiated in the Low Intensity Testing Reactor (LITR) at Oak Ridge, Tenn., and users were supplied with higher specific activity material, assayed, and in solution form.

A remote manipulator cell for handling multikilocurie amounts of radioactivity was completed and placed in operation at Oak Ridge during this reporting period. Radiation sources containing more than 15,000 curies of cobalt 60 have been simultaneously handled in this cell. The addition of this facility has made it possible to assemble and fabricate large radiation sources without underwater operations. The largest single source assembled to date, 10,000 curies of cobalt 60, was prepared for General Electric Co. to use in studies of radiation damage.

Physics

In physics research, during the first half of 1956 techniques and equipment were improved for working with high-energy accelerators in order to advance knowledge about fundamental nuclear particles; a predicted but elusive particle, the neutrino, was discovered; the properties of the newly identified antiproton were investigated; and low-energy reasonances of neutrons released by plutonium fission were measured. Very pure isotopes of heavy elements were prepared for research, and fundamental studies were carried out in a number of promising fields.

High Energy Physics Research

Discovery of the free neutrino. Experimental evidence for the existence of a nuclear particle of vanishingly small mass and without electrical charge, the neutrino, was collected in this reporting period by a team of research investigators from Los Alamos Scientific Laboratory, operated for the Commission by the University of California. This is the second theoretically predicted nuclear particle the existence of which has been detected at Commission laboratories within recent months. The first, the antiproton, is reported on in the following section.

The Nobel laureates, Enrico Fermi and Wolfgang Pauli, predicted the existence of the free neutrino to account for (among other things)

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the release of energy, otherwise unaccounted for, in a radioactive process known as beta decay. The neutrino was postulated to carry away part of the energy released in this process.

The neutrino interacts very weakly with material—that is, it is extremely penetrating—and would pass through billions of miles of solid matter. Its detection consequently posed an extremely difficult scientific problem.

Frederick Reines and Clyde Cowan, Jr., who headed the research team, believed they first observed the neutrino in 1953 when, with the help of other scientists, they set up equipment near a production reactor at Hanford, Wash.[22] They installed a rather novel liquid scintillation system as a sensitive detector. Although evidence obtained at that time indicated the neutrino's existence, the experiment was not entirely conclusive. Cosmic rays and other background radiation made it difficult to make sure of the signals of the neutrino.

A new and more complex detecting system was built and last fall was set up deep underground near one of the large production reactors of the Commission's Savannah River plant, operated by the E. I. duPont de Nemours & Co., many of whose personnel cooperated in the experiment. Several months of work enabled the scientists to conclude that they had checked each important characteristic of the neutrinos caught in their equipment.

The detector included a target containing more than 100 gallons of water in which cadmium salts had been dissolved. Cadmium is a strong absorber of neutrons. The target was "watched" by a scintillation system containing over 1,000 gallons of nuclear radiation sensitive liquid, and 330 large photomultiplier tubes. Despite the large size of the detector, and the billions of neutrinos produced within the reactor which passed through the detector each second, only a few neutrino captures were observed in the target each hour.

The discovery marks the first time that scientists have, knowingly, caused a direct reversal of the process of beta decay. In the process of beta decay, the nucleus of an atom emits a negative electron. In fact, a neutron in the atomic nucleus apparently loses this negative charge and becomes a proton. In the present experiment, stable protons in the target water, were made to absorb neutrinos, emit positive electrons, and become neutrons. The particle thus detected by simultaneous detection and identification of the positron and neutron shows the expected properties of the neutrino as predicted by the theory of Fermi and Pauli.

The importance of the discovery is that it confirms theories which scientists believe will ultimately evolve into an understanding of the nature of the forces which hold together the atomic nucleus.

[22] See p. 31, Fifteenth Semiannual Report (July–December 1953).

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Antiproton research. A major research program carried out at the University of California Radiation Laboratory, Berkeley, with the bevatron during this report period was the investigation of the properties of the antiproton. This research followed the discovery of the antiproton in October 1955 by electronic techniques.[23] It was expected that if an antiproton came into contact with a proton (or neutron) a mutual annihilation would result which would transform the mass of both particles into energy. The technique used to demonstrate the annihilation properties of the antiproton consisted of placing a stack of photographic plates coated with nuclear emulsion in the path of antiprotons produced by the bevatron. Any charged nuclear particle passing through nuclear photoplates produces an image which, after development, consists of a track-like series of small silver grains. This technique permitted observation of the fate of an antiproton going through the photoplates.

Shortly after the discovery of the antiproton, the same bevatron beam which had been shown to contain antiprotons was used to irradiate a stack of photoemulsion plates. Half the exposed plates was sent to Italy to be examined by a group of scientists at the University of Rome, the remaining half was studied at Berkeley. While no evidence of interactions was found in the California study, the Italian group reported discovering one "star" in the emulsion, the first antiproton interaction seen by man.

The depicted star was caused by an antiproton entering a nucleus of either a silver or bromine atom in the photoemulsion. The resulting explosion liberated seven heavy particles such as protons or alpha particles, and two mesons, probably pions (see photograph). The antiproton track, "L" in the photograph, extended 4 inches into the emulsion and the fact that it produced a large star indicated that it was a negative particle. The energy released may be calculated from an analysis of the star. Tracks (a) and (b) in the photograph are interpreted as those of pi mesons, and the other tracks as those of protons or alpha particles. Only charged particles are visible since neutrons escape direct detection.

Since this star was found, 30 antiprotons have been detected in nuclear photoplates in a large cooperative effort by physicists in Berkeley. In all cases antiprotons have been seen to annihilate with either a proton or a neutron since the energy released in the process has been shown to be greater than that corresponding to the mass of a single proton. Thus the existence of the antiproton predicted in 1930 by P. A. M. Dirac, an English Nobel laureate, has been conclusively proved.

[23] See pp. 59–60, Nineteenth Semiannual Report to Congress (July–December 1955).

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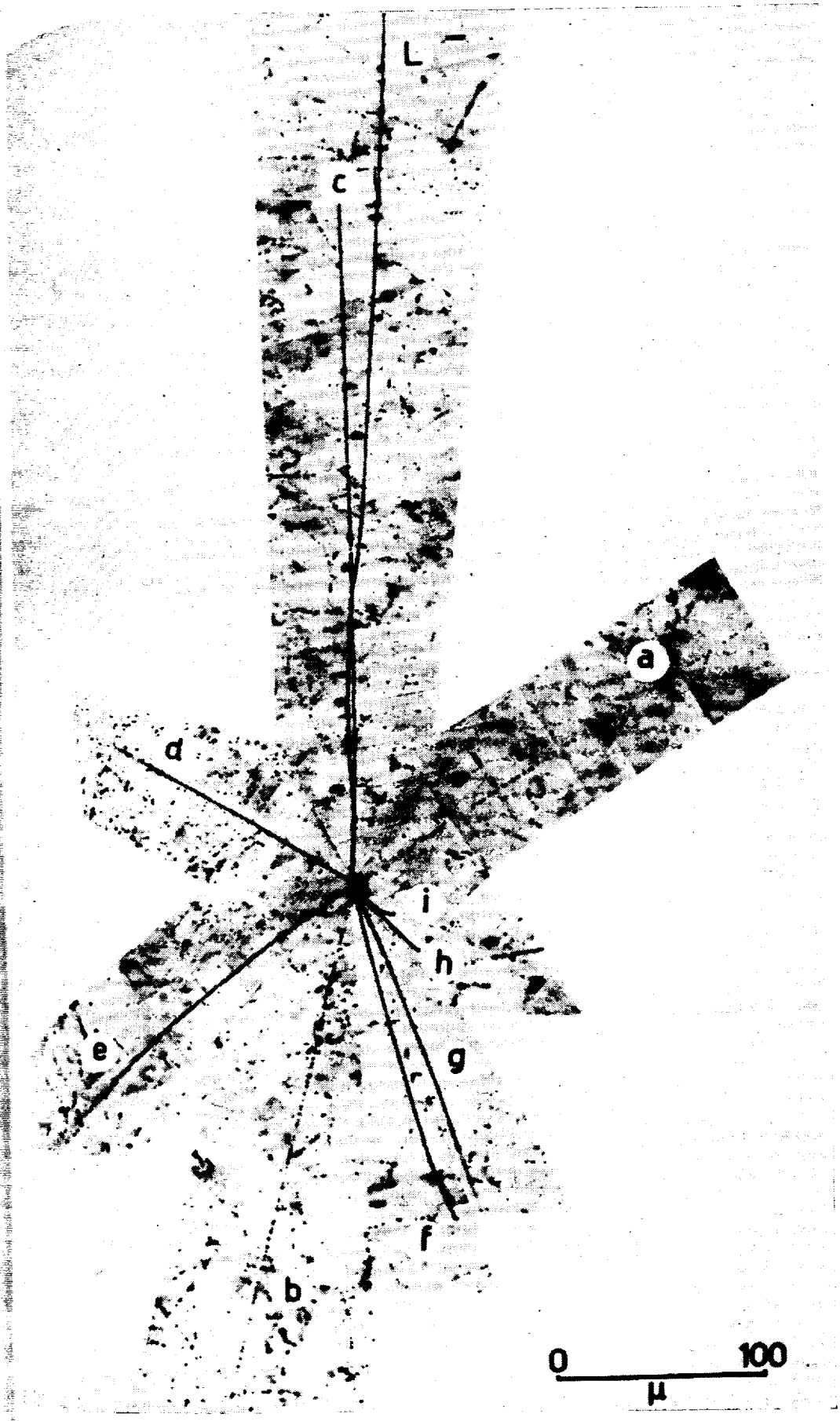

ANTIPROTON STAR

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Some interesting facts have been learned about the annihilation phenomenon. In the annihilation most of the energy is carried away in pi mesons, about 5 pi mesons on the average being emitted. It was also found that antiprotons have a much larger probability than expected of interacting with protons (or neutrons) when passing through matter. It is now thought that this must mean there are strong mutual forces between the antiproton and proton (or neutron), which cause annihilation to occur at larger relative distances apart than was first predicted.

Heavy-mesons and hyperons. The use of the cosmotron at Brookhaven National Laboratory, Upton, Long Island, N. Y. and the bevatron at University of California Radiation Laboratory, Berkeley, Calif., has made available for laboratory study new and important data on the interaction and the interrelation of fundamental nuclear particles. Many particles previously found only in cosmic radiation now can be produced in sufficient numbers in laboratories for quantitative investigation. The heavy mesons and hyperons[24] are as yet little understood. The heavy meson has less mass than a neutron or proton; the hyperon has a mass equal to that of a proton or neutron plus that of a meson. In seeking to understand the relationship of the mesons and hyperons to each other, and to the better known nuclear particles such as the proton and neutron, investigators have studied the simplest interactions, since these should be the easiest to understand. The production of new particles in the elementary collision of an accelerated proton with another free proton, or studies of the interaction of one of the newly produced particles with other protons represent such simple interactions.

The mechanical and electrical restrictions of such accelerators as Brookhaven's cosmotron make it difficult to use free protons as a target inside the machine since hydrogen, needed in the liquid state to achieve necessary target density, requires a temperature of 252.8 degrees below zero centigrade to become liquid. Brookhaven has successfully developed an efficient method for extracting from the cosmotron an intense proton beam and directing it on a liquid hydrogen target placed outside the accelerator. This makes it possible to study the important elementary acts of production of heavy mesons and hyperons in hydrogen. Extracting the beam also permits greater freedom in locating apparatus for the detection of the particles. Since the new particles are highly unstable, having lifetimes between one-millionth and one-millionth of one millionth of a second, freedom of placement is an important advantage in experimentation.

The heavy-meson beam facilities at University of California's bevatron have been greatly improved during the past year. As a re-

[24] See p. 35, Sixteenth Semiannual Report (January–June 1954).

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[25] See pp. 52–53,

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all, significant contributions have been made to understanding the production and properties of heavy mesons. The rate of production of positive heavy mesons by 6.2 Bev protons is approximately five times the rate at 3 Bev, and at present a beam of 5,000 positive heavy mesons per hour makes counter experiments possible.

Photographic emulsions have been exposed to both positive and negative heavy mesons. The emulsion work at Berkeley has yielded much information on the masses and other properties of the various types of mesons. Hyperons and unstable nuclear fragments have also been studied in emulsion, since they are among the products resulting when negative heavy mesons interact with ordinary nuclei.

In addition to the large amount of emulsion research on these particles performed at Berkeley, there have been many emulsion exposures made for other scientific groups both in this country and abroad. Mutually corroborative work was done, and a natural expansion of the scope of the studies has resulted from this combined effort. The accelerated research program and the accompanying increased rate of information exchange have made major contributions to high-energy physics.

Xenon bubble chamber. Recently, Dr. Donald A. Glaser of the University of Michigan, Ann Arbor, Mich., developed the "bubble chamber," a new instrument for studying the mass, energy, and reactions of high-energy nuclear particles.[25] In order to follow the nuclear events of very high-energy particles that have long range, it is necessary to study them as they come to rest in a dense material. Previous to Dr. Glaser's development of a chamber filled with superheated ether, these studies could be made only in cloud chambers operated under very high pressure—of the order of 700 times the normal atmospheric pressure—or in photographic emulsions.

Since Glaser's success with this technique, scientists have been experimenting with placing other materials in the bubble chamber, among them liquid hydrogen, propane, and other hydrocarbons.

During this report period, Dr. Glaser developed a bubble chamber that uses liquid xenon. He found that pure xenon would not work in the bubble chamber, but when diluted with a few percent of a hydrocarbon it functioned very well. It is now planned to exploit this development by providing for a liquid xenon chamber large enough to stop the highly energetic particles from the multibillion-volt machines. The chamber will provide, for the first time, a particle detector which will allow the effects of all particles from high-energy reactions, as well as gamma rays from decay of neutral particles, to be seen at the same time.

[25] See pp. 52–53, Eighteenth Semiannual Report to Congress (January–June 1955).

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Fast Chopper—Fission of Plutonium

The average number of prompt fission neutrons produced in fission by neutrons of plutonium atoms has been measured at Argonne National Laboratory for numerous resonances in the region of neutron energy below 100 electron volts. It is found to be constant within a few percent throughout this region. This constancy fitted with general theoretical expectation but was contrary to results showing a resonance around 0.3 electron volt which were reported at the International Conference on the Peaceful Uses of Atomic Energy in Switzerland last August. Similar constancy at low-energy resonances subsequently was found at several other laboratories, but the results have not been extended into higher resonances.

The apparatus used in the study, installed at the Argonne Research Reactor (CP–5), consisted of a newly designed chopper for producing neutron bursts, a new type of detector for recording triple coincidences between fission events and two of the secondary neutrons produced in them, and a new electronic analyzer and recorder that sorts out these triple events into 1,024 separate intervals of time measured from the instant the burst of neutrons was produced at the chopper. The events are thus investigated for 1,024 different values of the velocity of the neutrons. The detector of the fission events employs a xenon gas scintillator developed at Argonne, and produces pulses that are very short compared with those obtained in early fission chambers which depended upon collection of ions. Because of the speed scintillator, much more plutonium can be used without excessive piling up of the counts from the alpha particles. Efficiency consequently is increased, and the time of detection of the neutrons can be more accurately determined.

Basic Nuclear Physics

The directions of emissions of alpha particles from nonspherical nuclei have been found to be susceptible to experimental observation in recent experiments at Oak Ridge National Laboratory, Oak Ridge, Tenn. The alpha-emitting nuclei are built into special salts, that in certain crystalline forms have strong molecular electric fields. These fields act upon the nuclei so that, at very low temperatures, the nuclei point along preferred directions in the crystal. The observations then are made by comparing the alpha emission rate from different faces of the crystal at temperatures low enough (about 1 degree absolute) to made sure that nuclear alignment is present, and at higher temperatures (several degrees absolute) where no alignment is present. Pronounced directional asymmetry of alpha particle emission has been observed in neptunium 237 and in uranium 233.

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Recent experiments at Oak Ridge on the states of atomic ionization produced by radioactive decay have shown that the ionization can be much more extensive than heretofore realized. The experiments are conducted by magnetic analysis of atoms after decay, and the results show how frequently one, two, three, or more, electrons are thrown from the atom. In xenon, the process of internal conversion of a nuclear gamma ray removes an electron from an inner shell of the atom. As a consequence, the complete outer electron shell containing 8 electrons usually is stripped off, and half the total complement of 54 electrons may be ejected. The exact atomic mechanisms for these events are as yet imperfectly understood.

Mass Spectrometric Study of Equilibrium at High Temperatures

The so-called Knudsen cell method has long been used for study of vapors in equilibrium with solids or liquids. The cell consists of a small furnace, completely closed except for a pin hole from which gases can escape. The amount that escapes is so slight that it does not affect the equilibrium between the solid and vapor present. By condensing and weighing the escaping material, it is possible to determine the vapor pressure at the temperature of the cell, provided the molecular composition of the escaping gas is known.

At Argonne National Laboratory, in experiments with such a cell, the escaping molecules were ionized by a stream of electrons and the resulting positive ions were analyzed in the mass spectrometer. A considerable number of metal-metal oxide mixtures has been studied. In many cases, molecules of quite unexpected composition—the molybdenum oxide, Mo_5O_{15}, for example—have been found in the vapor.

The experiments necessitate changing the interpretation of much earlier data obtained without such analyses, and throw light on the composition of the metal-oxygen molecules that are stable at high temperatures.

Highly Purified Isotopes of Heavy Elements

Electromagnetically enriched isotopes of plutonium, as well as isotopes of uranium, are now available in small quantities for nuclear research studies among Commission laboratories and contractors. The enriched products are allocated for use in both basic and applied research programs.

The highly purified isotopes are prepared at Oak Ridge in 24-inch radius calutrons which have been modified to meet the exacting requirements for multistage separation of relatively small quantities of rare feed materials. The focus in the improved machines is such that

the scattering of isotopes into adjacent isotope collectors is only 2 or 3 percent. Since isotopes of high purity are required for precise nuclear measurements, more than one stage of separation is usually necessary.

Gram quantities of uranium 234 and 236 above 95 percent purity, and tens of grams of 99.9 percent uranium 235 and 99.999 percent uranium 238 have been obtained from the two-stage separation of special uranium feed materials.

The quantity and purity of the separated isotopes are, of course, determined by the availability and composition of suitable feed materials. Single-stage isotope separations of plutonium, obtained from highly irradiated natural uranium, have yielded gram amounts of plutonium 240 and a few hundred milligrams of plutonium 241, with maximum purities of 85 percent and 62 percent respectively. Typical total isotope collection rates are: uranium, three-mass-unit separation, 2 grams per hour; uranium, one-mass-unit separation, 600 milligrams per hour and plutonium, one-mass-unit separation, 300 milligrams per hour.

A method for recovering the rare radioisotope protactinium 231 from an uranium production residue was devised at Mound Laboratory, Miamisburg, Ohio. The first gram produced will be used at Oak Ridge National Laboratory to extend knowledge of the chemical and physical properties of the element.

Controlled Thermonuclear Program

The Atomic Energy Commission's program of research on the controlled release of nuclear energy from fusion continued during the first half of 1956 at three major sites—Los Alamos Scientific Laboratory, Los Alamos, N. Mex., the Livermore, Calif., laboratory of the University of California Radiation Laboratory, and at Princeton University, Princeton, N. J. Smaller projects were carried forward at New York University in New York City and Oak Ridge National Laboratory at Oak Ridge, Tenn.

Although it may be possible to use a number of light elements in the fusion process, the controlled thermonuclear program has as its ultimate goal the controlled release of energy from the fusion of deuterium (heavy hydrogen) nuclei, and the use of this energy to provide an economic source of power. Since deuterium occurs in great abundance in sea water, it would constitute a source of energy virtually without limit.

As contrasted with the fission process, in which a very heavy nucleus is split into lighter nuclei, the fusion process being studied under the Controlled Thermonuclear Program involves a merging of two ex-

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extremely light nuclei to form a heavier nucleus. Both processes are accompanied by a release of energy. In order to bring about fusion, sufficient kinetic energy must be provided to light nuclei so that they can overcome their mutual electrostatic repulsion and approach close enough to each other to allow fusion to occur. Accomplishing this will require creating a system in which light particles move in more or less random directions and are reflected many times from confining barriers before either escaping or undergoing fusion. It is estimated that the energies that would have to be provided to light nuclei so as to overcome their electrostatic repulsion correspond to temperatures of several hundred million degrees centigrade.

Since at these temperatures—equivalent to those in the interior of the sun—a reaction chamber of any material would vaporize instantly, another method of containment has to be devised. The only thing which conceivably is capable of containing this type of reaction is an electric or magnetic field, which might be used to insulate the walls of a reaction chamber from extremely high temperatures at the center of the container.

Thus, in essence, the problem involved in controlling a thermonuclear reaction is that of ionizing a suitable material (such as deuterium), heating the resulting plasma to temperatures of 100,000,000 degrees centigrade or higher, and confining it at this temperature long enough to permit an appreciable fraction of the ions to fuse with a consequent release of energy. The energy thus released would then have to be converted into electrical power either directly or through suitable heat exchangers.

Each laboratory engaged in the program is pursuing a somewhat different approach to this problem. The research certainly is on a very long-term basis, but it is probable that success will be achieved eventually. It is, however, reasonable to expect that an approach as yet unformulated may yield the greatest promise of success.

A number of statements can be made about the probable characteristics of a fusion reactor. Any thermonuclear power unit gives promise of being extremely safe. The amount of fuel within the thermonuclear machine at operating temperatures would be simply that required to sustain a normal power output of the device at any instant, and this amount would be extremely minute. The fuel supply itself would be stored outside the machine chamber and would be wholly incapable of participating in the reaction without first being introduced into the reactor and heated. The possibility of a serious accident due to failure of a component or to human error seems virtually negligible. In addition, there probably would be no fission products to escape in case of an accident.

Any thermonuclear reactor that consumed hydrogen isotopes as a fuel would produce intense fluxes of neutrons. As a result of the

copious yields and high energies of the neutrons involved, care would have to be taken to provide adequate shielding from this radiation. It is conceivable that a controlled thermonuclear reactor (burning a fuel of helium 3, for example) might eventually be developed which would produce no neutrons at all, and for which no neutron shielding would be required. Such a reactor is purely of academic interest for the foreseeable future, since the temperatures which would have to be achieved in this case to energize the helium atoms would be much greater than even the enormous temperatures required for deuterium.

Soviet paper on thermonuclear research. Appreciable interest was aroused recently by a pronouncement of an active program of the Union of Soviet Socialist Republics in the controlled thermonuclear field. Soviet scientist I. V. Kurchatov, in a paper entitled "On the Possibility of Producing Thermonuclear Reactions in a Gas Discharge," presented in May at Harwell, England, gave some insight into the theoretical and experimental work under way in his country.

Chemistry

During the reporting period, improvements were sought in the liquid chemical methods used to separate fission products from reactor output, as for example, the substitution of a continuous dissolving method for batch processes. Studies were also undertaken at Atomic Energy Commission laboratories on such problems as inorganic substitutes for ion exchange resins; on gaseous forms of neptunium and plutonium; the mutual solubility of liquid metals and fused salts; high temperature properties of the dioxide of uranium which is of interest for power reactors; and the nuclear chemistry of transuranic elements.

Research on Separation Processes

Improvements of processes. The Metal Recovery Plant at Oak Ridge National Laboratory recovers fissionable materials and byproducts by dissolving the fuel metal in acid and using aqueous solution chemistry for purification. The plant presently is being expanded. This will permit recovery on a larger scale so that it can serve also as a facility for large-scale testing of improvements designed to lower the cost of routine processing operations. Some of the improvements, already proved satisfactory on a small scale, are:

1. Operation of equipment under water to eliminate expensive shielding.

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2. Pumping of liquids by pulse action and by an air-lift, using equipment that has no moving parts and therefore should have lower upkeep charges than present equipment.
3. Separation of solids from liquids, or of two mutually insoluble liquids from each other, by a hydroclone, a centrifugal device that has no moving parts.
4. Conveying of fuel elements to a dissolver by an automatic, continuous device, two models of which have been designed.
5. Continuous dissolution of fuel elements. The use of continuous dissolution for heterogeneous reactor fuels instead of batch operation permits significant economies. Not only the dissolver but such auxiliary equipment as condensers, piping, and gas processing can also be designed to handle an average processing load rather than a peak load as in batch dissolution. In addition, a lower concentration of acid is used to dissolve the fuel elements, which means further economies since the useful life of the dissolver and acid-recovery equipment is significantly extended.

In the hermex process, Oak Ridge National Laboratory is developing a method for recovering unirradiated uranium in scrap metal, or irradiated uranium in spent fuel elements, by dissolving in boiling mercury. The purified uranium metal is recovered from the amalgam by physical methods, without having been converted to a salt and then reduced, as in processes now in use.

Other separation research. Development studies on fluorination of reactor fuel elements, followed by fractional distillation of the fluoride products, is supported by basic research. The basic program has resulted in new fundamental information in the field of fluorine chemistry.

Brookhaven National Laboratory is seeking on a pilot plant scale to determine the economic and engineering feasibility of the dissolution and uranium contamination phases of the bromine trifluoride process. In addition to developing methods of analyzing bromine trifluoride, bromine pentafluoride, uranium hexafluoride, and bromine, an attempt is being made to determine the effects of the following variables on the dissolution rate: temperatures up to 150 degrees centigrade; composition of the four-component dissolving solution; behavior of plutonium and fission products in dissolution operation; conversion of bromine pentafluoride to bromine trifluoride; and the history and type of natural uranium fuel element. Brookhaven is also studying the design and construction of equipment that must operate in this highly corrosive system.

Basic research on high temperature chemistry, supporting pyrometallurgical processing methods, have been under investigation at

Atomics International, a division of North American Aviation, Inc., at Santa Susana, Calif. Volatile fission products and some uranium have been separated from irradiated thorium uranium metal by flash distillation in the arc zone of an arc-melting apparatus. Molten thorium becomes contaminated by the partial reduction of its container at high temperatures; therefore, arc-melting techniques, which employ cooled containers, are favored for thorium fuel processing. (Other research in separation processes is reported in the Reactor Development section.)

Inorganic Ion Exchangers

Ion exchange has, in recent years, become one of the most popular techniques for separating both organic and inorganic materials, partly because of the availability of relatively stable and moderately priced commercial organic ion-exchange resins. While these resins have satisfactory properties for many separations, they have shortcomings for some applications in the atomic energy field. Most serious is the sensitivity of resins to ionizing radiation, their destruction at high temperatures, and, in at least some applications, a rather weak selectivity. Inorganic materials were expected to offer solutions to some of these problems. Clays and similar silicates have long been known to be ion exchangers but their limited chemical stability precludes use in many applications. A search for new inorganic ion-exchange materials was thus initiated at Oak Ridge National Laboratory.

In initial stages of this search, a surprisingly large number of relatively simple inorganic compounds was found which, at least at room temperature, showed interesting ion-exchange properties. Many insoluble hydrous oxides, such as those of titanium, zirconium, thorium, and tin, were found to be good anion exchangers. Amorphous or microcrystalline insoluble salts containing polyvalent anions were found to be cation exchangers. Typical examples were phosphates, molybdates, tungstates, and arsenates of zirconium. With these compounds, separations and exchange reactions may be achieved in essentially the same manner as with the commercial ion exchangers and in some cases the separations are superior.

Neptunium and Plutonium Hexafluorides

The study of neptunium hexafluoride and plutonium hexafluoride is of considerable interest since these are the only known compounds of the transuranium elements that are significantly volatile at room temperature. Although these radioactive gases are extremely reactive

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and have to be handled with unusual precautions, suitable techniques for working with them have recently been devised by Argonne National Laboratory scientists. Knolls Atomic Power Laboratory, Schenectady, N. Y., has also improved its methods of preparing plutonium hexafluoride. Reactions have been studied and some thermodynamic properties have been calculated from the infra-red spectrum. As a result of this work, and of investigations being made at Los Alamos Scientific Laboratory, Los Alamos, N. Mex., a considerable amount of new and valuable information has now been obtained on the physical and chemical properties of these elements.

Mutual Solubility of Liquid Metals and Salts

Two types of material are of great interest for possible use in reactors for the production of electrical power. These are fused salts and liquid metals, both of which are finding increasing use as heat transfer agents in power and process industries, and which are potentially useful coolants for reactors. The Atomic Energy Commission is supporting considerable fundamental research on these classes of material.

Recent work at Oak Ridge National Laboratory has revealed some interesting properties of intermediate systems, consisting of mixtures of salts and metals. Cesium halides and cesium metal were found to be completely miscible at the melting point of the salts (as low as 630 degrees centigrade), and even sodium and its halides were completely miscible between 1000 and 1100 degrees centigrade. These observations are of great interest in connection with theories of fused salts and liquid metals, and point to the possibility of obtaining certain properties intermediate between those of salts and metals.

High Temperature Properties of Uranium Dioxide

To obtain information concerning materials of interest not only for pyrometallurgical processing but also for power reactors, compounds of uranium and thorium are being studied at high temperatures at Argonne National Laboratory. The volatility and stability of an important compound of uranium, uranium dioxide, have been measured at temperatures between 1300 and 2500 degrees centigrade. In going through this temperature interval the vapor pressures changed by a factor of 100 million. At 2400 degrees centigrade significant amounts of the dioxide were transported by vaporization. It was found that the solid vaporized predominately as gaseous uranium oxide and that this molecule was one of the most stable gaseous molecules.

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Spectrographic Determination of Oxygen in Metals

It is now generally agreed that the presence of oxygen in metals may greatly influence the physical properties of the metal. Determination of the actual oxygen content of metals by chemical methods is a singularly difficult task. The possibility of quantitatively determining the oxygen and other gaseous content of metals by emission spectroscopic techniques is being explored in the Ames Laboratory. This study has resulted in developing a technique for determining the oxygen content of steel and rare earth metals. The methods devised are just as accurate and decidedly more rapid and sensitive than the chemical procedures.

Rare Earths

The Ames Laboratory continued to scale up its rare earth separations plant, and is making pilot plant studies on processes for producing rare earth metals. A considerable number of industrial companies have shown a great deal of interest in producing pure rare earth salts and metals, and several companies expect to request licenses on Government patents so as to use the Ames processes for their operations.

Nuclear Chemistry of the Transuranic Elements

Research continued on the newly discovered elements and their isotopes during this reporting period. Nuclear chemists at Argonne National Laboratory have recently processed an additional quantity of plutonium subjected to intense bombardment in the Materials Testing Reactor [26] at the National Reactor Testing Station, Idaho. As a result, milligram quantities of americium 243, curium 244, and plutonium 242, as well as smaller quantities of californium 252 and einsteinium 253, are now available for investigation. Plutonium 242, americium 243, and curium 244 are substantially longer-lived than the previously available isotopes of these elements and this will simplify many basic studies, particularly of curium chemistry. Irradiation of the californium fraction have confirmed the existence of fermium 252 and fermium 253, tentatively identified in previous work at Argonne.

Considerable amounts of curium 244, californium 249 and 252, americium 243, and berkelium 249 were recovered by nuclear chemists at the University of California Radiation Laboratory, Berkeley, from the processing plutonium bombarded in the Materials Testing Reactor. Most of these isotopes are being utilized for further bombardments by

[26] See p. 41, Sixteenth Semiannual Report to Congress (January–June 1954).

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Several new isotopes of einsteinium and fermium have been discovered at Berkeley by bombarding berkelium 249 and californium 249 and 252 with alpha particles from the 60-inch cyclotron. Among the isotopes produced by this method in the einsteinium group were the isotopes 249, 250, 251 and 252 and in the fermium group, the isotopes 250 and 252. Californium 244, berkelium 247 and 248, and mendelevium 256 also were discovered.

Knolls Atomic Power Laboratory under a joint program with Atomic Energy of Canada, Limited, has carried on studies of highly irradiated plutonium samples. Einsteinium and fermium have been found in the samples, as well as lighter transuranic elements.

Fluorescence in the actinide group of elements was observed for the first time by the nuclear chemistry group at Berkeley. Fluorescence has long been known in the lanthanide group, and it was disturbing that this phenomenon had not hitherto been observed in the actinide elements, since theory tended to correlate the characteristics of these two groups of elements.

Metallurgy

Studies of Metal Defects

Lattice irregularities. Studies have been conducted at the Atomics International laboratories of North American Aviation in an attempt to describe and identify the kinds of disruption introduced into a metallic lattice by irradiation.

Studies have developed techniques using electron irradiations that permit introducing only the simplest lattice irregularities, namely single atoms knocked from their normal lattice sites into poistions between other atoms in their normal lattice sites. By knowing exactly what imperfections are caused, experimenters can subsequently identify their behavior in more complex situations. In this way it has been possible to work-harden a specimen mechanically and then irradiate it with approximately 1 million volt electrons and cause a partial recovery of the work-hardening, i. e., the irradiation softens the metal. This is assumed to be accomplished by the introduction of a nonequilibrium concentration of lattice vacancies. This observation is in contrast to the usual behavior under irradiation where the changes are most often found to be similar to additional work-hardening.

In another approach, researchers described the very complex disruptions in the structure of metals that occur during the stopping of fission fragments or other very energetic massive particles. The

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particular question for which a description is sought is the configuration of the atoms in the neighborhood of the energetic particle after it has come to rest. There are currently two theories concerning this arrangement and several experiments are under way in an attempt to decide between these alternates.

Plastic deformation. Single crystals of metals deform under application of stress by mechanisms generally referred to as "slip" and "twinning". Both mechanisms involve atomic movements on specific planes and in specific directions in the crystal lattice. The type of planes on which slipping or twinning occurs, their abundance or multiplicity in the crystal, and the critical stresses necessary to initiate these processes, all have a bearing on the plastic deformability of the metal and on the manner in which the grains align themselves in such operations as rolling, extruding, etc.

A study of these deformational processes in alpha-uranium single crystals at Argonne National Laboratory indicated a considerably more complex situation than generally found in more common metals of higher crystal symmetry. Under compression at room temperature no less than two slip systems and three twinning systems have been identified; still others are known to exist. Some of the twinning systems discovered are not usually found in metal crystals.

Basic Studies in Liquid Metal Fuel Program

One of the most important metallurgical problems in the Liquid Metal Fuel Reactor Program is selecting a material for the reactor vessel, piping, and heat exchanger. Since low chromium steels have been widely used in the boiler and oil industries, they appeared attractive for this use.

Experiments at Brookhaven National Laboratory in which these steels were tested in contact with circulating uranium-bismuth liquid fuel have shown that in the hotter sections of the circulating systems constituents of the steels were dissolved in the liquid metal and then were deposited in the cooler regions. The result was that circulation was stopped by the formation of metallic plugs in the piping. However, if 200 to 250 parts per million of zirconium were dissolved in the liquid metal, the transfer of material was very markedly reduced.

Investigators believe that the zirconium is adsorbed on the surface of the steel, and that nitrogen, an impurity in the steel, diffuses to this surface and reacts with the zirconium to form the very stable compound, zirconium nitride. Apparently, this layer acts as a barrier against further dissolution of the constituents of the steels.

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This explanation has been checked by studies in the mercury system. It has long been known that additions of titanium to mercury in mercury boiler plants reduced the corrosion of steels by the hot mercury, but the reason was not known. An X-ray study of the surfaces of steels in contact with mercury containing titanium has shown the presence of titanium nitride and titanium carbide. The discovery suggests that in this liquid too, the reduction in corrosion is due to the formation of a barrier layer.

If this method of reducing the corrosion of steels by the uranium-bismuth fuel system proves to be adequate, an inexpensive material will be available for construction of components of the uranium-bismuth liquid metal fuel reactor.

Other Studies

Radiation damage to graphite. The detailed mechanism of the effects of neutron irradiation on graphite has been under investigation for a number of years in several commercial laboratories, but, due to the great complexity of the observed data, no consistent model for this process has been formulated until recently. Low temperature irradiation and annealing experiments performed during the past year have provided the necessary additional data to outline a definite mechanism.

This model, discussed in a paper prepared jointly by investigators from the Argonne National Laboratory and the Atomics International Division of North American Aviation, and given at the International Conference on Peaceful Uses of Atomic Energy in Geneva, August 1955, was semiquantitative for low to moderate neutron irradiations, but only qualitative for very heavy neutron doses.

High purity uranium metal. Basic metallurgical studies require a much higher purity of uranium than is generally used in reactors. In order to provide this degree of purity, scientists at Argonne National Laboratory developed an electrolytic refining process and melting procedure that produces metal with a total impurity content of about [illegible] parts per million. The metal is now being produced at Argonne National Laboratory in sufficient quantities to satisfy the needs of various researchers in the United States in addition to several requests from European laboratories.

Scientists at Argonne have used this material in developing a unique process for preparing single crystals of alpha uranium. These crystals are being used for such basic studies, as on self-diffusion, irradiation damage, and plastic deformation.

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Biology and Medicine

During the last 6 months new methods were developed for using atomic energy products and techniques to treat cancers, the effects of radiation upon living creatures were further determined, and studies of methods of waste disposal yielded promising new knowledge. The examples of research findings reported here came from only a few of the projects which are under way in national laboratories and at Commission-sponsored projects in universities, colleges, hospitals, and other research institutions.

A contract was signed for construction of a research hospital, to include a medical nuclear reactor, at Brookhaven National Laboratory.

The Commission helped assure safety and health protection at this spring's weapons tests in the Pacific. It has continued its strong and detailed assistance to the Federal Civil Defense Administration, has kept its informative material in this field up to date, and is helping to provide local civilian defense groups with training tools.

Brookhaven National Laboratory Medical Research Center

A contract for construction of a new Medical Research Center at Brookhaven National Laboratory, Upton, Long Island, N. Y., was awarded in June to the Malan Construction Corp., Long Island City. Total cost of the Medical Research Center including a medical reactor will be approximately $6.4 million. The one-story Medical Center will cover a gross area of 118,000 square feet and will house a 48-bed research hospital, an industrial medical branch, and research departments in medical physics, pathology, microbiology, biochemistry and physiology.

The Brookhaven medical reactor, the first designed exclusively for medical research and treatment, will incorporate unique features to insure wider medical application of neutrons, flexibility of treatment, and availability of special short-lived radioisotopes. The medical reactor will be housed in a steel, gas-tight building, 60 feet in diameter and 54 feet high, covering a gross area of 6,000 square feet.

Completion of construction of the Medical Research Center is scheduled for 1958.

Cancer Research Programs

At the Argonne Cancer Research Hospital, Chicago, Ill., several lines of approach have been used in cancer therapy.

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and destroy the pituitary gland in animals and humans suffering from cancers that have been transported from their original sites to other parts of the body.

Radioactive cesium has been used to treat tumors by sewing through the tumor mass with extremely thin tubing through which the cesium is flowed. Numerous problems in measuring the radiation dose have been encountered but are slowly being overcome.

The production, localization, and the *effects of antibodies* formed specifically against tumor cells, are being studied by means of radioisotopes. The aim is to learn whether and how these substances could be used for successful therapy, and also to learn more about the immunochemical similarities among tumors of different origin. It was recently shown that tumor antibodies, tagged with radioiodine, were localized to a greater extent by cancer cells than by normal cells. The cancerous growth was not retarded, however. Another observation was that animals fasted after injection had localized more of the antibody in the tumor cells than had animals fed normally. Oxygen uptake in treated tumor cells was greater than in untreated tumor cells.

The *high energy sources* for cancer therapy—the cobalt 60 teletherapy unit and the Van de Graaff generator—are continually being altered and refined for more effective application. Radiations produced by them are being used routinely to treat patients with primary or secondary cancers.

A beam-bending device also is being constructed for use with the 60 million electron volt linear accelerator which will allow more precise radiation of tumors in humans.

The nature of the capacity to resist *leukemia*, a cancer of the blood, is being studied in several strains of mice. It is hoped that the results of these investigations will explain the protective action afforded by the reticuloendothelial system (blood cells in the liver, lungs, bone marrow, etc.) against this disease and will throw light upon factors involved in blood formation.

Animals whose pituitaries have been excised have been used for investigating the plasma factors that control red blood cell formation. A plasma fraction has been prepared which appears to contain these factors, and emphasis is being given to investigating their physiological behavior as well as their isolation.

At Brookhaven National Laboratory the general problem of the application of *short-lived radioactive isotopes* to diagnosis, therapy, and the study of biological effects of radiation on whole cells and small regions within cells is under study. Primary interest is given to radioactive isotopes which are ingested by, or injected into, patients and thereby become what have been termed "internal emitters." The short-lived isotopes presently used in the program have radiological half-lives ranging from approximately 20 minutes to a few hours.

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A major effort at Brookhaven has been in the field termed "*selective kinetics*"—broadly defined as the development of knowledge whereby radioactive isotopes may be placed "on target" in the body. A radioactive isotope placed in the blood stream becomes distributed in a matter of a few minutes throughout the entire vascular system. The substance leaves the blood stream to enter tissues at speeds which vary for different tissues—the so-called primary distribution. With the passage of time it frequently will undergo a secondary distribution, that is, leave the regions of early accumulation to become more evenly distributed through all body structures. In not more than a few hours, secondary distribution usually has become the dominating pattern.

If experimenters use a radioactive isotope which will decay to a harmless stable element in a period somewhat less than the interval during which the primary distribution is paramount, radiation will be delivered chiefly to the structures or organs concerned in this first phase; all other regions of the body will escape significant radiation. Since the blood stream is the most effective passageway to cancers, it is the route of choice, providing the time spent on this highway can be kept short enough so that no major radiation effects occur to the blood-forming tissues themselves. This is not an easy task, since these tissues are among those most susceptible to radiation. Early exploratory tests with patients are under way.

For instance, in the problem of attacking cancers of the liver, whether the cancers arise within the liver or are transported there from other body regions, it is now possible to control favorably the distribution of manganese 56, a radioactive isotope having a half-life of 2 hours 36 minutes. In one compound of manganese and with one route of administration used, the accumulation in the liver will be only 10 percent of the injected dose in 15 minutes. Another compound of manganese and another route of injection will, within 15 minutes, localize 90 percent of the injected dose in the liver region for a short period (about 5 minutes).

Another phase of this same general problem requires concentrating boron compounds in a brain tumor while the rest of the brain remains almost free of boron for a brief time (about 30 minutes). This would permit much more effective use of neutron capture by the boron to treat the tumor. A number of new boron compounds look promising for this use.

At Oak Ridge Institute for Nuclear Studies, Oak Ridge, Tenn., a continuing study has been made of patients with accumulations of fluid resulting from transported, or metastatic cancers. Studies have been undertaken to determine the therapeutic usefulness of yttrium 90 and lutecium 177 as isotopes for injection into the cavities where the fluids accumulate. These isotopes remain well localized and, from a

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point of view of metabolism and distribution, are highly suitable for this type of therapy. It is not yet possible to state their relative merits in comparison with colloidal gold 198 or chromic phosphate with phosphorus 32. The optimum doses of yttrium and lutecium necessary to produce an adequate radiation effect have not yet been determined.

Special Radioisotopes Program

The object of a special isotope program at Brookhaven National Laboratory is (1) to increase the number and variety of radioisotopes available, (2) to develop and supply certain radiosotopes which otherwise would be unavailable but which are in demand or would be in demand if available, and (3) to put radioisotopes already available in new or different forms so as to increase their usefulness.

The first radioisotope thus developed was *iodine 132*. This isotope has a half-life of only 140 minutes. Its parent tellurium 132 has a half-life of over 3 days and constitutes a continuing source of fresh iodine 132. Scientists at Brookhaven developed a simple system so that a user could extract iodine 132 repeatedly from the tellurium. Hence, by shipping the longer-lived parent, tellurium, scientists are enabled to use a very short-lived radioiodine in their own laboratories, instead of having to bring their work to the nuclear reactor. Iodine 132 has, for certain purposes, many advantages over iodine 131, currently used in large volume, but its use supplements the latter rather than replaces it.

Fluorine 18, a previously unavailable isotope, was produced, and experiments have been done to study the action of fluorine to prevent decay of teeth.

In addition to developing such specialties as those mentioned above, the Brookhaven radioisotope production unit also has undertaken to put more conventional isotopes into *forms convenient for special uses*. Perfect spheres of fused inert clay have been manufactured having diameters ranging from 5 ten-thousandths of an inch up to 35 thousandths of an inch, and having incorporated in them various radioisotopes selected for their particular characteristics such as appropriate half-life, energy of radiation, type of radiation, etc. Such spheres have proved useful to investigators studying the control of deep-seated inoperable brain tumors and other diseases.

Shipments were made during the reporting period of two radioisotopes of special utility in the life sciences—*magnesium 28 and iodine 132*—although these radioisotopes still are considered in the developmental stage.

These radioisotopes were produced in the program for small-scale output of special radioisotopes, or special forms of radioisotopes.

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This has been carried on for several years at Brookhaven National Laboratory to supplement the Commission's quantity production of radioisotopes at Oak Ridge National Laboratory, Oak Ridge, Tenn. Magnesium 28 is the only radioisotope of this element which is practical to use as a tracer. Demand for magnesium 28 from medical scientists and biologists already is very great.

Brookhaven continued its *irradiation service*, averaging during the reporting period about 120 irradiations a month for 30 separate concerns, such as hospitals, industrial firms, and Government agencies. The average number of irradiations for the laboratory's own projects totalled well above 200 a month. In addition, low specific activity cobalt 60 sources were produced in the reactor at the rate of about 1,500 curies per month and distributed to users.

Radiation Effects and Treatment

Effects of Internal Radiation

Effects of internal radiation are under continuing study by the Commission's national laboratories, as well as by other investigators working under Commission sponsorship. Since many of the maximum permissible concentrations (MPC) set for dispersal media (air and water) and published in National Bureau of Standards Handbook 52 are based on limited biological information, a program of research in internal dosimetry has been in progress at Oak Ridge National Laboratory for several years. The work has included spectrographic analysis of tissue for major, minor, and trace, element distribution and concentration in man; studies of the distribution and excretion of enriched uranium in man; pilot studies of distribution and excretion of critical nuclides in research animals to test the validity of MPC values.

Arrangements have been made with medical authorities in different parts of the country to help determine how these elements may vary in man according to age, sex, and place of residence. These data will establish a basis for a "standard" or "average" man upon which calculated MPC values can be made more universally comparable.

*Radioactive Strontium Fall-out**

An estimate of the potential hazards of fall-out from tests of atomic devices was presented by Atomic Energy Commissioner Willard F. Libby during the last 6 months in an address made at Northwestern University, Evanston, Ill., on January 19, and in a scientific paper de-

*Commissioner Thomas E. Murray does not subscribe to this section of the report.

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ivered before the American Philosophical Society in Philadelphia, on April 20.

Dr. Libby's conclusion, based on a special Commission study designated "Operation Sunshine", was that the long-term effects of fall-out from high-yield weapons was not as great as generally supposed. A high-yield burst places the major part of bomb debris in the stratosphere, from which it descends slowly over a period of years, he declared in the January address. He cited as the greatest long-term hazard radiostrontium, a chemical relative of calcium which has an average life of about 40 years, high retention in the skeleton, and a low rate of elimination.

The half-life of most of the fission products from high-yield detonations is extremely short, except for strontium. Dr. Libby said, "Nature has wisely provided a built-in mechanism for discriminating against the uptake of radiostrontium in favor of calcium by plants, animals, and human beings."

"From world-wide evidence for fall-out in relation to recent studies of the maximum permissible concentration of strontium 90 in humans," he stated, "it can be concluded that the hazard from the present rate of testing nuclear weapons is insignificant. A total of 11,000 megatons of TNT equivalent of fission [deposited uniformly over the earth] would just yield a strontium 90 content in humans equivalent to the maximum permissible concentration—an amount considered safe. At less than 10 times this value, or below 110,000 megatons energy equivalent of fission, statistically observable incidence of bone tumor should not appear."

At 30 or 40 times the permissible dosage level—or 330,000 to 440,000 megatons—the likelihood of untoward effects would be appreciable, Dr. Libby said, but even the lowest figure he cited—11,000 megatons—was very far in excess of the total energy released to date.

In the April paper, Dr. Libby gave the technical data justifying the conclusions presented earlier. He reported analyses for calcium and for strontium 90 of soils, plants, animals, and foodstuffs obtained from various parts of the world.

Based on studies of the comparative effects of strontium 90 and radium 226 in experimental animals, and of the effects of radium in humans, the generally accepted maximum permissible skeletal content of strontium 90 in humans has been placed at one microcurie. Since the body of the average adult has about 1,000 grams of calcium, this finding would give an estimate of the maximum permissible average concentration of strontium 90 in the adult skeleton at 1 microcurie per 1000 grams of calcium. In the paper, Dr. Libby used this ratio of strontium 90 to calcium as an "MPC unit" (Maximum Permissible Concentration unit). Bones in growing children have a somewhat higher MPC. Even at 10 times the MPC unit, no appreciable occur-

rence of bone tumor should be detected, he said, but at 30 to 40 times the MPC unit, this would probably no longer be the case.

The paper cited analyses of milk from the Wisconsin milk shed area showing an average strontium 90 content of one one-thousandths of the MPC. Foreign milks and cheeses have a strontium 90 content only one-third that of the average in the United States.

One of nature's built-in safety mechanisms as cited by Dr. Libby is that the average milk contains only one-sixth the strontium 90 content of the feed eaten by the cow.

Another mechanism is that strontium 90 deposited on soil does not find its way into water supplies by leaching. The content of rivers and lakes corresponds to only a little more than that accountable by direct fall-out on the surface area of the water.

Analyses of samples of air, rain and soil lead to the conclusion that the strontium 90 contained in the stratosphere would correspond to about 13 millicuries per square mile if it were deposited uniformly over the surface of the entire earth—an amount far below any quantity which might be expected to result in bone tumors if ingested by world population.

Tests of weapons conducted in the Nevada area result in most of the fall-out being deposited locally within the controlled testing area and, therefore, little hazard from the strontium 90 fission products are to be expected on either a United States or world-wide basis. Tests which are conducted in the Pacific are so arranged that the local fall-out is deposited seaward and affects no inhabited atolls.

Measurements of the descent of strontium 90 from the stratosphere indicate that the maximum content of the earth's surface will occur around 1975 with an average world-wide concentration of about one one-hundredth of the maximum permissible concentration. Nature's built-in safety factor previously referred to would lower the content of humans to approximately one one-thousandth MPC unit or less. Thus it appears that at the present level of weapons' testing, the present and potential contribution of strontium 90 to the world ecology is not a significant factor.

Radiation Genetics

It has been known for a number of years that the radiosensitivity of cells changes markedly when they pass through different stages of cell division. In assessing the genetic hazard of radiation, it is necessary to know whether sensitivity to inducement of mutations is increased or decreased as the germ cells mature and, if so, the magnitude of this change. To investigate this problem, experiments were undertaken at Brookhaven National Laboratory to measure this effect in fruitflies.

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Fruitfly females were irradiated with both X-rays and thermal neutrons. The females were mated at different intervals after irradiation and the eggs collected. Eggs taken from females mated immediately after irradiation had been irradiated as mature egg cells. Eggs from females mated 10 days after irradiation had been irradiated at the earlier oocyte stage. Eggs from females mated at times between these extremes had been irradiated at intermediate stages of maturation.

Three types of genetic damage have been measured: (1) dominant lethal mutations, (2) X chromosome elimination, and (3) sex-linked recessive lethal mutations.

It was found that oocytes had the fewest mutations and that the frequency of mutation caused by radiation was successively greater as batches of eggs approached becoming mature ova. Dominant lethal mutations showed a far greater increase in mutation rate in successive batches of eggs (between oocytes and mature ova) than did either the X chromosome losses or sex-linked recessive lethals.

In the case of sex-linked recessive lethals, it appeared that radiation-induced mutation never would fall to the so-called spontaneous mutation rate. Progeny from fruitflies which have received a dose of radiation will always carry a larger number of sex-linked recessive lethal mutations. This number will be less if the female is not mated until some time after irradiation.

It was found that the fecundity of animals treated at all stages was about the same in spite of greatly different mutation rates, which means that cells undergo fertilization even when carrying a heavy degree of mutation.

In programs of radiation genetics study, effects of radiation on the genetic constitution have to be sharply differentiated from the genetics of radiation toxicity. Studies under way at the Oak Ridge National Laboratory and in part at Iowa State College essentially fit the first classification. The Argonne National Laboratory genetic studies in the gamma ray toxicity program are concerned with the role of genetic constituents in controlling the radiation response.

In the Argonne experiments four inbred strains of mice and their hybrids are being tested with single and repeated gamma ray exposure. The most obvious observation to date has been that the LD 50/30 (amount of radiation required to cause 50 percent of a population to die within 30 days) varies from strain to strain in such a way as to indicate that there are factors in the genetic constitution that enable certain strains of mice to resist radiation better than others.

There appears to be a single factor in radiation sensitivity, as evidenced by a consistent positive correlation between the response to a single dose of radiation measured by LD 50/30, and the responses to

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continuing irradiation measured by the average dose accumulated by populations irradiated for the duration of life.

However, a single sensitivity factor cannot give an adequate description of strain and sex differences for there are changes in the rank order of sensitivity between strains and between sexes within a strain at different daily doses over the range from 200 to 12 roentgens (r) per day. This implies the existence of several independent genetic factors in sensitivity.

Studies of Radiation Tolerance

Although many studies of radiation tolerance have been completed since the Nation's atomic energy program was initiated, a need continues to exist for data that will provide a good quantitative estimate of the amount of ionizing radiation that human beings can tolerate.

At Argonne National Laboratory, research has been under way on the effects of different penetrating radiations on animal and plant systems to help predict the effects of radiation exposure in man. Studies produced curves of survival among animal populations after the experimental animals were exposed to pure fast-neutron radiation and pure gamma rays. The mechanisms in animals of the effect of these two types of radiation apparently were somewhat different.

When the animals were exposed to fission (fast) neutrons, a certain total amount of neutron irradiation would produce the same survival pattern even when the amount of irradiation given in a single dosage was greatly reduced. In fact, for a given total exposure, the LD 50/30 remained the same even when the rate of exposure was reduced by a factor of 16. This was not true for gamma rays. Decreasing the dose rate of gamma radiation by a factor of 16 increased by 40 percent the amount of radiation required to produce the LD 50/30 dosage. The number of survivors also increased when the gamma ray dose rate was lowered.

An important result from the study was the observation that in a range of dose with neutron radiation, most deaths occurred within 3 to 5 days after a lethal irradiation; while with cobalt 60 gamma rays, most of the deaths did not occur until 12 to 15 days after irradiation.

A very basic observation was made in this study. The effects of one type of radiation supplemented the effects of the other type, that is, at certain gamma ray dose levels the addition of an equivalent dose of neutron radiation resulted in a death rate predictable in most cases from known LD 50/30 values. When the gamma component of the mixed radiation was reduced below these levels, the additive effect weakened somewhat. This departure from additivity was exhibited only for deaths occurring during the early period after exposure—

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before the ninth day. After the twelfth day the probability of death was completely predictable on an additive basis, even with the gamma component reduced.

Work with mixtures of neutron and gamma radiations at sublethal levels is being continued to determine the very important question of the additive effect of mixtures of these radiations in producing such delayed effects as tumor incidence, cataract formation, and shortening of life span.

The studies of toxicity from acute neutron exposure have been largely completed and present work at Argonne emphasizes the chronic effects of sublethal doses of neutron radiation and the relative biological impact of neutron and gamma radiations. With completion of the Argonne CP–5 reactor, one face of which was modified and reserved for animal experimentation, it became possible to irradiate experimental animals in a much wider range of neutron fluxes than was previously available. An additional feature was that the neutron intensity was more uniform throughout the field. With this improvement, a large number of animals can receive approximately equal doses of fast neutrons in contrast to earlier experiments where only small groups could receive uniform exposure at a time.

The gamma radiation facility consists of two underground rooms—a so-called low level room, and a high level room—with concrete walls and ceilings and interior dimensions of 18 by 25 by 25 feet. The high level room contains two cobalt 60 sources—1,000 and 100 curies respectively—each of which can be preselected and raised to a predetermined height by remote control mechanisms. This room has been in operation for approximately 2 years. The low level gamma ray room differs only in the strength of the cobalt 60 source which is about 7 curies.

Through proper selection of the source and placement of animals, it is possible to irradiate whole populations of animals at dose-rates ranging from less than 1 roentgen per day to 10,000 roentgen per hour. A total population of animals can be irradiated at different dose-rates at one time under identical environmental conditions.

In one program of gamma irradiation studies, three basic radiation patterns are being observed: base-line duration-of-life exposures; split-dose; and single-dose exposures.

In the base-line duration-of-life exposures, approximately 5,000 to 6,000 mice will be used. Thirty-two dose-rates ranging from 6 to 50,000 *r* per day are being used and from 2 to 15 independent replications are entered at each dose level. The interest lies in establishing the radiation dose that will cause a given response. From this study it is hoped to determine the maximum amount of radiation which a population can receive on a continuing basis without suffering an observable effect that is statistically significant. It is expected that

the tests may determine the base-line for effects such as observable changes in the blood or blood systems, tumor incidence, and tissue changes. The study will also provide detailed analysis of the critical regions where dose rate sharply changes survival patterns.

One feature observed after radiation exposure is an apparent physiological aging of the animal. In all the studies mentioned above, male and female animals are being used to compare the response of each sex to clarify the processes of aging with accumulated radiation injury. Compared with man, the age groups studied represent the young, mature, and middle-aged adult.

Histological (tissue), cytogical (cell), and histochemical studies are being done on all animals undergoing continuous exposure to gamma radiation. Classification and quantitative evaluation of cell and tissue changes are being made with particular emphasis on the intestines, the testes, and the liver.

In the small intestine, the crypt cells are severely damaged at all dosage levels above 43 roentgen per day. The damage reaches a peak in the first 3 to 5 days following the beginning of exposure. Crypt cells that survive this initial period apparently can give rise to sufficient mucosal cells to maintain the epithelial lining and after 30 days, repair of the intestinal lining is essentially complete and cell multiplication indices are approaching normal.

In the testes approximately all elements are gradually depleted to the point of their complete elimination at all dose levels studied. At any given daily dose the rate of elimination is proportional to the duration of the exposure. There is no evidence of recovery.

In the liver little histological or cytological change occurred but histochemical studies revealed a drastic reduction in glycogen content.

In blood studies the reticulocytes (young blood cells) showed perhaps the most interesting results. There was an abrupt fall to a minimum quantity within 3 days after irradiation at all levels examined, followed by a rise that appeared even after the highest daily radiation dosage levels (56 roentgen per day) and the level did not fall again until near the end of life. High reticulocyte levels coexisted with a low red-blood corpuscle count and the phenomenon is not accounted for. Possibilities are that radiation increases the maturation time of the reticulocytes, that it decreases the life span of the reticulocyte, or that it causes some fraction of the young red blood corpuscle population to suffer heavy mortality.

Radiation Dosimetry

Oak Ridge National Laboratory has developed various methods of measuring the dose due to fast neutrons which make possible a

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determination of the neutron dose in the presence even of high intensity gamma radiation.

These methods use a proportional counter applicable to general neutron monitoring and laboratory studies, and a series of threshold detectors especially for measurements of neutron dose from nuclear weapons tests. The threshold detector method was used in Operation Teapot, the Nevada weapons tests of 1955, to determine neutron spectra and dose as a function of distance from the various types of devices tested.

Treatment of Irradiation Injury

It has been known for several years that an injection of living blood-forming cells taken from the bone marrow or spleen would enable survival of an irradiated animal that otherwise would die. Much evidence has been presented which demonstrates that blood-forming cells will transplant and grow when placed in the abdominal cavity and other sites of an irradiated or normal animal. In the irradiated animal, it also was shown that blood-forming cells from another species would transplant and grow for at least limited periods of time.

Recent important experiments from a number of laboratories have demonstrated that when blood-forming cells are injected into the blood stream of an irradiated animal, they go to the irradiated animal's blood-forming organs (bone marrow, spleen, lymph nodes) where they may multiply and replace the blood-forming cells destroyed by the irradiation.

It was shown by scientists in England, using a strain of mice with easily identifiable chromosomes, that the spleen blood-forming cells of a mouse from this strain, after intravenous injection, went to the blood-forming organs of the irradiated mouse. The English workers also showed that the irradiated mouse that was injected intravenously with rat bone marrow cells subsequently developed bone marrow cells that showed the rat type and number of chromosomes.

At Oak Ridge National Laboratory experiments during the past few months have shown that the new transplanted bone marrow produced functioning blood cells. It was demonstrated with immunologic techniques that bone marrow cells from one type of rat produced that type of red blood cell when injected into another type of rat that had been irradiated. Using an immunologic technique, Oak Ridge also showed that rat bone marrow injected intravenously into an irradiated mouse subsequently caused the mouse to have only rat red-blood cells.

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National Academy of Sciences Radiation Studies

The initial report of a study by the National Academy of Sciences, "The Biological Effects of Atomic Radiation" was issued in June 1956.[27] The study, financially supported by a grant from the Rockefeller Foundation, was begun last year by a group of distinguished scientists who undertook to make initial findings and recommendations on the effect of radiation on human beings and their environment based on analyses of accumulated data in the areas of genetics, pathology, waste disposal and dispersal, oceanography and fisheries, meteorology, and agriculture and food supplies.

The Commission cooperated with the National Academy by providing data resulting from the extensive research programs which the Commission has sponsored on the biologic effects of nuclear radiation.

A major part of the research upon which the report was based was conducted under Commission sponsorship. The Commission is giving the report careful study, and will continue to assist the Academy.

In a statement issued when the report was made public, the Chairman of the Commission said that the Academy study "represents a public service of major importance," and congratulated the Academy and the distinguished scientists who participated in its findings for the issuance of "a constructive and independent study."

The Foreword of the Academy report states that "the use of atomic energy is perhaps one of the few major technological developments of the past 50 years in which careful consideration of the relationship of a new technology to the needs and welfare of human beings has kept pace with its development. Almost from the very beginning of the days of the Manhattan Project [the wartime atomic energy agency] careful attention has been given to the biological and medical aspects of the subject. By contrast, the automobile industry revolutionized our pattern of living and working, but we are only now beginning to appreciate the problems of safety, urban congestion, nervous tension, and atmospheric pollution which have accompanied its development. In the same way, the development of the aircraft industry outran our knowledge of how to meet the environmental needs of the human beings it intended to transport through the skies."

The following statement was among the major conclusions of the report:

"Thus far, except for some tragic accidents affecting small numbers of people, the biologic damage from peacetime activities (including the testing of atomic weapons) has been essentially negligible. Furthermore, it appears that radiation problems, if they are met intelli-

[27] See p. 92, Eighteenth Semiannual Report (January–July 1955).

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ently and vigilantly, need not stand in the way of the large-scale development of atomic energy. The continuing need for intelligence and vigilance cannot be too strongly emphasized, however."

Waste Disposal Research

The production of large volumes of liquid radioactive wastes as byproducts of the operation of reactors and chemical processing plants has posed challenging economic and radiological problems since the beginning of the industry.

For many years at the Hanford Works, Richland, Wash., large volumes of liquid wastes of low level radioactivity, such as contaminated reactor-cooling waters, have been disposed of to the ground or to the Columbia River under controlled conditions. Highly radioactive solutions of fission products from the separations plants have been stored in large underground steel tanks for eventual reworking, or for a lessening of radioactivity through decay that would permit safe release to the environment.

One aspect of the problem studied under the Commission's biophysics research program was the movement of radioactive elements through the soil into ground water, and with the ground water toward points of possible use. Laboratory and field investigation in the earth sciences has clarified the behavior of the most significant isotopes and has shown that, through ion exchange, soils can remove the more hazardous materials. Isotopes of low exchangability were found generally to be those of shorter half-life or of lower abundance.

The Hanford area generally has several hundreds of feet of dry soil lying above the water table, and this in turn lies above highly impermeable basaltic lava flows thousands of feet thick. While the active clay fraction of the soils is small, conditions were found to be highly conducive to the removal from solution of cesium 137, strontium 90, rare earths, plutonium and uranium—the more significant contaminants in the wastes. Ruthenium 106 (12-month half-life) was little adsorbed but is of less concern due to the estimated times it takes ground water from disposal points to reach the river.

A somewhat similar problem has been the return of reactor cooling water directly to the Columbia River. In passing through the reactor the water becomes contaminated by the radioactivation of residual or other impurities, or by introduction of radioactive materials from the reactor fuel or water tubes. Most isotopes so produced decay during the short hold-up period before the water is released to the river, but certain ones persist, such as sodium 24, manganese 56, arsenic 76, copper 64, phosphorus 32, calcium 45, strontium 89 and 90, barium

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140, zinc 65, iron 59, chromium 51, and rare earths. However, the studies have established that contamination of water at points of domestic water intake below Hanford has averaged less than 2 percent of the limit set by the U. S. Bureau of Standards Handbook 52. Extensive analysis work on the reactor effluents before and after dilution by the river have produced these findings—and also have led to the development of unique sampling methods, refined analytical techniques, and automatic monitoring equipment.

A major objective of the waste disposal program at Oak Ridge National Laboratory is to develop and evaluate methods for safe disposal into the ground of high level radioactive wastes. First work was on fixation of typical reactor process wastes into ceramic masses of earth materials, and fluxes admixed with the wastes. The studies now have been extended to include pilot scale experiments using field pits for disposal. Solid clinkers containing the essential waste constituents are formed by prolonged heating at high temperatures of the waste-flux admixtures after they are placed in the pits. Concurrent studies determine the heating requirements, uniformity of the ceramic mass, adequate fixation of the radionuclides in the clinker, evolution of aerosols during heating, and methods for preventing excessive dispersion of waste materials into the surrounding air, water or soil

Studies have continued on surface pits excavated in the Conasauga shale formation and used for disposing of intermediate level radiochemical liquid wastes from Oak Ridge. The geologic and hydrologic conditions in the waste pit area have been defined more completely. Field investigations in progress, and related laboratory studies, are designed to determine more definitely: (1) the volume of liquid wastes seeping into the shale, (2) the retention of radionuclides in the soil formations, (3) the pattern of the underground flow of chemical wastes in comparison with the flow of ground water, and, (4) if required, practical means for minimizing the seepage of wastes from the pits into the shale.

Increased and more specific studies are being made to determine the dispersion of waste constituents to the environment and the potential hazard to human, plant and animal life. Dispersion of wastes in ground water, surface water, and the soil is being estimated by (1) test wells; (2) stream gaging; (3) radiation measurements; and (4) sampling and analyses of water and soils. Current studies of the ecological aspects include (1) laboratory investigations of the effects of radiation on specific soil organisms and animals; (2) uptake of radionuclides by soil organisms and vegetation; and (3) preliminary field studies on the long-term biological effects of wastes released into the soil.

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Safety Precautions At Weapons Tests

During Operation Redwing test series at the Eniwetok Proving Ground in the Pacific, elaborate precautions are being taken to protect health and assure safety. A danger area of some 375,000 square nautical miles, roughly rectangular in shape, was blocked out and notifications broadcast more than 2 months in advance of the tests. Within the danger zone, there were no inhabited lands—no installations except for some test facilities. Regular air and sea searches of the danger area were carried out. As reported by news observers, before the Cherokee shot, a Japanese fishing craft was found on the perimeter of the area and escorted to safe regions.

The major safety precaution, aside from blocking out and patrolling the danger zone, was selection of a weather condition which was not only favorable for a shot but which would assure that the radioactive fall-out would come within the danger zone. Special studies of tropical weather, and methods of forecasting, were worked out for this purpose.

In addition, in areas outside the danger zone, arrangements were made for emergency evacuation of island inhabitants should this prove necessary, due to shift in winds or some other unforeseeable occurrence. After a detonation, the fall-out was monitored by plane crews tracking the radioactive cloud, and by radiological experts stationed on peripheral inhabited islands, and at stations of the weather reporting network. Fall-out also was monitored throughout the world.

In the United States itself, 39 monitoring stations are located in various cities across the country. Twenty-seven of these stations have been set up by the U. S. Public Health Service and 12 stations by the Atomic Energy Commission. Samples collected by these stations are forwarded to the Commission's Health and Safety Laboratory in New York for immediate analysis and evaluation. At approximately 70 locations throughout the world, in addition to the stations in the United States, monitoring stations are also set up.

A program to make measurement of radioactivity in sea water and in marine organisms is being conducted in the Pacific. Readings of radioactivity in the surface water are taken and water samples are collected at various depths below the surface. Plankton and fish are analyzed for possible radioactivity. After the test series, marine surveys will continue and will extend as far westward as radioactivity is detectable. In addition, land and marine biological surveys will be conducted on Eniwetok and Bikini Atolls and in the lagoons.

Further details on safety arrangements are described in Appendix 2, a background paper issued to observers during Operation Redwing.

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Civil Defense Activities

During the first half of 1956, there was an increasing tempo of interchange of information with, and assistance to, the Federal Civil Defense Administration, by the Atomic Energy Commission.

Participation in Nuclear Tests

The extensive participation of the Federal Civil Defense Administration, and of other Federal agencies and industrial organizations in Operation Teapot through Federal Civil Defense Administration sponsorship was described on pp. 81–83 in the Eighteenth Semiannual Report (January–June 1955). Joint planning for further Civil Effects Tests on an even broader scale is under way and preliminary conferences have been held at Washington and at Federal Civil Defense Administration headquarters in Battle Creek, Mich., between representatives of the Commission, FCDA, and other interested agencies. The final Civil Effects reports of Operation Teapot are being issued with emphasis placed on elimination, or segregation, of classified material, so that a large mass of information on the civil effects of nuclear detonations can be released, not only to civil defense organizations, but also to the general public.

Distribution of these reports already is under way; the majority of the final reports will be completely unclassified. The preliminary reports which they supersede were widely distributed.

Arrangements were made for an FCDA representative to be assigned to the Joint Task Force staff througout Operation Redwing at the Eniwetok Proving Ground this year to keep FCDA currently informed of test developments pertinent to civil defense planning. This follows previous practice except that, in the current operation, the FCDA representative is not an observer, but is assigned directly to the Scientific Task Group of the Joint Task Force.

In addition 17 FCDA-designated special observers viewed two detonations of Operation Redwing at the invitation of the Commission and the Department of Defense.

Technical Assistance

The Commission is expanding its scientific and technical assistance by adding consultant services to assist in civil defense matters. The Health and Safety Laboratory, New York Operations Office, is helping FCDA develop specifications and procure equipment for aerial monitoring of radiation. The feasibility of the technique was demonstrated during Operation ARME, conducted at the Nevada Test Site in October 1955 for FCDA-sponsored personnel.

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Loans of Radiation Sources

Cobalt 60 sources were lent to civil defense organizations of the States of New Jersey, Maryland, Delaware and Washington, and the City of Tacoma, Wash., for civil defense demonstration and training purposes, upon endorsement by the FCDA. A larger, 3-curie cobalt source has been made available to the State of Georgia for radiation detection instrument calibration. Sources and dosimeters were lent to FCDA National Headquarters and Region IV for use in instructor training courses.

Eligibility of several FCDA Headquarters and regional radiological defense personnel to receive and use radioactive sources was established.

Revision of "The Effects of Atomic Weapons"

"The Effects of Atomic Weapons," published jointly by the Commission and the Department of Defense in June 1950 as a definitive handbook is currently undergoing revision to include the latest knowledge of weapons effects gathered by experiment and observation in laboratory work and test series since preparation of the first issue of the handbook. Publication is scheduled for early 1957 under the title "Effects of Nuclear Weapons."

Security

During the last 6 months, the Atomic Energy Commission revised its criteria and administrative review procedures for determining the eligibility for security clearance of persons in the atomic energy program or entering it. The Commission announced the revision on May 10, 1956, and published the regulation that same day in the *Federal Register*, to take effect immediately.[28] The last revision, which took place in 1950,[29] extended to prospective employees the right to a hearing which previously had been limited to employees.

Eight years of experience in the field of personnel security clearances, and the recommendations of representatives of the scientific community contributed to the current revision. In January 1955, at a conference of the directors of eight Commisson laboratories, it was recommended that a committee [30] of scientific, legal, and security per-

[28] The regulation is printed in Appendix 7.

[29] See p. 35, Ninth Semiannual Report (July–December 1950).

[30] The committee included Dr. Norris E. Bradbury, Los Alamos Scientific Laboratory, Los Alamos, N. Mex.; Dr. Ernest O. Lawrence, University of California Radiation Laboratory, Berkeley, Calif.; Dr. Walter H. Zinn, Argonne National Laboratory, Lemont, Ill.; Dr. Clarence E. Larson, Oak Ridge National Laboratory, Oak Ridge, Tenn. (succeeded by Dr. Alvin Weinberg); William Mitchell, General Counsel of the Commission; John A. Waters, Security Division of the Commission.

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sonnel be established to assist the Commission in revising the personnel security standards and procedures.

The revised review procedures and criteria apply to employees and applicants for employment with the Commission, its contractors, agents, licensees, holders of access permits, and other persons as designated by the General Manager, concerning whom questions of eligibility for clearance have arisen. The new regulation also established standards under which reconsideration would be permitted for cases in which clearances previously had been granted or denied.

The policy in this field, as given in the regulations, declares:

> "It is the policy of the Atomic Energy Commission to carry out its responsibility for the security of the atomic energy program in a manner consistent with traditional American concepts of justice. To this end, the Commission has established criteria for determining eligibility for security clearance and will afford those individuals described in paragraph 4.2 [of the regulation] the opportunity for administrative review of questions concerning their eligibility for security clearance."

There are four main differences between the new regulation and the previous standards and procedures:

1. The previous section on "Criteria for Determining Eligibility for Security Clearance" has been clarified by the new regulation, particularly in the area of associations.
2. The new regulation provides for appointment to hearing boards of counsel whose function will be to develop all information, favorable and unfavorable, bearing upon an individual's eligibility for clearance.
3. The new regulation recognizes the use of informal interviews to determine, where possible, the eligibility of an individual for security clearance.
4. The new regulation provides that when a hearing board determines the presence of a witness is important to the resolution of material issues, the board shall request the appropriate Commission officials to arrange, if possible, for the witness to appear, and be subject to examination and cross-examination. If such a witness is unavailable, his unavailability and the reasons therefor will be considered by the hearing board in making its determination. Because of the confidential nature of sources of some information, confrontation of witnesses may not always be possible. In such cases, the hearing board may request the Commission to arrange for such a witness to testify privately and be subject to questioning by the board.

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Nuclear Materials Management

Policy Review

A review of policy on management of nuclear materials to ascertain whether changes were necessary in view of the increased volume and scope of Atomic Energy Commission activities was completed during the reporting period. The conclusion reached was that the basic system was sound and generally appropriate to the source and special nuclear materials controlled.

Standard Samples

A committee was formed [31] to evaluate a series of uranium isotopic standards for suitability as reference material in determining quantities of materials transferred, and on inventory, for use by the Commission, its contractors, and licensees. The committee reviewed scientific data supporting the stated uranium and uranium 235 contents of the standards, and will make recommendations to the Commission.

Concurrently with the review by the Uranium Isotopic Standards Committee, a study group was formed to consider the broader question of how best to provide all standard reference materials and standard measurements methods needed in atomic energy activities. The National Bureau of Standards, Department of Commerce, stated that it was willing to distribute standards and to participate in the development and certification of standard materials. The Atomic Energy Commission will continue for a few years to handle the major portion of these activities.

Annual Meeting on Materials Management

Approximately 175 contractor and Commission personnel met in Washington during the week of May 7, 1956, to discuss materials management. Joint sessions were held on policy, auditing and accounting, chemical and physical measurements, and mathematical statistics. Some 43 papers were presented.

Inspection

The Atomic Energy Commission is engaged in formulating policies and procedures for the review and inspection of direct activities, and those of contractors, licensees, and permit holders. A number of in-

[31] See Appendix 2.

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spections and appraisals was accomplished under this program during the reporting period. Plans have been developed for coordinating inspection programs related to foreign activities.

Inspection of Licensees

A statement of policy was approved during this reporting period to govern inspection of all licensee activities. It provides that direct employees of the Commission conduct inspections assisted, where necessary, by technical consultants.

Initial guidance has been established for inspection procedures to assure uniformity and adequacy of inspections which will determine whether or not byproduct and source material licensees are operating in accordance with license provisions and Commission rules and regulations. These inspections have been assigned to field offices.

Inspections of facilities, such as the research reactors located at Armour Research Foundation of Illinois Institute of Technology, Battelle Memorial Institute, Pennsylvania State University, and the University of Michigan, have been made to ascertain compliance with (1) provisions of the license or construction permit and (2) approved operating procedures at the time of start-up and subsequent operation.

When inspectors visit licensee facilities, State officials are invited to attend, and many from State inspection services are accompanying Commission inspectors reviewing byproduct licensee activities.

Inspection of Commission Offices and Contractors

Criteria and standards were established for the development of field office inspection programs which will produce adequate appraisals of contractor performance. Reviews were made of audit, inspection, and appraisal activities within the Commission, and of special problems arising in connection with these activities. A study of basic policies covering the accountability for source and special nuclear material was completed.

Construction and Supply

Construction Program

During the fiscal year ended June 30, 1956, costs incurred by the Commission for new plant and equipment were estimated to be about $295 million. This represented a decrease of 66 percent from $842 million during the previous fiscal year. As of June 30, 1956, the

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nation's capital investment in atomic energy facilities had risen to about $6.75 billion, before depreciation reserves.

The level of construction activity remained essentially constant during the fiscal year, with monthly construction costs ranging between $22 and $28 million. Incurred costs during the last 6 months amounted to $135 million, compared with $160 million in the 6 months ended December 31, 1955. It is expected that the present level of activity will continue during the next 6-month period.

Construction programs currently under way include feed materials facilities at St. Louis, Mo., at Fernald, Ohio, Portsmouth, Ohio, and Paducah, Ky.; production facilities at Hanford, Wash., and Savannah River, S. C.; and expansion of weapons fabrication facilities at Rocky Flats, Colo. Work also is under way on major new facilities at various installations for the reactor development and physical research programs.

Disposal of Contaminated Scrap

The Commission recently changed its regulations to permit limited sales of ferrous metal scrap, the surface of which has been contaminated by uranium and which exceeds criteria normally applicable for alpha activity. Sales are subject to careful measures of health protection and are limited to 10 tons by any one operations office during a 30-day period.

This change resulted from continuing efforts to provide for the disposal of lightly contaminated materials without adverse effects on public health or industry.

Freight Rates and Classification

Negotiations with eastern, southern, and western rail carriers resulted in obtaining the same reduced basis of freight rates on ammunition, explosives, and ordnance (approximately 55 percent of the first class rate), as recently made effective for the Department of Defense. This provides rates 10 percent below those previously available to the Commission.

The rail classification committees have reported a need to establish specific item descriptions and ratings for carload and less-than-carload shipment of radioactive materials. The current lack of classification descriptions and ratings is frequently a problem in resolving with the carriers a reasonable basis for charges.

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Auction Sales

Good results from auction sales have continued. Gross returns from sales of surplus personal property which included used construction machinery and materials at Oak Ridge, Tenn., and Hanford, Wash., during the last 6 months were 29.1 percent and 38.3 percent, respectively, of the original cost of the property. During the last 28 months, 16 auctions were held at seven locations; sales of property which cost approximately $33.2 million brought gross returns of approximately $8.5 million, or 25.6 percent of original cost.

Awards to Firms in Disaster Areas

Pursuant to a request from the President, the Office of Defense Mobilization in August 1955 asked all Government agencies to submit reports on awards to firms located in the Northeastern flood disaster area. In January 1956, the reporting requirement was extended to cover flood-damaged areas in the states of California, Oregon, Nevada, and Washington. Effective March 7, 1956, ODM terminated the requirement to report awards made to firms in the Northeastern area. On April 18, 1956, the requirement for reporting on awards in the West was terminated.

From August 1955 to February 1956, the Commission and its cost-reimbursable contractors awarded over 15,000 contracts and purchase orders totalling about $15.9 millions to firms located within the Northeastern area. Between January 13, 1956 and April 18, 1956, over 7,500 contracts totalling approximately $5.4 million were awarded to firms located in the Western flood-damaged areas.

Small Business

In a hearing before the Senate Small Business Committee's Subcommittee on Government Procurement, Commission representatives on March 29, 1956, reviewed actions, policies, programs, and system of contract reporting, as designed to assure that a fair proportion of total supplies and services are procured from small business concerns.

Small business continued to receive a substantial portion of Commission procurement dollars. Subcontracts going to small business increased from $209.7 million or 26.7 percent of the $785.5 million total in the fiscal year ended June 30, 1951, to $149.3 million or 46.9 percent of the $318.5 million total for three quarters of the fiscal year 1956. From July 1, 1951 to March 31, 1956, Commission cost-reimbursable contractors awarded $1.132 billion or 39.7 percent of a total of $2.85 billion to small business firms. Direct contract awards to small busi-

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ss during the same period amounted to $214 million, or 3.2 percent of the total amount.

Mobilization Planning

Material progress has been made during this period in the planning to insure continuity of operations of the Washington headquarters and field installations under emergency, disaster, and mobilization conditions. In January an agency-wide exercise was held to test the operational readiness of the headquarters and field emergency relocation centers in preparation for Operation Alert 1956 to be conducted in July.

The Commission participated actively in various mobilization readiness programs of the Office of Defense Mobilization (ODM). Commission representatives assisted in formulating ODM plans for varying mobilization conditions and participated in inter-agency tests of these plans.

Community Operations

Property Disposal at Oak Ridge and Richland

Several major steps were taken to carry out the Atomic Energy Community Act of 1955 which provides for disposing of Federally owned property in Oak Ridge, Tenn., and Richland, Wash.

Priority regulations, published in the *Federal Register* February 15, 1956, and effective March 16, 1956, established priorities among prospective purchasers of residential and commercial property. (See regulation in Appendix 7 for details.)

On February 14 the President issued an executive order making the Administrator, Housing and Home Finance Agency, responsible under the Act of 1955 for sale and financing. The Federal Housing Administration completed, during the last 6 months, its appraisals of all real property to be offered for sale at Oak Ridge and Richland. The Housing and Home Finance Agency established a disposal office at its Washington headquarters and disposal supervisory offices at Oak Ridge and Richland. The appraised value of each property offered was posted in each community. The residents at Richland voiced objections to the appraisals at Richland. The HHFA Administrator is delaying making a finding of feasibility of sale at both Richland and Oak Ridge pending consideration by the Subcommittee on Communities, of the Joint Committee on Atomic Energy, on questions raised by the Richland residents.

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A total of 115 of the 123 individual residential lots at Oak Ridge, leased by competitive bidding prior to passage of the Atomic Energy Community Act, now have been sold under the Act. Completing a program started several years ago, 38 church sites have been sold at Oak Ridge. The sale of church sites at Richland is continuing with a total of 14 sold to date.

Utilities and City Facilities, Oak Ridge and Richland

The city councils at the communities were notified that the Commission was prepared to discuss the transfer of utilities and municipal installations to local organizations.

The *Richland* City Council has established July 4, 1957 as a tentative date for its incorporation, and the Richland school board has indicated it may be able to accept transfer of school facilities at about the same time. Negotiations were undertaken with the Methodist Board of Hospitals and Homes to transfer Kadlec Hospital at Richland to the Board some time in September 1956. More than three-fourths of the Richland residents' vote was for transfer of the hospital to the Methodist Board.

The Richland Council also polled the residents on whether or not a natural gas distribution system should be brought into the community and, if the vote were affirmative, whether the franchise should be awarded by the Commission or handled later by the new city government. An overwhelming majority of those voting favored bringing in natural gas, and a smaller majority preferred that the Government award a contract.

A permanent assignment of 450 housing units at Richland has been offered to the Sixth Army, which indicated an interest in purchasing or controlling the occupancy of these units for use of military personnel.

The *Oak Ridge* Planning Commission retained consultants to develop a zoning ordinance and subdivision regulations, and the Town Council took on consultants on municipal affairs. No time schedule for the incorporation of Oak Ridge has been established.

Construction at Los Alamos

At Los Alamos, plans have been completed for construction of 226 housing units to complete the replacement of temporary, substandard housing. This will bring to 442 the total of new units, 587 temporary units have been demolished.

A land development study is under way to determine the feasibility of selling land for private construction at Los Alamos. Public meetings are being held to seek views of Los Alamos residents.

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Organization and Personnel

Principal personnel changes during the last 6 months include confirmation by the Senate on January 27, 1956, of the appointment of Atomic Energy Commissioner Harold S. Vance, who had served under a recess appointment since October 1955.

On June 4, 1956, Commissioner Willard F. Libby was renominated by President Eisenhower for a 5-year term and was confirmed by the Senate June 19, 1956. Dr. Libby was first appointed in 1954 to fill an unexpired term.

Robert E. Hollingsworth, formerly Assistant Director, Division of Production, was appointed Assistant General Manager for Administration, replacing James L. Kelehan, who resigned to enter private industry.

Paul F. Foster, formerly Special Assistant to the General Manager (Liaison), was appointed Assistant General Manager for International Activities, and was succeeded by John L. McGruder.

Bryan F. LaPlante, formerly Assistant Director for Washington Area Security Operations, Division of Security, was appointed Special Assistant to the General Manager (Congressional Relations), effective April 9, 1956, replacing William C. Wampler.

C. D. W. Thornton, formerly Chief, Office of Operations Analysis and Planning, Office of the General Manager, resigned to enter private industry, and was succeeded by Paul C. Fine, Assistant to Commissioner John von Neumann, as Acting Director.

Allan E. Jones was appointed Manager, Grand Junction Operations Office, effective February 1, 1956, replacing Sheldon P. Wimpfen.

Organization and Management

The Commission's Operations Office at Albuquerque, N. Mex., has been redesignated as the Albuquerque Operations Office (ALOO). Formerly known as the Santa Fe Operations Office, ALOO administers a substantial portion of the weapons program under direct supervision of the Director of Military Application. The Area Offices of Los Alamos, N. Mex., Sandia, N. Mex., Kansas City, Mo., Rocky Flats, Colo., Buffalo, N. Y., and South Albuquerque, report to the Albuquerque Operations Office, of which Kenner F. Hertford is manager.

The Commission has consolidated activities in foreign raw materials procurement in the Division of Raw Materials with its management of the domestic ore program by transferring the position of Joint

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Secretary of the Combined Development Agency from the Division of International Affairs to the Division of Raw Materials.

The Division of Raw Materials has streamlined management of its program in the western part of the United States. Jurisdiction over exploration activities, previously carried out under the direct supervision of the Washington Headquarters through Branch Offices located at Denver, Colo., and Salt Lake City, Utah, has been transferred to the Grand Junction Operations Office, which is responsible also for mining activities. The small Plant City, Fla., Field Office was closed June 30, 1956.

Effective May 31, 1956, an Office of Special Projects was established with responsibility for Commission activities relative to disarmament and, as assigned, for handling special projects in the international nuclear program. The Division of International Affairs, of which John A. Hall is Director, remains responsible for handling matters related to the Agreements for Cooperation. Edward R. Gardner has been appointed Director, Office of Special Projects, effective May 31, 1956.

Responsibility for analyzing and coordinating long-range plans for production and utilization of source and special nuclear materials, was assigned to the Office of Operations Analysis on March 28, 1956. The name of the office was changed to the Office of Operations Analysis and Planning.

The Commission has completed its review of problems identified by McKinsey and Co. of New York, in its management survey. The McKinsey survey found that extensive effort had been directed toward improvement of arrangements for carrying out responsibilities in the civilian applications area under the Atomic Energy Act of 1954.

Also completed was an extensive analysis of the use of advisory boards and committees to assure that the Commission was complying with Section 161.a. of the Atomic Energy Act of 1954 in establishing the groups and was using them effectively. The advisory nature of the functions of such boards and committees has been clearly established and assured by the provision of a Government official as full-time chairman in any case in which the subject matter of the committee's consideration might be deemed to be susceptible to influence by private interests. Provision is made for periodic review of the need for continued advisory services and the scope of such services in various areas, as well as of the qualifications of members to serve the public objectives of the Atomic Energy Act.

Commission Employment

Policy and procedures concerning Commission consultants and members of its advisory committees and boards were reviewed in the

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light of the fact that growth in the peaceful uses of atomic energy is broadening the participation of private and industrial interests in the program. Some procedural changes were adopted to reinforce policy requiring that Commission consultants and members of advisory committees and boards to avoid conflicts between their private interests and their services to the Commission.

A comprehensive review was made of policy and procedure on recruitment and selection of personnel. Improvements in procedure were adopted designed to help assure that fully qualified persons are available and selected for each opening.

Scientific and Technical Manpower

The Commission made a comprehensive study covering all activities which contribute to training scientists, engineers and technicians in various fields related to atomic energy. The study showed a need for stimulating and coordinating these activities and for gathering more definitive information concerning total United States' potential requirements (see Education and Training).

Awards

The Commission approved establishment of the Enrico Fermi Award on a permanent basis. The award will be granted not oftener than once each year, upon the recommendation of the General Advisory Committee, and with the approval of the President, for an especially meritorious contribution to the development, use, or control of atomic energy. The award is authorized by Section 157.b.(3) of the Atomic Energy Act of 1954. The amount was fixed at $50,000, which may be given to a single individual or divided among two or more.

On April 26, 1956, the Enrico Fermi Award was granted for the first time, the recipient being Dr. John von Neumann, now a member of the Atomic Energy Commission, for contribution to the theory, design, and construction of fast computers, and to the role of computers in the control and use of atomic energy.

The Commission will hold an annual honor awards ceremony at which appropriate recognition may be given to employees who have performed especially meritorious service. Presentations to employees will include (1) Distinguished Service Awards (2) Outstanding Service Awards (3) unusual Superior Performance Awards and (4) awards for 30 years or more of Federal service.

Dr. Charles Kenneth Leith, an outstanding geologist and mineralogist of international reputation, served as a member of the Combined Development Agency from its inception in 1944 until April

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1956. Upon his retirement, Dr. Leith was presented a Certificate of Appreciation signed by the Commissioners.

Dr. Walter H. Zinn resigned effective June 30, 1956 after serving 10 years as Director of the Argonne National Laboratory. In recognition of his achievements and leadership as a scientist and administrator, and in acknowledgment of his contribution to the atomic energy program, Dr. Zinn was presented a special commendation from the Commissioners.

Employment and Turnover

Direct employment by the Atomic Energy Commission increased about 3 percent during the last 6 months to total 6,349 in March 1956. The ratio of Commission employment to operating contractor employment continued to decrease, however, and is currently about one Federal employee to 14 contractor employees.

The total number of employees separated from the Commission during the first three months of 1956 (1.1 per hundred employees per month) declined about 20 percent from an 1.4 average for 1955. The rate of resignations also declined (1.1 to 1.0) but at a lesser rate—9 percent. The chart (p. 130) contrasts the lower separation and higher resignation rates in Commission activities with Government-wide experience. Relatively greater stability in Commission employment, because of program growth, probably contributes to the lower separation rate, while the higher resignation rate is a consequence of two factors:

1. Quits among lower grade employees were nearly double those in the middle and higher grades. Tenure of women generally is shorter and less stable than that of men. Since nearly half the Commission employees are in the lower grade jobs, which are filled predominantly by women, and because a larger proportion of women are employed by the Commission than by the Government as a whole, the effect of their typically higher turnover rate was more pronounced.
2. Scientists and engineers in the middle and higher grades quit at rates higher than those of administrative and other professional employees but lower than that of women. The nation-wide shortage of scientific and engineering personnel promotes competition among all employers for their services.

Contractor Employment

Commission operating contractors' employment showed a further gain in the first half of 1956, though the rate of increase has slowed

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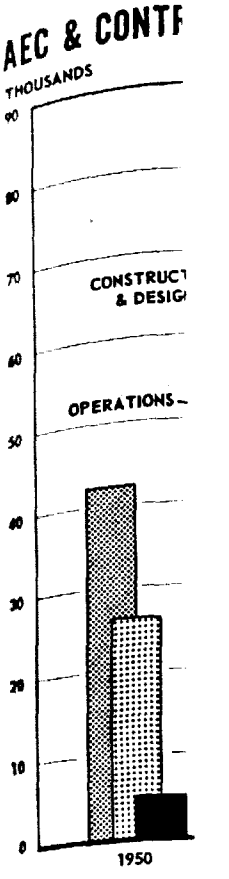

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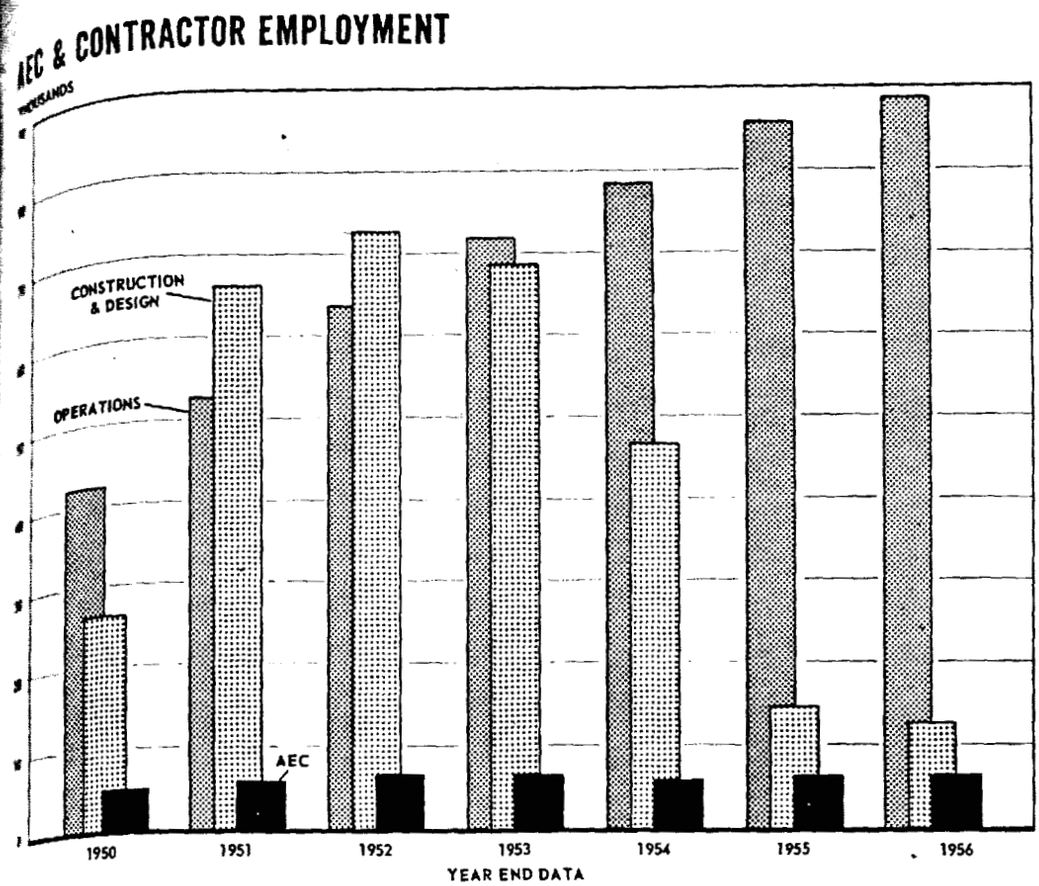


The May total of 89,204 comprised 49,067 in production activities, 33,341 in research and development work, and 6,796 in miscellaneous services. During the past 3 years, compared to 10 percent in research and development, employment in production activities has increased about 40 percent, as production facilities expanded at Portsmouth, Ohio; Savannah River, S. C.; Paducah, Ky.; Oak Ridge, Tenn.; Hanford, Wash.; Fernald, Ohio; and St. Louis, Mo.

Construction and design employment declined sharply during the 2-year period ended in September 1955 (from 73,400 to 16,700). A tapered decline to the May level of 11,777 occurred during the past 8 months. Currently, the greatest activity is at Eniwetok, Fernald, Oak Ridge, St. Louis, Savannah River, and Hanford.

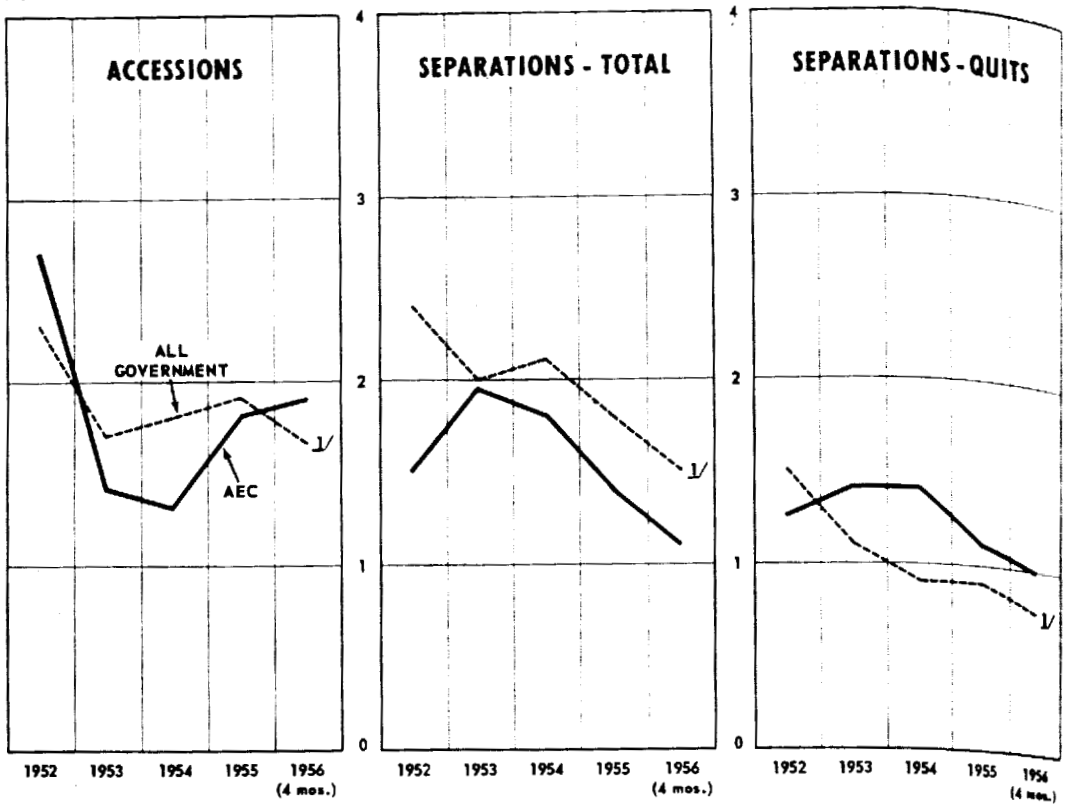
Operating Contractor Employee Turnover

In 1955, separations per 100 employees among operating contractors average 1.3 per month, the same rate as in 1954. Turnover data published by the Bureau of Labor Statistics showed separation rates of 1.6 per month for all inorganic chemical industries; 1.2 for those dealing with products of petroleum and coal; and 3.3 for all manufacturing industries.

Commission contractor separations include intracompany transfers (only 10 percent of separations) because such losses affect Federal

AEC & ALL FEDERAL GOVERNMENT TURNOVER RATES

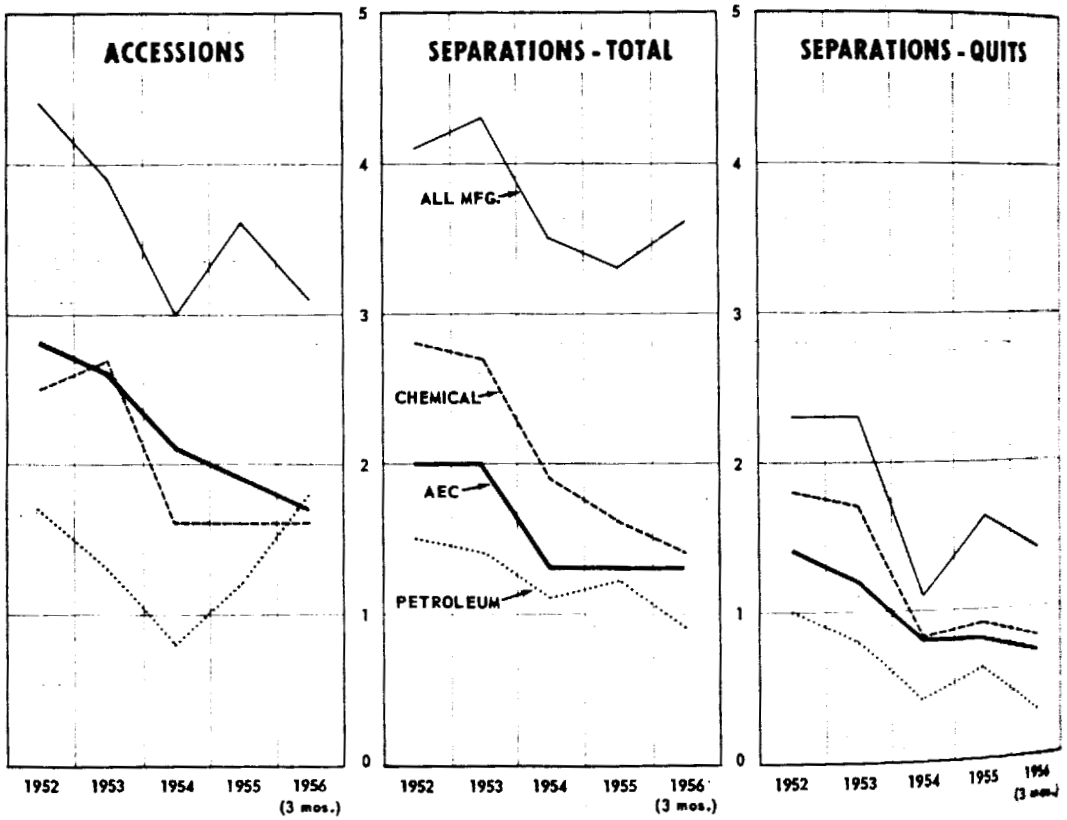
MONTHLY AVERAGES PER 100 EMPLOYEES



1/ Data available only through February.

AEC OPERATING CONTRACTOR & INDUSTRY TURNOVER RATES

MONTHLY AVERAGES PER 100 EMPLOYEES



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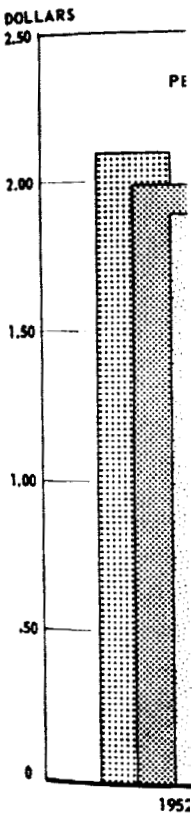

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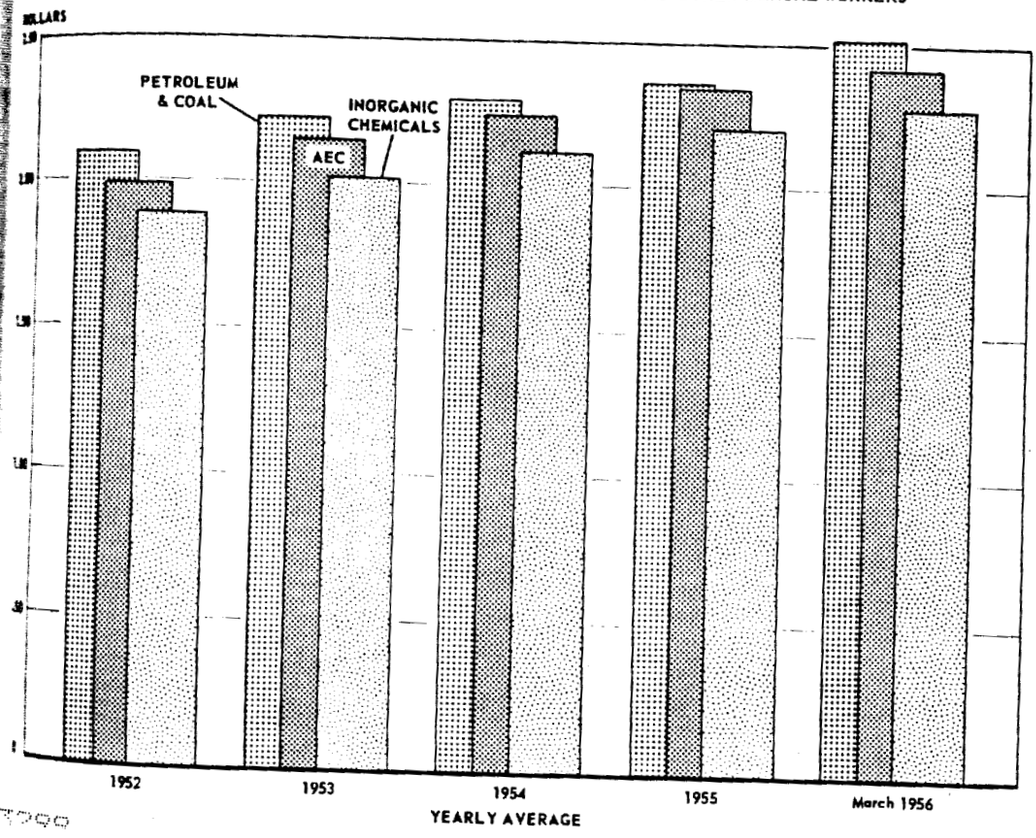
programs. A moderate movement of experienced employees between the contractors' private plants and Federal operations is desirable and benefits both the Government and contractors. The rate at which employees have been interchanged has declined during the past 2 years, and in each year the Commission program has gained more than it has lost by a ratio of about 12 to 7.

Contractor hiring of new employees dropped from a rate of 2.1 per month in 1954 to 1.9 in 1955. Accessions exceeded separations by 46 percent, reflecting the program's continued rapid growth. Contractors' rates of turnover closely paralleled those of petroleum and chemical industries, and the net gain contrasted with the 9 percent by which accessions exceeded separations in all manufacturing industries.

Earnings of Atomic Energy Workers

During the past 2 years the rate of increase in earnings of Commission operating contractor's production and other manual employees has been retarded somewhat. These workers averaged $2.34 per hour in gross earnings during 1955, an increase of 4.5 percent as compared with 4.7 and 8.1 percent increases in 1954 and 1953 respectively. In March 1956, however, average gross earnings among employees of Commission contractors were at an all-time high of $2.422 per hour—5 cents above that of workers with products of petroleum and coal and

GROSS AVERAGE HOURLY EARNINGS PRODUCTION AND OTHER MANUAL WORKERS



19 cents above inorganic chemicals—the two industries selected as most comparable to atomic energy in processes and equipment. However, the 6-percent increase pattern in the oil industry, set early in 1956, was not reflected in these figures.

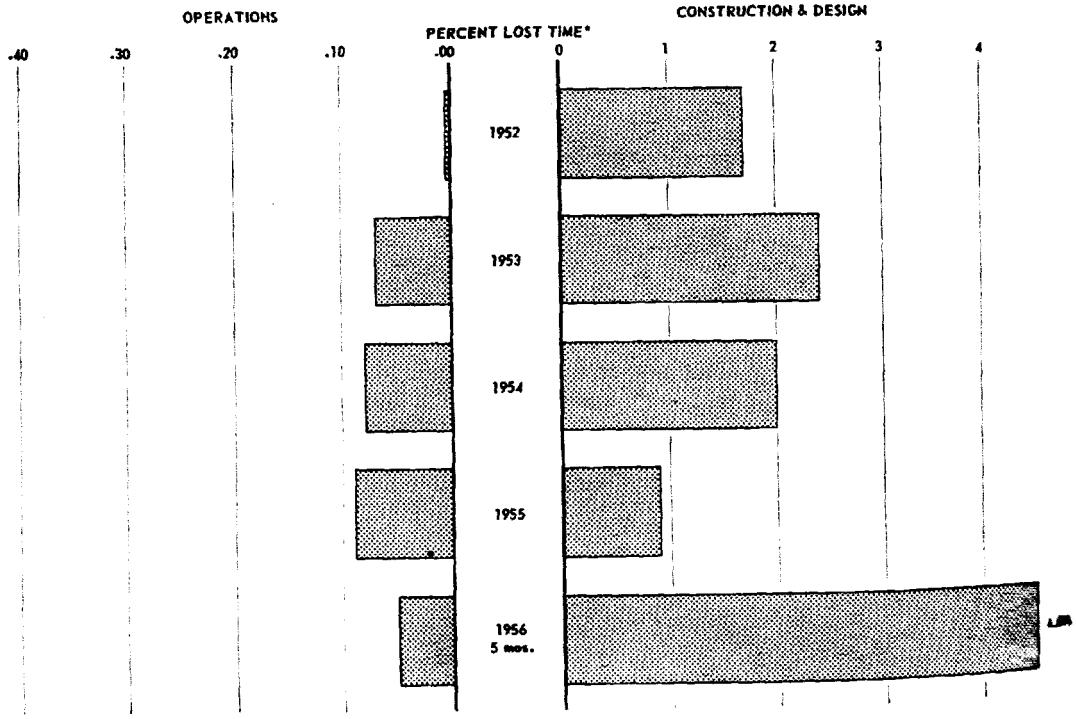
Work Stoppages

During the first 5 months of 1956, Commission operating activities were interrupted by two work stoppages. Both strikes involved workers employed by American Car and Foundry Industries at Buffalo, N. Y. Neither strike was sanctioned by the bargaining agent, the United Steelworkers of America. As in previous years, the ratio of time lost to time scheduled is insignificant (0.5 percent) in operations in comparison with that lost in construction activities.

A strike of Zia town maintenance and service employees at Los Alamos, N. Mex., was initiated by teamsters and laborers after negotiations over contract renewal with the basic maintenance crafts had broken down. Some 580 Zia employees were involved directly and the strike resulted in a total loss of 57,600 man-hours including some construction work affected by the establishment of picket lines. The 1956 loss for 5 months of 1956 in town maintenance and service activities was 1.1 percent.

Although the Commision has done considerably less construction during the past year, idleness from strikes during the first 5 months of 1956 was relatively greater than during the same period of any known

CONTRACTOR WORK STOPPAGES



* Percent lost time of scheduled work time.

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previous year. It amounted to 4.6 percent of the working hours scheduled. Of 16 work stoppages in construction during the period, three strikes at Hanford, Wash., were the most serious.

It is Commission policy to encourage its construction contractors to negotiate labor agreements wherever a project is so large as to overshadow other local construction. Since August 1947, the amount of construction at Hanford, Wash., had made it desirable to cover all construction crafts by a project agreement which provided certain uniform conditions including daily "isolation pay" in lieu of travel and subsistence. Early this year, because relatively little programmed construction remained at Hanford, the agreement was abandoned at the insistence of seven unions and to conform with Commission policy of encouraging adherence to area labor conditions, negotiated by local unions and local employer organizations, wherever the volume of construction permits.

As a result of the change, several disputes arose over travel allowances proposed to replace isolation payments. Consequently, of the total of 521,040 man-hours lost in the first 5 months of this year 461,796 were lost at Hanford. Considerable improvement occurred at Oak Ridge, Tenn., where loss of scheduled work time dropped to 0.1 percent during the first 5 months of 1956 from 1.9 percent during a similar period in 1955.

The Atomic Energy Labor-Management Relations Panel has handled only two disputes involving employees of operations contractors during the last 5 months. In both cases, one involving Phillips Petroleum Co. at Arco, Idaho, and Oil, Chemical and Atomic Workers, AFL–CIO, the other involving Union Carbide Nuclear Corp. and Atomic Trades and Labor Council AFL–CIO, at Oak Ridge, Tenn., the Panel's recommendations provided the basis for settlement. At the request of the Federal Mediation and Conciliation Service, the Panel took jurisdiction and the workers returned to the job on June 6, 1956.

Safety Experience

The occupational injury record during 1955 was the best ever experienced in the Atomic Energy Program. Disabling injuries were reduced 24 percent over 1954. The severity of injuries as measured by loss of worktime decreased 41 percent. There were fewer fatal accidents than in 1954. Dollar losses from fire and explosion continued at a low rate during the last 6 months of 1955. The Commission recognized 39 outstanding safety records by contractors and Commission offices.

An explosion of zirconium scrap metal, which cost two lives at Oak Ridge in May 1956, is being thoroughly investigated. The findings will be widely disseminated because of the great interest in this metal.

Research work has been inaugurated into the causes of spontaneous ignition of certain metals (see Reactor Development).

The Washington Safety and Fire Protection Branch has increased its efforts to make available to licensees, other governmental agencies, and the general public, information about hazards and safeguards peculiar to Commission industrial operations. A film, "The Mechanism of Uranium Poisoning" was produced. A publication, "Radiation Hazards in Firefighting," was placed on public sale. A Radiation Safety Primer package consisting of a set of slides, a cartoon book, and the "Instructors Handbook" was made available for public purchase. Other publications are in preparation.

The Fire Hazards of Atomic Industry Course, regularly held in the East, was conducted for the first time on the West Coast.

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APPENDIX 1

Organization and Principal Staff of U. S. Atomic Energy Commission

Atomic Energy Commission	Lewis L. Strauss, *Chairman*. Willard F. Libby. Thomas E. Murray. Harold S. Vance. John von Neumann.
General Manager	K. E. Fields.
Deputy General Manager	R. W. Cook.
Special Assistant to General Manager (Liaison)	John L. McGruder.
Special Assistant to General Manager	Charles Vanden Bulck.
Special Assistant to General Manager (Congressional)	Bryan F. LaPlante.
Assistant General Manager	Harry S. Traynor.
Assistant General Manager for Administration	Robert E. Hollingsworth.
Assistant General Manager for International Activities	Paul F. Foster.
Assistant General Manager for Manufacturing	David F. Shaw.
Assistant General Manager for Research and Industrial Development	A. Tammaro.
Controller	Don S. Burrows.
General Counsel	William Mitchell.
Secretary to Commission	W. B. McCool.
Chief, Office of Operations Analysis and Planning	Paul C. Fine, Acting.
Director, Office of Special Projects	Edward R. Gardner.
Director, Division of Biology and Medicine	Dr. Charles L. Dunham.
Director, Division of Civilian Application	Harold L. Price.
Director, Division of Classification	C. L. Marshall
Director, Division of Construction and Supply	John A. Derry.
Director, Division of Information Services	Morse Salisbury.
Director, Division of Inspection	Curtis A. Nelson.
Director, Division of Intelligence	C. H. Reichardt.

Director, Division of International Affairs	JOHN A. HALL.
Director, Division of Military Application	Brig. Gen. ALFRED D. STARBIRD, USA.
Director, Division of Nuclear Materials Management	D. F. MUSSER.
Director, Division of Organization and Personnel	OSCAR S. SMITH.
Director, Division of Production	E. J. BLOCH.
Director, Division of Raw Materials	JESSE C. JOHNSON.
Director, Division of Reactor Development	W. KENNETH DAVIS.
Director, Division of Research	T. H. JOHNSON.
Director, Division of Security	JOHN A. WATERS, Jr.
MANAGERS OF OPERATIONS OFFICES AND AREAS:	
Albuquerque (N. Mex.) Operations Office	KENNER F. HERTFORD.
Dayton (Miamisburg, Ohio) Area	JOHN H. ROBERSON.
Kansas City (Mo) Area	WESLEY M. JOHNSON.
Los Alamos (N. Mex.) Area	PAUL A. WILSON.
Rocky Flats (Colo.) Area	GILBERT C. HOOVER.
Chicago (Ill.) Operations Office	J. J. FLAHERTY.
Hartford Area	ERNEST B. TREMMEL.
Lockland (Ohio) Area	E. M. VELTEN.
Pittsburgh (Pa.) Area	LAWTON D. GEIGER.
Grand Junction (Colo.) Operations Office	ALLAN E. JONES.
Hanford (Wash.) Operations Office	J. E. TRAVIS.
Idaho (Idaho Falls) Operations Office	ALLAN C. JOHNSON.
New York (N. Y.) Operations Office	MERRIL EISENBUD.
Brookhaven (Long Island, N. Y.) Area	E. L. VAN HORN.
Oak Ridge (Tenn.) Operations Office	S. R. SAPIRIE.
Fernald (Cincinnati, Ohio) Area	CLARENCE L. KARL.
New Brunswick (N. J.) Area	C. J. RODDEN.
Paducah (Ky.) Area	KENNEDY C. BROOKS.
Portsmouth (Ohio) Area	KENNETH A. DUNBAR.
St. Louis (Mo.) Area	FRED H. BELCHER.
San Francisco (Calif.) Operations Office	HAROLD A. FIDLER.

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Savannah River (Aiken, S. C.) Operations Office	ROBERT C. BLAIR.
Dana (Terre Haute, Ind.) Area	CHARLES W. REILLY.
Schenectady (N. Y.) Operations Office	JON D. ANDERSON.

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APPENDIX 2

Membership of Committees

STATUTORY COMMITTEES

Joint Committee on Atomic Energy—Eighty-fourth Congress

This committee was established by the Atomic Energy Act of 1946, and continued under the Atomic Energy Act of 1954, 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.

Senator Clinton P. Anderson (New Mexico), *Chairman.*
Senator Richard B. Russell (Georgia).
Senator John O. Pastore (Rhode Island).
Senator Albert Gore (Tennessee).
Senator Henry M. Jackson (Washington)
Senator Bourke B. Hickenlooper (Iowa).
Senator Eugene D. Millikin (Colorado).
Senator William F. Knowland (California).
Senator John W. Bricker (Ohio).
Representative Carl T. Durham (North Carolina).
Representative Chet Holifield (California).
Representative Melvin Price (Illinois).
Representative Paul J. Kilday (Texas).
Representative John J. Dempsey (New Mexico).
Representative W. Sterling Cole (New York).
Representative Carl Hinshaw (California).
Representative James E. Van Zandt (Pennsylvania).
Representative James T. Patterson (Connecticut).
James T. Ramey, *Executive Director*

Military Liaison Committee

Under Sec. 27 of the Atomic Energy Act of 1954, "there is hereby established a Military Liaison Committee consisting of—a. a Chairman, who shall be the head thereof and who shall be appointed by the President, by and with the advice and consent of the Senate, who shall serve at the pleasure of the President, and who shall receive compensation at the rate prescribed for an Assistant Secretary of Defense; and b. a representative or representatives from each of the Departments of the Army, Navy, and Air Force, in equal numbers, as determined by the Secretary of Defense, to be assigned from each Department by the Secretary thereof and who will serve without additional compensation. The Chairman of the Committee may designate one of the members of the Committee as Acting Chairman to act during his absence. The Commission shall advise and consult with the Department of Defense, through the Committee, on all atomic energy matters

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which the Department of Defense deems to relate to military applications of atomic weapons or atomic energy including the development, manufacture, use, and storage of atomic weapons, the allocation of special nuclear material for military research, and the control of information relating to the manufacture or utilization of atomic weapons; and shall keep the Department of Defense, through the Committee, fully and currently informed of all such matters before the Commission. The Department of Defense, through the Committee, shall keep the Commission fully and currently informed on all matters within the Department of Defense which the Commission deems to relate to the development or application of atomic energy. The Department of Defense, through the Committee, shall have the authority to make written recommendations to the Commission from time to time on matters relating to military applications of atomic energy as the Department of Defense may deem appropriate. If the Department of Defense at any time concludes that any request, action, proposed action, or failure to act on the part of the Commission is adverse to the responsibilities of the Department of Defense, the Secretary of Defense shall refer the matter to the President whose decision shall be final."

Hon. HERBERT B. LOPER, *Chairman*
Brig. Gen. JOHN P. DALEY, United States Army.
Maj. Gen. JOHN S. UPHAM, United States Army.
Rear Adm. DAVID L. MCDONALD, United States Navy
Rear Adm. COURTNEY SHANDS, United States Navy.
Maj. Gen. HERBERT B. THATCHER, United States Air Force.
Brig. Gen. RICHARD T. COINER, United States Air Force.

General Advisory Committee

This committee was established by the Atomic Energy Act of 1946 (Sec. 2 (b)), and is continued by Sec. 26 of the Atomic Energy Act of 1954. 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.

Dr. I. I. RABI, chairman; professor of physics, Columbia University, New York, N. Y.
Dr. JESSE W. BEAMS, professor of physics, University of Virginia, Charlottesville, Va.
Dr. J. B. FISK, executive vice president, Bell Telephone Laboratories, Murray Hill, N. Y.
Dr. WARREN C. JOHNSON, dean of physical sciences, University of Chicago, Chicago, Ill.
Dr. EDWIN M. MCMILLAN, professor of physics, UCRL, Berkeley, Calif.
Dr. V. MURPHREE, president, ESSO Research and Engineering Co., New York, N. Y.
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. JANE H. HALL, secretary; assistant director, Los Alamos Scientific Laboratory, UCLA, Los Alamos, N. Mex.

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PATENT COMPENSATION BOARD

This board was established in April 1949 pursuant to Section 11 of the Atomic Energy Act of 1946, and is the Board designated under Section 157a of the Atomic Energy Act of 1954. Section 157 provides that upon application for just compensation or awards or for the determination of a reasonable royalty fee certain proceedings shall be held before such a board.

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 studies the major technical activities of the Atomic Energy Commission program and advises the Commission on classification and declassification matters, making recommendations with respect to the rules and guides for the control of scientific and technical information. The committee consists of six members appointed for a term of 5 years on a rotating basis.

Dr. WARREN C. JOHNSON, chairman; dean of physical sciences, University of Chicago, Chicago, Ill.
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, Atomics International, North American Aviation, Inc., Downey, Calif.
Dr. WINSTON M. MANNING, director, chemistry division, ANL, Lemont, Ill.
Dr. J. R. RICHARDSON, 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 programs in medical and biological research and health and recommends to the Commission general policies in these fields.

Dr. GIOACCHINO FAILLA, chairman; director, radiological research laboratory, College of Physicians and Surgeons, Columbia University, New York, N. Y.
Dr. JOHN C. BUGHER, director, medical education & public health, Rockefeller Foundation, New York, N. Y.
Dr. CHARLES H. BURNETT, professor of medicine, University of North Carolina, Chapel Hill, N. C.
Dr. SIMEON T. CANTRIL, director, Tumor Institute of Swedish Hospital, Seattle, Wash.
Dr. H. BENTLEY GLASS, professor of biology, The Johns Hopkins University, Baltimore, Md.
Dr. SHIELDS WARREN, vice chairman; pathologist, New England Deaconess Hospital, Boston, Mass.
Vacancy.

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Advisory Board of Contract Appeals

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

P. BRANDIS, Jr., dean of the law school, University of North Carolina, Chapel Hill, N. C.

D. ELLIOTT, director of institute for judicial administration, New York University, New York, N. Y.

KINGSLEY, dean, school of law, University of Southern California, Los Angeles, Calif.

R. PURVES, executive director, American Institute of Architects, Washington, D. C.

F. TAGGART, dean, school of business administration, University of Michigan, Ann Arbor, Mich.

Advisory Committee on Industrial Information

committee, formed in 1949, appraises technological developments within the national atomic energy program and makes recommendations which serve as guides in the formulation of information-for-industry policy.

D. KIRKPATRICK, chairman; vice president and director of editorial development, McGraw-Hill Book Co., Inc., New York, N. Y.

ALLAN G. GRAY, technical editor, Steel, Penton Publishing Co., Cleveland, Ohio.

HARDY, National Association of Manufacturers, Washington, D. C.

HENNEY, consulting editor, Nucleonics and Electronics, McGraw-Hill Publishing Co., Inc., American Institute of Radio Engineers, New York, N. Y.

ELMER HUTCHISSON, editor, Journal of Applied Physics, American Institute of Physics, New York, N. Y.

H. JACOBSON, Electric Light and Power, Haywood Publishing Co., Chicago, Ill.

E. JESSUP, editor, Civil Engineering, The American Society of Civil Engineers, New York, N. Y.

W. KRAMER, editor, Power Engineering, The Technical Publishing Co., Chicago, Ill.

S. LEE, American Institute of Electrical Engineers, New York, N. Y.

WALTER J. MURPHY, editorial director, Applied Publications, American Chemical Society, Washington, D. C.

A. PAWLEY, research secretary, American Institute of Architects, Washington, D. C.

H. ROBIE, secretary emeritus, American Institute of Mining and Metallurgical Engineers, New York, N. Y.

T. SCHWARTZWALDER, The American Ceramic Society, Inc., Columbus, Ohio.

F. SULLIVAN, editor, The Iron Age, Chilton Publication, Inc., Philadelphia, Pa.

E. THUM, editor, Metal Progress, American Society for Metals, Cleveland, Ohio.

H. TOWNSEND, secretary, Atomic Industrial Forum, Inc., New York, N. Y.

A. TUCKER, publications manager, American Society of Mechanical Engineers, New York, N. Y.

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Dr. ALBERTO F. THOMPSON, chief, office of scientific information, National Science Foundation, Washington, D. C.

F. J. VAN ANTWERPEN, editor, Chemical Engineering Progress, American Institute of Chemical Engineers, New York, N. Y.

BERNARD M. FRY, secretary; assistant director, technical information service, 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 Decemer 1947 to aid in establishing new policies on distributng radioactive materials and to review existing policies. The committee reviews all initial applications for use of radioisotopes in human beings, and all other requests for their use in research, education, and industry which are referred to it by the Commission.

Dr. DONALD S. CHILDS, Jr., Mayo Clinic, Rochester, Minn.

Dr. JOHN E. CHRISTIAN, associate professor, department of pharmaceutical chemistry, Purdue University, Lafayette, Ind.

Dr. HENRY J. GOMBERG, assistant director, Phoenix Memorial Laboratory, University of Michigan, Ann Arbor, Mich.

Dr. LEON O. JACOBSON, associate dean, division of biological sciences, University of Chicago, Chicago, Ill.

Dr. H. R. NELSON, departmentment of physics, Battelle Memorial Institute, Columbus, Ohio.

Dr. EDITH H. QUIMBY, associate professor of radiology, College of Physicians and Surgeons, Columbia University, New York, N. Y.

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 Reactor Safeguards

This committee was formed in 1953 from the former Reactor Safeguard Committee and the Industrial Committee on Reactor Location Problems. The committee reviews safety studies referred to it by the Commission staff and advises the commission with regard to the hazards of proposed or existing reactor facilities and the adequacy of proposed reactor 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. HARVEY BROOKS, professor of physics, Harvard University, 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, atomic energy research project, Western Reserve University, Cleveland, Ohio.

Dr. I. B. JOHNS, Monsanto Chemical Co., Everett, Mass.

Dr. MARK H. MILLS, radiation laboratory, University of California, Livermore, Calif.

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R. OSBORN, manager of industrial development, general chemical division, Allied Chemical and Dye Corp., New York, N. Y.
A. ROGERS, manager, central engineering, Allied Chemical and Dye Corp., Morristown, N. J.
EL C. STRATTON, supervising chemical engineer, engineering and loss control division, the Travelers Insurance Co., of Hartford, Conn.
ARL WOLMAN, head, department of sanitary engineering and water resources, The Johns Hopkins University, Baltimore, Md.
HARRY WEXLER, chief, scientific services division, U. S. Weather Bureau, Department of Commerce, Washington, D. C.
J. HOLLAND, secretary; U. S. Atomic Energy Commission, Washington, D. C.

Advisory Committee of State Officials

committee was established by the Commission in September 1955 as a means taining the views and advice of State regulatory agencies in connection with Atomic Energy Commission's regulatory activities in the field of public health safety.

DANIEL BERGSMA, commissioner of health, Trenton, N. J.
C. BLACKMAN, chief, division of industrial safety, California Department of Industrial Relations, San Francisco, Calif.
ROY L. CLEERE, executive director, Colorado State Department of Public Health, Denver, Colo.
ISS M. EVERTS, Jr., director, division of sanitation and engineering, Oregon State Board of Health, Portland, Oreg.
IS G. FROST, deputy attorney general of Maine, Augusta, Maine.
ALBERT E. HEUSTIS, commissioner of health, Lansing, Mich.
LLIAM T. LINTON, executive director, water pollution control authority, South Carolina State Board of Health, Columbia, S. C.
A. POOLE, director, bureau of environmental sanitation, State Board of Health, Indianapolis, Ind.
ALD P. ROBERTS, chief, industrial hygiene section, Tennessee Department of Health, Nashville, Tenn.
RENCE I. STERLING, Jr., chief sanitary engineer, division of sanitation, Department of Public Health of the Commonwealth of Massachusetts, Boston, Mass.
IRVING TABERSHAW, director, division of industrial hygiene, New York State Department of Labor, New York, N. Y.
ARTHUR B. WELSH, medical coordinator for civil defense, Department of Health of Pennsylvania, Harrisburg, Pa.

Committee on Raw Materials

committee was appointed in October 1947 to review the Atomic Energy mission's raw materials program and to advise on questions of exploration, elopment, and procurement.

OLD F. FIELD, consulting mining engineer, Duluth, Minn.
NCIS C. FRARY, technical advisor, aluminum research laboratory, Aluminum Company of America, New Kensington, Pa.
. GUSTAFSON, consulting geologist, M. A. Hanna Co., Cleveland, Ohio.
IST H. ROSE, project director, metallurgy, Materials Advisory Board National Research Council, Washington, D. C.
ER O. SNELLING, research chemist, Allentown, Pa.

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ORVIL R. WHITAKER, consulting mining engineer, Denver, Colo.

CLYDE WILLIAMS, president and director, Battelle Memorial Institute, Columbus, Ohio.

Committee For Uranium Isotopic Standards

This committee, established by the Commission in March 1956, reviews all recorded evidence supporting standards on the primary generative product (uranium 235 and uranium 238) and depleted materials, evaluates the standards, and recommends any additional action which the Commission should take to establish the Certified Uranium Isotopic Standards.

DONALD F. MUSSER, chairman; director, division of nuclear materials management, U. S. Atomic Energy Commission, Washington, D. C.

Dr. MACK INGHRAM, professor of physics, University of Chicago, Chicago, Ill.

Dr. RALPH F. LUMB, division of nuclear materials management, U.S. Atomic Energy Commission, Washington, D. C.

Dr. CHARLES METZ, supervisor, analytical work, Los Alamos Scientific Laboratory, Los Alamos, N. Mex.

Dr. HORACE W. NORTON, professor of agricultural statistics, Agricultural Experiment Station, University of Chicago, Urbana, Ill.

Dr. EDWIN ORLEMANN, professor of chemistry, University of California, Berkeley, Calif.

Dr. LEONARD PEPKOWITZ, supervisor, analytical work, Knolls Atomic Power Laboratory, Schenectady, N. Y.

CHARLES D. W. THORNTON, assistant to president, Farnsworth Electronics Co., Ft. Wayne, Ind.

Dr. EDWARD WICHERS, chief of chemistry, National Bureau of Standards, Washington, D. C.

Metallurgy and Materials Advisory Panel

The panel was established in October 1955 to advise the Division of Research as to how it can best increase the effectiveness of the research program on metallurgy, solid state physics, and ceramics.

Dr. HARVEY BROOKS, division of engineering sciences, Harvard University, Cambridge, Mass.

Dr. MORRIS COHEN, department of metallurgy, Massachusetts Institute of Technology, Cambridge, Mass.

Dr. EDWARD EPREMIAN, division of research, U.S. Atomic Energy Commission, Washington, D. C.

Dr. MAXWELL GENSAMER, professor of metallurgy, Columbia University, New York, N. Y.

Dr. JOHN P. HOWE, Atomic International Division, North American Aviation, Inc., Downey, Calif.

Dr. ALBERT R. KAUFMAN, vice president, Nuclear Metals, Inc., Cambridge, Mass.

Dr. FREDERICK SEITZ, department of physics, University of Illinois, Urbana, Ill.

Dr. JOHN C. SLATER, department of physics, Massachusetts Institute of Technology, Cambridge, Mass.

Nuclear Cross Sections Advisory Group

This group is appointed on a yearly basis to make a continuing review of the Commission's program of nuclear cross section measurements, and to evaluate

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needs for cross section information in the various activities of the Commis-
The following members were appointed to serve from July 1955 to
1956.

RICHARD F. TASCHEK, chairman; physics division, Los Alamos Scientific Laboratory, Los Alamos, N. Mex.
LOWELL M. BOLLINGER, department of physics, Argonne National Laboratory, Lemont, Ill.
TOM W. BONNER, department of physics, Rice Institute, Houston, Tex.
JOSEPH L. FOWLER, physics division, Oak Ridge National Laboratory, Oak Ridge, Tenn.
HERBERT GOLDSTEIN, Nuclear Development Corporation of America, White Plains, N. Y.
WILLIAM W. HAVENS, Jr., department of physics, Columbia University, New York, N. Y.
DONALD J. HUGHES, department of physics, Brookhaven National Laboratory, Upton, Long Island, N. Y.
GEORGE A. KOLSTAD, vice chairman; physics branch, division of research, AEC, Washington, D. C.
HENRY W. NEWSON, department of physics, Duke University, Durham, N. C.
JACK M. PETERSON, cyclotron group, University of California Radiation Laboratory, Livermore, Calif.
ERWIN F. SHRADER, division of research, U. S. Atomic Energy Commission, Washington, D. C.
THOMA M. SNYDER, manager, nuclear physics section, Knolls Atomic Power Laboratory, Schenectady, N. Y.
IRA F. ZARTMAN, division of reactor development, U. S. Atomic Energy Commission, Washington, D. C.
CARROL W. ZABEL, secretary; department of physics, Los Alamos Scientific Laboratory, Los Alamos, N. Mex.

Patent Advisory Panel

panel was appointed in January 1947. It makes informal reports and mendations to the Commission and its staff on various questions of policy procedure relating to patents and inventions.

THOMAS AUSTERN; of Covington & Burling, Washington, D. C.
WILLIAM H. DAVIS; of Davis, Hoxie & Faithfull, New York, N. Y.
A. DIENNER; of Brown, Jackson, Boettcher & Dienner, Chicago, Ill.
W. OOMS; firm of Casper W. Ooms, Chicago, Ill.

Personnel Security Review Board

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

PURCELL, chairman; of Purcell & Nelson, Washington, D. C.
PAUL E. KLOPSTEG, consultant, Evanston, Ill.
WILLIAM E. LEAHY, president, Columbus University, Washington, D. C.

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Reactor Physics Planning Group

This group is appointed for one year terms to consider the status of development of reactor physics data in relation to the development of reactor concepts. The committee's recommendations have been extremely valuable in charting the future of work in the field of reactor physics.

Dr. ROBERT A. CHARPIE, assistant director, Oak Ridge National Laboratory, Oak Ridge, Tenn.

Dr. E. RICHARD COHEN, group leader, theoretical physics, North American Aviation, Inc., Downey, Calif.

Dr. KARL COHEN, consultant, atomic power equipment dept., General Electric Co., Schenectady, N. Y.

Dr. GERHARD G. DESSAUER, director, physics section, E. I. duPont de Nemours & Co., Savannah River Plant, Augusta, Ga.

Dr. W. K. ERGEN, physicist, Oak Ridge National Laboratory, Oak Ridge, Tenn.

Dr. PAUL GAST, consulting physicist, engineering department, General Electric Co., Hanford Works, Richland, Wash.

Dr. GERALD GOERTZEL, assistant technical director, Nuclear Development Corp. of America, White Plains, N. Y.

Dr. HENRY HURWITZ, consulting physicist, Knolls Atomic Power Laboratory, Schenectady, N. Y.

Dr. IRVING KAPLAN, head, reactor physics division, Brookhaven National Laboratory, Upton, Long Island, N. Y.

Dr. SIDNEY KRASIK, manager of physics of PWR, atomic power division, Westinghouse Electric Corp., Pittsburgh, Pa.

Dr. FRITZ W. MEZGER, manager, applied mathematics, General Electric Co., Cincinnati, Ohio.

Dr. WARREN E. NYER, atomic energy division, Phillips Petroleum Co., Idaho Falls, Idaho.

Dr. HUGH PAXTON, physicist, Los Alamos Scientific Laboratory, Los Alamos, N. Mex.

Dr. THOMA M. SNYDER, manager, nuclear physics section, Knolls Atomic Power Laboratory, Schenectady, N. Y.

Dr. BERNARD I. SPINRAD, physics section, Argonne National Laboratory, Lemont, Ill.

F. W. THALGOTT, reactor engineering division, Argonne National Laboratory, Lemont, Ill.

Dr. IRA F. ZARTMAN, division of reactor development, U. S. Atomic Energy Commission, Washington, D. C.

Sherwood Steering Committee

This committee was approved by the Commission on January 27, 1954. The committee meets as the need arises to analyze the overall problem, recommend new projects to be undertaken, suggest who might do the work, review progress and proposals, and recommend desirable emphasis and levels of support to the director of the division of research.

Dr. AMASA S. BISHOP, division of research, U. S. Atomic Energy Commission, Washington, D. C.

Dr. WILLIAM M. BROBECK, assistant director, University of California Radiation Laboratory, Berkeley, Calif.

Dr. LYMAN SPITZER, Jr., Forrestal Research Center, Princeton University, Princeton, N. J.

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EDWARD TELLER, associate director, University of California Radiation Laboratory, Berkeley, Calif.

JAMES L. TUCK, technical director, Los Alamos Scientific Laboratory, Los Alamos, N. Mex.

Stack Gas Problem Working Group

The appointment of this group was authorized in May 1948 to advise the Atomic Energy Commission and its contractors on problems in the treatment and control of gaseous effluents. The group meets formally at irregular intervals but renders continuing assistance in the field of air cleaning through specific research and development work directed by individual members and by individual consulting service to the various Commission installations.

ABEL WOLMAN, chairman; head, department of sanitary engineering and water resources, The Johns Hopkins University, Baltimore, Md.

PHILIP DRINKER, professor of industrial hygiene, Harvard University School of Public Health, Boston, Mass.

LYLE I. GILBERTSON, director, research and engineering department, Air Reduction Co., Inc., Murray Hill, N. J.

J. GORMAN, division of reactor development, U. S. Atomic Energy Commission, Washington, D. C.

H. FRASER JOHNSTONE, professor of chemical engineering, University of Illinois, Urbana, Ill.

CHARLES E. LAPPLE, Stanford Research Institute, Palo Alto, Calif.

J. A. LIEBERMAN, division of reactor development, U. S. Atomic Energy Commission, Washington, D. C.

WILLIAM P. YANT, director of research and development, Mine Safety Appliances Co., Pittsburgh, Pa.

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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. Voigt

Argonne Cancer Research Hospital (University of Chicago, contractor), Chicago, Ill.

The participating institutions associated with Argonne National Laboratory (listed immediately below) are also affiliated with the Argonne Cancer Research Hospital.

Director ..... Dr. Leon O. Jacobson
Associate Director ..... Dr. Robert J. Hasterlik

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

Director ..... Vacant
Deputy Director (Acting Director) ..... Dr. Norman Hilberry
Business Manager ..... John H. McKinley
Assistant Director, Technical Services ..... John T. Bobbitt

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 University of Agriculture and Applied Science
- 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

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

Plant Manager, Westinghouse Electric Corp	JOHN W. SIMPSON
Manager, PWR Project	JOSEPH C. RENGEL
Manager, SFR Project	ALEXANDER SQUIRE
Manager, A1W Project	JOHN T. STIEFEL
Manager, S5W Project	DOUGLAS C. SPENCER
Manager, F1W Project	KARL W. SCHWANEKAMP
Manager, S1W Site, NRF, Idaho	JOHN M. YADON

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 Trustees	Adm. EDWARD L. COCHRANE
President, AUI	LLOYD V. BERKNER
Vice President, AUI and Laboratory Director	Dr. LELAND J. HAWORTH
Deputy Laboratory Director	Dr. GERALD F. TAPE
Assistant Director	Dr. ROBERT A. PATTERSON
Assistant Director	WILLIAM H. FIELDS

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

General Manager	F. E. CREVER
Manager, SIR Project	K. A. KASSELRING
Manager, SAR Project	B. H. CALDWELL, Jr.
Manager, Technical Department	F. E. CREVER, Acting
Manager, Auxiliary Operations Department	S. B. STROM

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	EDWARD C. MCCARTHY

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

The sponsoring universities of the Institute are:

- Agricultural and Mechanical college of Texas
- Alabama Polytechnic Institute
- Catholic University of America
- Clemson Agricultural College
- Duke University
- Emory University
- Florida State University
- Georgia Institute of Technology
- Louisiana State University
- Meharry Medical College
- Mississippi State College
- North Carolina State College
- North Texas State College
- Rice Institute
- Southern Methodist University
- Tulane University of Louisiana
- Tuskegee Institute
- Vanderbilt University
- Virginia Polytechnic Institute
- University of Alabama
- University of Arkansas
- University of Florida
- University of Georgia
- University of Kentucky
- University of Louisville
- University of Maryland
- University of Mississippi
- University of North Carolina
- University of Oklahoma
- University of Puerto Rico
- University of South Carolina
- University of Tennessee
- University of Texas
- University of Virginia

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

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

Director	Dr. A. M. WEINBERG
Deputy Director	Dr. J. A. SWARTOUT
Assistant Laboratory Director	Dr. G. E. BOYD
Assistant Laboratory Director	Dr. R. A. CHARPIE
Assistant Laboratory Director	Dr. E. D. SHIPLEY
Assistant Laboratory Director	Dr. R. W. JOHNSON
Assistant Laboratory Director	Dr. C. E. WINTERS

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

Director	Dr. ERNEST O. LAWRENCE
Associate Director	Dr. LUIS W. ALVAREZ
Associate Director	Dr. DONALD COOKSEY
Associate Director	Dr. EDWIN M. MCMILLAN
Associate Director	Dr. GLENN T. SEABORG
Associate Director	Dr. EDWARD TELLER
Associate Director	Dr. HERBERT F. YORK
Assistant Director	WILLIAM M. BROBECK
Director, Crocker Laboratory Medical Physics	Dr. JOSEPH G. HAMILTON
Director, Donner Laboratory of Medical Physics	Dr. J. H. LAWRENCE
Director, Livermore Laboratory	Dr. HERBERT F. YORK
Business Manager and Managing Engineer	WALLACE B. REYNOLDS

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Materials Development Laboratory (National Lead Co., contractor), Winchester, Mass.

Technical Director and Manager ..... JOHN BREITENSTEIN

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

Director ..... Dr. HENRY A. BLAIR
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

National Reactor Testing Station, Idaho Falls, Idaho.

Nevada Test Site, Las Vegas, Nev.

Eniwetok Proving Ground, Marshall Islands

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APPENDIX 4

Radioactive Isotope Distribution Data [1]

Radioactive Isotope	Aug. 2, 1946 Dec. 31, 1955		Jan. 1, 1956 May 31, 1956		Total to May 31, 1956	
	Activity (Curies)	Shipments	Activity (Curies)	Shipments	Activity (Curies)	Shipments
Iodine 131	3,240	28,700	301	2,023	3,541	[illegible]
Phosphorus 32	918	16,965	68	1,091	986	[illegible]
Carbon 14	39	2,385	3	121	42	[illegible]
Tritium	1,101	329	543	50	1,644	[illegible]
Strontium 89, 90	392	932	11	63	403	[illegible]
Cobalt 60	96,389	1,191	33,789	100	130,178	[illegible]
Cesium 137	2,410	636	2,595	58	5,005	[illegible]
Iridium 192	4,760	193	2,407	49	7,167	[illegible]
Irradiated Units [2]	11,930	11,608	880	869	12,810	[illegible]
Others	430	13,874	107	1,451	537	[illegible]
Total	109,679	76,813	39,824	5,875	149,503	[illegible]
Shipments to AEC installations	----------	9,463	----------	508	----------	[illegible]

[1] Domestic shipments from Oak Ridge National Laboratory.
[2] Includes irradiated units of Iodine 131 and Phosphorus 32.

LOCATION AND TYPE OF NEW USERS

Jan. 1—May 31, 1956

States and Territories	Medical Institutes and Physicians	Colleges and Universities	Industrial Firms	Federal and State Laboratories	Foundations and Institutes	Other	Total
Alaska	0	0	0	0	0	0	[illegible]
Alabama	0	0	2	0	0	0	[illegible]
Arizona	1	0	0	0	0	0	[illegible]
Arkansas	0	0	0	0	0	0	[illegible]
California	19	0	6	0	0	2	[illegible]
Colorado	1	0	1	0	0	0	[illegible]
Connecticut	2	0	4	0	1	0	[illegible]
Delaware	0	0	0	1	0	0	[illegible]
District of Columbia	1	0	0	0	0	0	[illegible]
Florida	3	0	1	0	0	0	[illegible]
Georgia	1	0	2	0	0	0	[illegible]
Hawaii	0	0	0	0	0	0	[illegible]
Idaho	0	0	1	0	0	0	[illegible]
Illinois	9	1	7	0	0	0	[illegible]
Indiana	4	1	1	0	0	0	[illegible]
Iowa	7	0	0	0	0	0	[illegible]
Kansas	3	0	0	0	0	0	[illegible]
Kentucky	1	0	0	0	0	0	[illegible]
Louisiana	0	0	0	0	0	0	[illegible]
Maine	0	0	3	0	0	1	[illegible]
Maryland	1	0	1	0	0	1	[illegible]
Massachusetts	2	1	7	0	0	0	[illegible]
Michigan	8	0	3	0	0	0	[illegible]
Minnesota	4	2	2	0	0	0	[illegible]
Mississippi	0	0	0	0	0	0	[illegible]
Missouri	8	0	1	0	0	0	[illegible]
Montana	2	0	0	0	0	0	[illegible]
Nebraska	1	0	1	0	0	0	[illegible]
Nevada	0	0	0	0	0	0	[illegible]
New Hampshire	0	0	0	0	0	0	[illegible]
New Jersey	5	0	11	0	0	0	[illegible]
New Mexico	1	0	0	0	0	0	[illegible]
New York	23	0	14	2	1	0	[illegible]
North Carolina	2	0	1	0	0	0	[illegible]
North Dakota	1	0	0	0	0	1	[illegible]
Ohio	4	0	4	0	0	0	[illegible]
Oklahoma	2	0	2	0	0	0	[illegible]
Oregon	1	0	0	0	0		

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LOCATION AND TYPE OF NEW USERS—Continued

Jan. 1–May 31, 1956

States and Territories	Medical Institutes and Physicians	Colleges and Universities	Industrial Firms	Federal and State Laboratories	Foundations and Institutes	Other	Total
Panama	0	0	0	0	0	0	0
Pennsylvania	4	0	7	0	0	0	11
Puerto Rico	2	0	0	0	0	0	2
Rhode Island	0	0	1	0	0	0	1
South Carolina	1	0	1	0	0	0	2
South Dakota	1	0	0	0	0	1	1
Tennessee	1	0	0	0	0	0	2
Texas	10	1	9	1	0	0	21
Utah	0	0	0	0	0	0	0
Vermont	0	0	0	0	0	0	0
Virginia	2	0	4	0	0	0	6
Washington	2	1	0	0	0	0	3
West Virginia	5	0	0	0	0	0	5
Wisconsin	0	0	0	0	1	0	1
Wyoming	1	0	0	0	0	0	1
Total	146	7	97	4	3	6	263

LOCATION AND TYPE OF ALL USERS

Aug. 2, 1946–May 31, 1956

Alaska	1	1	0	1	0	0	3
Alabama	10	3	16	4	2	0	35
Arizona	8	1	2	2	0	0	13
Arkansas	11	1	5	1	0	0	18
California	159	16	140	43	10	6	374
Colorado	30	3	12	4	2	3	54
Connecticut	16	5	48	2	1	0	72
Delaware	2	1	9	2	1	0	15
District of Columbia	15	3	6	17	0	1	42
Florida	26	6	6	4	0	1	43
Georgia	14	5	11	7	0	0	37
Hawaii	5	1	1	2	2	0	11
Idaho	3	1	4	0	0	1	9
Illinois	85	10	94	13	5	2	209
Indiana	24	4	30	0	0.	1	59
Iowa	17	4	9	0	0	0	30
Kansas	18	4	5	0	0	0	27
Kentucky	10	3	12	2	1	2	30
Louisiana	17	5	14	3	0	0	39
Maine	5	3	16	1	0	1	26
Maryland	18	5	22	16	0	2	63
Massachusetts	43	17	95	11	3	3	172
Michigan	43	7	39	2	0	1	92
Minnesota	18	9	11	1	0	0	39
Mississippi	4	1	7	3	0	0	15
Missouri	46	5	14	1	0	1	67
Montana	9	1	0	1	1	0	12
Nebraska	13	3	1	3	0	0	20
Nevada	4	0	3	1	0	0	8
New Hampshire	2	2	3	2	0	0	9
New Jersey	40	4	107	7	6	1	165
New Mexico	10	3	1	3	0	0	17
New York	189	27	166	25	9	6	422
North Carolina	18	6	13	7	0	1	45
North Dakota	7	2	0	1	0	0	10
Ohio	63	9	100	10	3	2	187
Oklahoma	21	1	25	1	3	0	51
Oregon	13	3	3	5	0	1	25
Panama	1	0	0	1	0	0	2
Pennsylvania	67	11	122	11	4	1	216
Puerto Rico	7	1	0	2	0	0	10
Rhode Island	4	2	13	1	0	0	20
South Carolina	5	3	3	2	0	0	13
South Dakota	8	2	0	0	0	0	10
Tennessee	23	4	10	6	0	2	45
Texas	84	7	80	8	4	1	184
Utah	7	3	5	2	0	0	17
Vermont	3	1	2	0	0	0	6
Virginia	14	4	20	8	0	0	46
Washington	16	5	11	7	0	0	39
West Virginia	16	2	7	2	0	0	27
Wisconsin	23	3	40	4	2	0	72
Wyoming	3	1	0	1	1	1	7
Total	1,318	234	1,363	263	60	41	3,279

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SHIPMENTS OF RADIOACTIVE ISOTOPES TO FOREIGN COUNTRIES

Country	Jan. 1, 1956 May 31, 1956	Total Jan. [illegible] to May 31, [illegible]
Argentina	0	[illegible]
Australia	1	[illegible]
Austria	1	[illegible]
Belgian Congo	0	[illegible]
Belgium	5	[illegible]
Bermuda	0	[illegible]
Bolivia [1]	0	[illegible]
Brazil	33	[illegible]
British West Africa	0	[illegible]
Canada	119	[illegible]
Chile	16	[illegible]
China	0	[illegible]
Colombia	9	[illegible]
Costa Rica	0	[illegible]
Cuba	39	[illegible]
Denmark	2	[illegible]
Dominican Republic	0	[illegible]
Egypt	0	[illegible]
El Salvador	1	[illegible]
England	3	[illegible]
Finland	0	[illegible]
France	5	[illegible]
Germany	3	[illegible]
Gold Coast	0	[illegible]
Greece	0	[illegible]
Guatemala	5	[illegible]
Honduras	0	[illegible]
Iceland	0	[illegible]
India	1	[illegible]
Indonesia	0	[illegible]
Ireland [1]	0	[illegible]
Israel	2	[illegible]
Italy	2	[illegible]
Japan	55	[illegible]
Korea [1]	0	[illegible]
Lebanon	0	[illegible]
Mexico	15	[illegible]
Netherlands	4	[illegible]
New Zealand	0	[illegible]
Nicaragua [1]	0	[illegible]
Norway	3	[illegible]
Pakistan	1	[illegible]
Paraguay [1]	0	[illegible]
Peru	10	[illegible]
Philippines	0	[illegible]
Portugal	0	[illegible]
Spain	1	[illegible]
Sweden	16	[illegible]
Switzerland	4	[illegible]
Syria [1]	0	[illegible]
Thailand	0	[illegible]
Trieste	0	[illegible]
Turkey	0	[illegible]
Union of South Africa	0	[illegible]
Uruguay	0	[illegible]
Venezuela	13	[illegible]
Yugoslavia	0	[illegible]
Total	369	[illegible]

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

KIND OF ISOTOPE	Jan. 1, 1956, May 31, 1956	Total Jan. [illegible] to May 31, [illegible]
Phosphorus 32	21	[illegible]
Iodine 131	170	[illegible]
Carbon 14	1	[illegible]
Sulfur 35	2	[illegible]
Iron 55, 59	25	[illegible]
Cobalt 60	20	[illegible]
Strontium 89, 90	12	[illegible]
Calcium 45	9	[illegible]
Other	109	[illegible]
Total	369	[illegible]

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The follow
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133 patents
have been n
granted on a

PATENT No.	
2,725,993	Positi
2,726,336	Calut
2,726,339	Conc
2,726,805	Ion P
2,727,000	Conc ular ides
2,727,150	Calut
2,727,151	Calut
2,727,152	Calut
2,727,154	Radi
2,727,190	Calut
2,727,890	Synt
2,727,995	Leak
2,727,996	Ther Ma
2,728,128	Meth and
2,728,220	Vibr
2,728,717	High
2,728,861	Radi
2,728,867	Gene
2,729,601	Elect
2,729,809	Polar
2,729,815	Swee
2,730,951	Elec
2,731,341	Urar ing
2,731,568	Radi
2,731,590	Poly
2,731,624	Elec
2,732,072	Filte
2,732,127	Diap
2,732,777	Ultr
2,732,807	Diap
2,733,123	Proc
2,733,124	Mar
2,733,125	Rec Pr
2,733,126	Ura
2,733,127	Prec T
2,733,128	Proc Pr
2,733,142	Pur
2,733,202	Elec

[1] Patents liste
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APPENDIX 5

AEC Owned Patents

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

The following 127 U. S. Letters Patents owned by the United States Government as represented by the Atomic Energy Commission are in addition to the patents listed in the Nineteenth Semiannual Report. The patents listed have been made available for licensing at periodic intervals. Licenses are granted on a non-exclusive, royalty-free basis.

Patent No.	Title	Patentee
[illegible] 993	Positioning Device	P. P. Smith, San Antonio, Tex.
[illegible] 336	Calutron Receivers	S. W. Barnes, Rochester, N. Y.
[illegible] 339	Concrete Radiation Shielding Means	L. B. Borst, Center Moriches, N. Y.
[illegible] 605	Ion Pump	E. O. Lawrence, Berkeley, and J. S. Foster, Jr., Livermore, Calif.
[illegible] 000	Concentration of Uranium Isotopes by Molecular Distillation of Uranium Poly Alkoxides	A. K. Brewer, S. L. Madorsky, Washington, D. C. and T. I. Taylor, Leonia, N. J.
[illegible] 150	Calutrons	E. O. Lawrence, Berkeley, Calif.
[illegible] 151	Calutron Receivers	W. E. Parkins, Berkeley, Calif.
[illegible] 152	Calutron Receiver	S. W. Barnes, Rochester, N. Y., W. M. Brobeck, Berkeley, Calif.
[illegible] 154	Radiation Detector	W. W. Goldsworthy, Orinda, Calif.
[illegible] 190	Calutron	W. M. Powell, Berkeley, Calif.
[illegible] 890	Synthesis of an Aldohexoside of a Flavonol	S. H. Wender, Norman, Okla.; C. H. Ice, Aiken, S. C.
[illegible] 995	Leak Detector	R. Loevinger, Berkeley, Calif., T. A. Chubb and G. W. Monk, Oak Ridge, Tenn.
[illegible] 996	Thermal Neutron Shield and Method for Making Same	T. Rockwell, III, Bethesda, Md.; V. L. McKinney, Jensen Beach, Fla.
[illegible] 128	Method of Producing Boron Carbide Articles and Product Thereof	C. Sheer, New York, N. Y.; J. Tittman, W. Orange, N. J.
[illegible] 220	Vibration Measuring Apparatus	M. J. Willner, Sandia Base, Albuquerque, N. Mex.
[illegible] 717	High Vacuum Distillation Apparatus	S. L. Madorsky, Wash., D. C.
[illegible] 861	Radiation Pocket Screamer	F. M. Glass, Oak Ridge, Tenn.
[illegible] 867	Generation of Power	V. C. Wilson, Santa Fe, N. Mex.
[illegible] 601	Electroplating on Beryllium	J. G. Beach and C. L. Faust, Columbus, Ohio
[illegible] 909	Polarity Selector	R. G. Hester, Redondo Beach, Calif.
[illegible] 815	Sweep Circuit	G. B. Andrews, Royal Oak; R. L. DeVoll, Grosse Point; and W. X. Lamb, Detroit, Mich.
[illegible] 951	Electromagnetic Centrifugal Pump	K. O. Donelian, Jackson Heights, N. Y.; J. R. Menke, Riverdale, N.Y.
[illegible] 341	Uranium-Silicon Alloy and Process of Producing Same	A. R. Kaufmann, Lexington, Mass.
[illegible] 568	Radiation Detection Device	G. Failla, New York, N. Y.
[illegible] 590	Polyphase Voltage Generator	B. H. Smith, Berkeley, Calif.
[illegible] 624	Electromagnetic Rod-Position Indicator	D. Krucoff, Chicago, Ill.
[illegible] 072	Filtering Apparatus	R. W. Dodson, Patchogue, N. Y.; G. Friedlander, Bluepoint, N. Y.; L. Helmholz, St. Louis, Mo.; and P. H. Watkins, Cambria, Va.
[illegible] 127	Diaphragm Pump	E. T. Booth, New York, N. Y.
[illegible] 777	Ultra High Speed Light Shutter	B. Brixner, Los Alamos, N. Mex.
[illegible] 807	Diaphragm Pump	V. L. Parsegian, New York, N. Y.
[illegible] 123	Production of UCl_4	M. B. Reynolds, Glenville, N. Y.; H. L. Pickering, Tulsa, Okla.
[illegible] 124	Manufacture of Uranium Tetrachloride	S. Rosenfeld, Berkeley, Calif.
[illegible] 125	Recovery of Uranium from Waste Metal Products	L. Spiegler, Woodbury, N. J.
[illegible] 126	Uranium Liberation	L. Spiegler, Woodbury, N. J.
[illegible] 127	Precipitation of Fluoride-Free Uranium Tetroxide.	L. Spiegler, Woodbury, N. J.
[illegible] 128	Process for the Recovery of Uranium in the Presence of Iron.	A. E. Ballard, Oak Ridge, Tenn.
[illegible] 142	Purification of Nickel Powder	J. W. Glenn, Kenmore, N. Y.
[illegible] 202	Electrolytic Cells	R. Q. Boyer, Berkeley, Calif.

[1] Patents listed as of May 30, 1956. Applicants for licenses should apply to Chief, Patent Branch, Office of the General Counsel, U. S. Atomic Energy Commission, Washington 25, D. C., identifying the subject matter by patent number and title.

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Patents Issued to the Commission Which Are Available for Licensing—Continued

Patent No.	Title	Patentee
2,733,342	Regulator for Calutron Iron Source	L. F. Wouters, Oakland, Calif.
2,733,343	Ionization Source	M. G. Inghram, Chicago, Ill., W. A. Chupka, Cambridge, Mass.
2,733,344	Ion Generator Regulator	R. DeLiban, Berkeley, Calif.
2,733,345	Regulator for Calutron Ion Source	L. F. Wouters, Oakland, Calif.
2,733,346	Ion Producing Mechanism	F. Oppenheimer, Berkeley, Calif.
2,733,347	Regulator for Calutron Ion Source	R. DeLiban, Berkeley, Calif.
2,733,348	Ion Source Units	E. J. Lawton and J. M. Lafferty, Schenectady, N. Y.
2,733,349	Calutron	E. O. Lawrence and W. M. Brobeck, Berkeley, Calif.
2,733,350	Calutron Control Circuit	K. R. MacKenzie, Richmond, Calif. and W. M. Brobeck, Berkeley, Calif.
2,734,042	Protective Coating Composition Comprising a Polymer of Chloroprene and an Alkaline Earth Metal Fluoride.	A. J. Carter, R. C. Hansen and C. M. Heiss, Detroit, Mich.
2,734,678	Magnetic Control Device for Pumps	T. H. Edwards, Richland, Wash.
2,734,795	Process for Preparation of Chlorides of Uranium.	E. C. Evers and C. J. Carignan, Cranston, R. I.
2,735,044	Magnetic Field Regulator	K. G. Macleish, Rochester, N. Y.
2,735,745	Oxidation of Uranosic Oxide to Uranium Trioxide with Nitric Acid Vapor.	E. R. Flook and R. G. Sweet, Kenmore, N. Y.
2,735,746	Method of Producing Uranium Tetrachloride.	H. R. McCombie, Pittsburg, Calif. E. L. Wagner, Oak Ridge, Tenn.
2,735,761	Ternary Uranium Alloy	F. A. Rough and H. A. Saller, Columbus, Ohio
2,735,811	Reactor Control	A. M. Weinberg, Oak Ridge, Tenn.; P. Morrison, Pittsburgh, Pa.; L. A. Ohlinger & G. J. Young, Chicago, Ill.
2,735,857	Uranium Alkoxy Compounds and Method of Preparing Same.	H. Gilman, Ames, Iowa; E. Bindschadler, Forest Hills, Pa.
2,735,943	Automatic Vapor Control	B. T. Wright, Los Angeles and W. R. Baker, Berkeley, Calif.
2,735,963	Suppressor Circuit	W. R. Baker and Q. A. Kerns, Berkeley, Calif.
2,736,634	Process for Extracting Uranium from Its Ores	A. M. Gaudin, Newtonville, and R. Schumann, Jr., Winchester, Mass.
2,736,651	Zirconium Ternary Alloys	A. D. Schwope, Cleveland and W. Chubb, Columbus, Ohio.
2,736,696	Reactor	E. P. Wigner, L. A. Ohlinger, G. J. Young, Chicago, Ill., and A. M. Weinberg, Oak Ridge, Tenn.
2,736,700	Lubricant for Cold Drawing of Thorium Wire	C. D. Graham, Jr., Birmingham, England, R. J. Donley, Elyria, Ohio.
2,736,801	Distributed Pulse Height Discriminator	C. E. Wiegand, Oakland and O. Chamberlain, Berkeley, Calif.
2,736,802	Pulse Height Analyzer System	L. Cranberg, Los Alamos, N. Mex.
2,736,806	Blocking Oscillator	J. C. Miller, Albuquerque, N. Mex.
2,736,808	Ion Producing Mechanism	W. M. Brobeck, Berkeley, Calif.
2,736,809	Ion Generator and Projector	C. G. Bacon, Oak Ridge, Tenn.
2,736,810	Charge Receptacles for Use in Ion Source Units.	A. F. Clark, Berkeley, Calif.
2,736,811	Calutron Receiver	H. F. Weaver, Berkeley, and C. M. Van Atta, Los Angeles, Calif.
2,736,812	Radioactivity Measuring Apparatus	A. I. Weinstein, Patchogue, and F. T. Bonner, Brooklyn, N. Y.
2,736,817	Pocket Radiation Meter	P. R. Bell, Jr., Oak Ridge, Tenn.
2,736,818	Measuring Device and Apparatus	F. R. Shonka, Riverside, Ill.
2,737,438	Recovery of Uranium from Gold	A. M. Gaudin, Newtonville, Mass.
2,737,439	Cyclic Processes of Producing UCl_4	J. M. Carter, Pasadena, Calif.
2,737,589	Ion Source for a Calutron	W. M. Brobeck, Berkeley, Calif.
2,737,590	Ion Source for a Calutron	E. J. Lofgren, Berkeley, Calif.
2,737,779	Condensable Vapor Extraction Apparatus	E. O. Lawrence, Berkeley, Calif.
2,738,346	Method for the Separation of Flavonoid Compounds.	S. H. Wender, Norman, Okla., C. H. Ice, Aiken, S. C.
2,738,426	Liquid Monitoring Device	W. M. Hurst, Oak Ridge, Tenn.
2,739,111	Metal Production by Electrolysis	R. A. Noland and C. Marzano, Chicago, Ill.
2,739,237	Amplifier Circuit	J. J. Stone, Jr., Clinton, Tenn.
2,739,285	Current Measuring Device	A. A. Windsor, Berkeley, Calif.
2,739,286	Alpha Survey Meter Circuit	R. W. Schede, Oak Ridge, Tenn.
2,739,566	Apparatus for the Production of Coatings of Purified Metals.	Z. M. Shapiro and J. McDonald, Pittsburgh, Pa.
2,739,935	Electrolytic Cutting of Metals	G. L. Kehl, Leonia, N. J.; I. Moch, Jr., New York, N. Y.
2,739,979	Preparation of Boric Acid Esters	R. F. Barnes, Joliet, and H. Diamond and P. R. Fields, Chicago, Ill.
2,741,541	Production of Uranium Sulphate	S. B. Smith, Woodstown, N. J.
2,741,543	Process for the Production of Deuterium Oxide.	H. C. Urey, Leonia, N. J.
2,741,592	Neutronic Reactor Measuring and Safety Rod Operating Apparatus.	L. B. Borst, Sayville, N. Y.; H. W. Newson, Oak Ridge, Tenn.
2,741,593	Fluid Cooled Neutronic Reactor	H. E. Metcalf, H. W. Johnson and R. S. Chisholm, Chicago, Ill.

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Patents issued to the Commission which are available for licensing—Continued

Patent No.	Title	Patentee
2,741,627	Production of Curium 243	S. G. Thompson, Richmond; B. B. Cunningham, Berkeley; and A. Ghiorso, Alameda, Calif.
2,741,628	Separation of Hafnium and Zirconium Salts	W. K. Plucknett, Tuckahoe, N. Y.
2,742,576	Portable Scintillation Survey Meter	R. A. Dandl, Auburn, Ala.
2,742,587	Demountable Filament Assembly	W. J. Armstrong, P. I. Corbell and K. H. McPhee, Cedar Rapids, Iowa.
2,742,788	Sewer Sampler	P. V. Henton, Pine Lawn, Mo.
2,743,154	Method of Recovery of Uranium by a Resin-in-Pulp Process.	D. Kaufman, Winchester, and G. W. Lower, Lexington, Mass.
2,743,155	Method of Preparing the Double Halide Salts of Thorium and Alkali Metals.	S. Z. Cardon, Euclid, Ohio.
2,743,156	Uranium Recovery Process	M. C. Metziger, A. Long and E. M. Stoltz, Jr., Joliet, Ill.
2,743,157	Re-extraction of Uranium from Organic Solvents.	F. T. Hagemann, Chicago; L. I. Katzin, Plainfield; and N. N. Hellman, Peoria, Ill.
2,743,158	Process for Producing Uranium Pentachloride	A. D. Webb, Oak Ridge, Tenn.; H. P. Kyle, Los Altos, Calif.
2,743,159	Recovery of Uranium from Aqueous Solutions.	G. A. Lutz, Columbus, Ohio.
2,743,161	Preparation of Anhydrous Vanadium Trifluoride.	D. E. Carpenter, C. P. Johnston, H. P. House and K. O. Johnsson, Oak Ridge, Tenn.
2,743,168	Sublimation Apparatus	R. Krohn, Berkeley, Calif; R. J. Schmidt, Oak Ridge, Tenn.
2,743,169	Horizontal Sublimation Apparatus	J. C. Hecker, Oak Ridge, Tenn.
2,743,170	Solvent Extraction Equipment	L. L. Burger, Richland, Wash.
2,743,173	Method of Preparing Metal and Apparatus Therefor.	G. Derge, Aspinwall, Pa.; G. P. Monet, Oak Ridge, Tenn.
2,743,174	Uranium-Titanium Alloys	J. R. Keeler and H. A. Saller, Columbus, Ohio.
2,743,222	Electrolytic Process for Recovering Uranium Compounds from Carbonate Leach Liquors.	G. W. Clevenger, Newtonville, Mass.
2,743,223	Organic Compound Bond Rupturing Process	L. T. McClinton, Chicago, Ill.; W. M. Garrison, Walnut Creek, Calif.; M. Burton, Mishawaka, Ind.
2,743,224	Submerged Reactor	L. A. Ohlinger, Chicago, Ill.
2,743,225	Reactor	L. A. Ohlinger, Chicago, Ill.; E. P. Wigner, Princeton, N. J.; G. J. Young and A. M Weinberg, Oak Ridge, Tenn.
2,743,226	Apparatus for the Bombardment of Samples with Fast Neutrons.	H. W. Newson, Durham, N. C.
2,743,228	Electrolytic Cells	R. Q. Boyer, Berkeley, Calif.
2,743,342	Magnetic Arc-Welder	E. S. Bettis, Fountain City, Tenn. E. R. Mann, Oak Ridge, Tenn.
2,743,371	Electronic Analyzer	Q. A. Kerns, Berkeley, Calif.
2,743,372	Low Weight Container for Radioactive Materials.	H. J. Browne and N. B. Garden, Berkeley, Calif.
2,743,416	Magnetic Field Measuring Device	J. M. Kelly, Jr., Seattle, Wash.
2,744,064	Re-Entrant Cooling Reactor	T. V. Moore, Queens, N. Y.
2,745,279	Pressure Testing Device and Method	P. E. Collins and Guy M. Inman, Richland, Wash.
2,745,552	Filter with Fractional Crystallization Means	W. H. Bruggeman, Watervliet, N. Y. B. G. Voorhees, Schenectady, N. Y.
2,745,964	Arc Regulator for Calutron Ion Source	R. DeLiban, Berkeley, Calif.
2,745,965	Calutron Receivers	E. J. Lofgren, Berkeley, Calif.
2,746,473	Valve Means for Charging Containers with Fluid.	L. A. Ohlinger, Chicago, Ill.
2,746,861	Ternary Zirconium Base Alloy Containing Sn and Ti.	W. Chubb, Jr. and L. L. Marsh, Jr., Columbus, Ohio.
2,747,126	Power or Voltage Measuring Means	D. J. Nigg, Prairie Village, Kan.
2,747,762	Pressure Chamber Closure Apparatus	R. B. Meuser, Oakland, Calif.
2,747,972	Charge Boat for Volatilization	Roy Krohn, Berkeley, Calif.

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APPENDIX 6

Publications of the U. S. Atomic Energy Commission

Listed here are a number of special publications sponsored by the AEC. In addition, the AEC encourages project scientists to submit nonclassified articles for publication in the established scientific and technical journals. Hundreds of reports, not published elsewhere, may be obtained from the Office of Technical Services, Department of Commerce, Washington 25, D. C. Lists of titles and prices of these reports are available from the Office of Technical Services. Essentially complete collections of the AEC's nonclassified reports are available in a number of libraries (see pages 167–168). Guides to the published and report literature may be found in Nuclear Science Abstracts (see page 164).

Semiannual Reports to Congress

The AEC semiannual reports to Congress on the progress of the Commission's program are published and made available to the public by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. An alternate title, indicating the principal subject of the report, has been given to each of the later reports. Indexes to the semiannual reports are also available from the Superintendent of Documents.

First Semiannual Report, January 1947.

Second Semiannual Report, July 1947.

Third Semiannual Report, January 1948.

Fourth Semiannual Report, *Recent Scientific and Technical Developments in the Atomic Energy Program of the United States*, July 1948. 35 cents.

Fifth Semiannual Report, *Atomic Energy Development, 1947–1948*, January 1949. 45 cents.

Sixth Semiannual Report, *Atomic Energy and the Life Sciences*, July 1949. 45 cents.

Seventh Semiannual Report, *Atomic Energy and the Physical Sciences*, January 1950. 50 cents.

Eighth Semiannual Report, *Control of Radiation Hazards in the Atomic Energy Program*, July 1950. 50 cents.

Ninth Semiannual Report, *AEC Contract Policy and Operations*, January 1951. 40 cents.

Tenth Semiannual Report, *Major Activities in the Atomic Energy Programs, January–June 1951*, July 1951. 35 cents.

Eleventh Semiannual Report, *Some Applications of Atomic Energy in Plant Science*, January 1952. 50 cents.

Twelfth Semiannual Report, *Major Activities in the Atomic Energy Programs, January–June 1952*, July 1952. 35 cents.

Thirteenth Semiannual Report, *Assuring Public Safety in Continental Weapons Tests*, January 1953. 50 cents.

Fourteenth Semiannual Report, *Major Activities in the Atomic Energy Programs, January–June 1953*, July 1953. 30 cents.

Fifteenth Semiannual Report, *Major Activities in the Atomic Energy Programs, July–December 1953*, January 1954. 45 cents.

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Sixteenth Semiannual Report, *Major Activities in the Atomic Energy Programs, January–June 1954*, July 1954. 45 cents.

Seventeenth Semiannual Report, *Major Activities in the Atomic Energy Programs, July–December 1954*, January 1955. 45 cents.

Eighteenth Semiannual Report, *Major Activities in the Atomic Energy Programs, January–June 1955*, July 1955. 50 cents.

Nineteenth Semiannual Report, *Major Activities in the Atomic Energy Programs, July–December 1955*, January 1956. 60 cents.

Cumulative Index to the First Fifteen Semiannual Reports to Congress, January 1947–December 1953. 35 cents.

Index to the Sixteenth Semiannual Report to Congress, January–June 1954. 10 cents.

Index to the Seventeenth Semiannual Report to Congress, July–December 1954. 15 cents.

Index to the Eighteenth Semiannual Report to Congress, January–June, 1955. 20 cents.

Index to the Nineteenth Semiannual Report to Congress, July–December 1955. 15 cents.

General Publications

The following is a list of nontechnical publications pertaining to atomic energy or the administration of the AEC programs, and available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

Selected Readings on Atomic Energy, November 1955, a bibliography of official publications, books, magazines, pamphlets and teaching units for educators, and indexes and bibliographies on atomic energy, 53 pages, 25 cents.

Isotopes—An 8-Year Summary of Distribution, March 1955, a detailed account of isotope utilization during the first 8 years of the Commission's distribution program. It is also a supplement of the 3-year and 5-year reports of similar title issued by the Commission in 1949 and 1951. This report is a useful reference to the uses of isotopes and a bibliography of published articles on isotope work, 364 pages, $2.00.

Prospecting for Uranium, revised October 1951, a nontechnical booklet prepared by the United States Geological Survey and AEC describing the uranium-bearing minerals, where to look for them, and instruments to use in prospecting and in laboratory testing and analysis of ores. It contains six color plates of principal minerals. Laws, regulations, and price schedules for uranium-bearing ores are included, 128 pages, 55 cents.

Prospecting with a Counter, revised July 1954, a summary of information on field counters, their operation, use, abuse, and their application to prospecting, mining and geologic problems, 68 pages, 30 cents.

Selling to AEC, revised 1955, provides certain basic information helpful to those who want to do business with the AEC or its contractors. It indicates who does the buying, what is bought, where procurement offices are located, and other general information, 28 pages, 25 cents.

Guide for Contracting of Construction and Related Engineering Services, revised January 1955, gives AEC policy on awarding contracts for construction and architect-engineering services, procedures followed when requests for bids are formally advertised and when contracts are negotiated. Operations offices and officials responsible for letting such contracts are listed, 16 pages, 15 cents.

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TECHNICAL PUBLICATIONS

The items listed below, together with the National Nuclear Energy Series described in the next section, are publications of scientific and technical interest.

Books

Principles of Nuclear Reactor Engineering, Samuel Glasstone, D. Van Nostrand Co., N. Y., 1955, is written for the student and the practicing engineer. An overall review of the fundamental scientific principles upon which reactor engineering is based, 861 pages, $7.95.

The Elements of Nuclear Reactor Theory, Samuel Glasstone and Milton C. Edlund, D. Van Nostrand Co., N. Y., 1952, is written for scientists, engineers, and advanced students interested in the field of nuclear reactors. It explains the physical concepts and processes involved in a nuclear chain reaction and the methods for calculating critical conditions for chain reacting systems, 416 pages, $4.80.

Sourcebook on Atomic Energy, Samuel Glasstone, D. Van Nostrand Co., N. Y., 1950, presents a comprehensive, technical description of the theory, history, development, and uses of atomic energy. Chapters are included on the structure of the atom, radioactivity, isotopes, neutron research, acceleration of charged particles, and other phases of nuclear science, 546 pages, $3.75.

Energy in the Future, Palmer Cosslett Putnam, D. Van Nostrand Co., N. Y., 1953, presents a study of the problem of where we can find sources of low-cost energy in an abundance equal to the maximum plausible demands by the expanding and industrializing populations of the future, and what is the maximum plausible role that nuclear fuels may be called on to play in the next 50 years, or so, 556 pages, $12.75.

The Effects of Atomic Weapons, 1950, prepared for the Department of Defense and the AEC by a board of editors under the direction of the Los Alamos Scientific Laboratory, presents a technical summary of the results to be expected from the detonation of atomic weapons, with chapters describing an atomic explosion, the shock from air, underwater, and underground bursts; blast, radiation, and fire effects; methods of protecting personnel; and decontamination methods, 456 pages, $1.25.[1]

Introduction to the Theory of Neutron Diffusion, Volume I, 1954, is intended for purposes of research in physics and mathematics as well as teaching on the graduate level. This monograph, presenting work sponsored by the Los Alamos Scientific Laboratory, gives a detailed discussion of the general equations of one-velocity neutron diffusion theory and of their solution for the special case of a homogeneous infinite medium with isotropic scattering. Emphasis is placed on fairly complete tables and graphs, 174 pages, $1.25.[1]

The Metal Beryllium, edited by D. W. White and J. E. Burke, American Society for Metals, Cleveland, Ohio, 1955, presents basic information on the element beryllium, and covers all aspects of beryllium technology for the use of workers in the field, with emphasis on the possible uses of beryllium in atomic energy work, 703 pages, $8.

[1] Available from Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

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Manuals, Handbooks and Reports

Nuclear Power Reactor Technology, May 1953, reports to the U. S. Atomic Energy Commission by four separate teams of industrial representatives appraising the prospect for possible nuclear power development. Studies were made to determine the engineering feasibility for designing, constructing and operating dual-purpose reactors to produce fissionable material and power, and to recommend industry's role in designing, building, and operating such reactors, 88 pages, 25 cents.[1]

Nuclear Power Reactors, Volume II, March 1955 (submitted October 1953), reports to the U. S. Atomic Energy Commission of two teams of industrial representatives. Appraises the practicability of building a nuclear reactor for the generation of central-station power. The study group undertook to determine whether any of the known reactor systems can be shown to be technically and economically feasible, and competitive for central-station power. Studies were made on the projected possibilities of different reactor systems, 30 pages, 15 cents.[1]

Handbook on Aerosols, 1950, contains chapters from the National Defense Research Committee Summary Technical Report, Division 10, declassified by the Army at the request of AEC, on the properties and behavior of aerosols, principles and instruments used in meteorology studies, and information useful in studies of the disposal of gaseous radioactive wastes, the dispersal of insecticides, the disposal of industrial gases, etc., 147 pages, 70 cents.

Handbook on Air Cleaning—Particulate Removal, Sheldon K. Friedlander, Leslie Silverman, Philip Drinker and Melvin W. First, Harvard University, September 1952, a compilation of data resulting from the study of air cleaning equipment and procedures. Such studies applied principally to the removal of radioactive dust and contamination from exhaust gases, etc., 89 pages, 45 cents.[1]

Liquid Metals Handbook, second edition (revised) January 1954, R. N. Lyon et al., compiled by the Department of the Navy and AEC, summarizes current information on the physical and chemical properties of liquid metals, their present industrial uses, and their use and potentialities as heat-transfer media, 269 pages, $1.25.[1]

Liquid Metals Handbook, third edition, 1955 (Sodium and NaK Supplement), edited by C. B. Jackson, compiled by the Department of the Navy and AEC, presents a significant amount of experimental data and analysis of thermal shock and thermal stresses, convective flow and mass transfer, mainly applicable to Sodium and NaK, 445 pages, $2.00.[1]

Handling Radioactive Wastes in the Atomic Energy Program, revised August 1951, reports on the sources and types of radioactive wastes in atomic energy operations, methods developed for their safe handling and disposal, and methods specified for the safe handling of radioisotopes by private users, 30 pages, 15 cents.[1]

Trilinear Chart of Nuclear Species, W. H. Sullivan, John Wiley & Sons, Inc., N. Y., 1949, shows physical data for all the nuclear species known as of June 1949, $2.50.

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[1] Available from Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

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Neutron Cross Sections, May 15, 1952, revised to include supplementary editions to 1955, a compilation of data in tabular and graphic form prepared by the AEC Neutron Cross Section Advisory Group. Cross section values for nuclides, elements, and compounds are given for neutrons ranging in energy from 0.000 electron volts to 100 Mev., 336 pages, $3.50.[1]

Reactor Handbook, provides a condensed and reliable source of nuclear reactor data.

Volume I.—*Physics*, two sections, Reactor Physics and Radiation Shielding 804 pages, $4.25.[1]

Volume II.—*Engineering*, eight sections. Light- and Heavy-water-cooled Systems, Liquid-metal-cooled Systems, Gas-cooled Systems, Aqueous Fuel Systems, Liquid-Metal Fuel Systems, Fused Salt Systems, Handling and Control, and Reactor Designs, 1088 pages, $5.50.[1]

Volume III.—*General Properties of Materials*, 610 pages, $3.50.[1]

Isotopes in Medicine, comprises a collection of papers presented at the September 1953 training course of the Medical and Special Training Divisions of ORINS. This publication covers the entire field of clinical isotope use. Discussion sessions are summarized and edited.

High Voltage Problems, J. D. Trimmer and Harry Pearlman, Clinton Engineer Works—Tennessee Eastman Corporation, Oak Ridge, Tenn., 1951, presents an account of work done in connection with the high voltage systems used in the electromagnetic separation process. Sparking and insulator breakdowns are treated in detail, 226 pages, $185.[2]

Vacuum Problems and Techniques, C. E. Normand, Frank A. Knox, G. W. Monk, Alan A. Samuel, W. R. Perret, Clinton Engineer Works—Tennessee Eastman Corporation, Oak Ridge, Tenn., 1950, describes and evaluates the original vacuum equipment required in the operation of the electromagnetic separation process. It presents significant improvements in efficiency resulting from changes in operating techniques, and brings together information widely spread throughout the literature, 265 pages, $1.75.[2]

Research Reactors, a volume describing the nuclear research reactors developed in the national atomic energy program. The document was prepared to present the details of the U. S. program to delegates attending the International Conference on the Peaceful Uses of Atomic Energy, Geneva, Switzerland, 1955, 452 pages, $2.00.[1]

Chemical Processing and Equipment, like *Research Reactors* described above, was prepared for the benefit of delegates to the International Conference. It describes the chemical and engineering aspects of processing materials associated with nuclear reactors. It includes descriptions of radio-chemical laboratories, remote control handling equipment, and the like, 1955, 302 pages, $2.00.[1]

Radioisotopes in Medicine, edited by Gould A. Andrews, Marshall Brucer, Elizabeth B. Anderson, is the published proceedings of the second advanced training course given by the Oak Ridge Institute of Nuclear Studies. The course was concerned with specialized medical application emphasizing more direct clinical uses of radioisotopes. Chapters include tumor localization, diagnostic and therapeutic uses of radioiodine, therapy with radioactive colloids and other phases of medical utilization of radioisotopes, 817 pages, $5.50.[1]

[1] Available from Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

[2] Available from Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C.

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Nuclear Level Schemes, K. Way, R. W. King, C. L. McGinnis, R. van Lieshout, 1955, is a ready reference source of nuclear information consisting of a collection of diagrams showing positions and properties of nuclear energy levels, characteristics of radioactive decay and nuclear reactions, together with a tabular compilation of the experimental data and bibliographic references to the original paper, 221 pages, $1.75.[1]

The Chemistry and Metallurgy of Miscellaneous Materials, edited by Laurence L. Quill, 1955, consists of individual papers dealing with miscellaneous chemical, metallurgical and structural subjects, 172 pages, $1.00.[2]

Determination of the Isotopic Composition of Uranium, edited by A. E. Cameron, 1950, presents some of the solutions to problems encountered in the adaptation of known methods and principals to the routine determination of the isotopic composition of uranium, 166 pages, $1.52.[2]

Electrical Equipment for Tanks and Magnets, edited by C. R. Baldock and E. D. Hudson, 1947, presents an account of the electrical engineering phases of the electromagnetic separation process as they related to electrical equipment used in the separation of isotopes, 401 pages, $2.65.[2]

Magnets and Magnetic Measuring Techniques, edited by R. K. Wakerling and A. Guthrie, 1949, is a report of the successful adaptation of the mass spectrographic method of separating uranium isotopes to an electromagnetic separation plant, with emphasis upon magnets and associated measuring techniques, 213 pages, $1.45.[2]

Electrical Circuits for Calutrons, edited by R. K. Wakerling and A. Guthrie, 1949, is a report of the successful adaptation of the mass spectrographic method of separating uranium isotopes to an electromagnetic separation plant, with emphasis upon electrical circuiting, 280 pages, $1.85.[2]

Electromagnetic Separation of Isotopes in Commercial Quantities, edited by R. K. Wakerling and A. Guthrie, 1949, is a report of the successful adaptation of the mass spectrographic method of separating uranium isotopes to an electromagnetic separation plant, and describes the production of isotopes by the electromagnetic separation process in commercial quantities, 434 pages, $2,65.[2]

Sources and Collectors for Use in Calutrons, edited by R. K. Wakerling and A. Guthrie, is a report of the successful adaptation of the mass spectrographic method of separating uranium isotopes to an electromagnetic separation plant, and describes the sources and collectors for use in calutrons, 1949, 273 pages, $1.85.[2]

Problems of Physics in the Ion Source, edited by Arthur H. Barnes, S. M. MacNeille, Chauncey Starr, presents the fundamental processes involved in the operation of calutron source units, and describes the experiments that enabled the investigators to determine these processes, 1951, 294 pages, $1.50.[2]

Reactor Shielding Design Manual, edited by Theodore Rockwell, III, 1956, describes the procedures and data which are used in the design, construction and testing of shielding for the reactor plants of the naval reactors program and for the Shippingport pressurized water reactor, 466 pages, $2.10.[1]

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[1] Available from Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

[2] Available from Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C.

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Periodicals and Catalogs

Nuclear Science Abstracts, issued twice a month by the AEC Technical Information Service, contains abstracts of all-current AEC declassified and unclassified reports, of non-AEC reports related to atomic energy, and of articles appearing in both of foreign and domestic periodical literature, $6 per year. ($8 per year foreign.) [1]

Isotopes—Catalog and Price List, Oak Ridge National Laboratory, Oak Ridge, Tenn., July 1952, lists and describes radioactive and stable isotopes available from ORNL and includes prices and instructions for ordering the isotopes, $1 per copy.

THE NATIONAL NUCLEAR ENERGY SERIES

These volumes were written by the scientists who performed the research and development on the atomic energy enterprise under the Manhattan Engineer District and later under the Atomic Energy Commission. The following volumes have been published for the AEC project by the McGraw-Hill Book Co., New York, N. Y.

Division I: The Electromagnetic Separation Process

Vacuum Equipment and Techniques, vol. 1, edited by A. Guthrie and R. K. Wakerling, 1949, describes the development and study of high vacuum equipment and high vacuum systems for the large-scale separation of isotopes by the electromagnetic process, 264 pages, $3.75.

The Characteristics of Electrical Discharges in Magnetic Fields, vol. 5, edited by A. Guthrie and R. K. Wakerling, 1949, cover most of the significant studies by the University of California Radiation Laboratory on electrical discharges with emphasis on studies of electrical discharges in vapors of uranium compounds, 376 pages, $5.

Division II: Gaseous Diffusion Project

Engineering Developments in the Gaseous Diffusion Process, vol. 16, edited by M. Benedict and C. Williams, 1949, describes a number of mechanical, electrical, and chemical engineering developments related to the operation and handling of materials used in the gaseous diffusion process—principally special plant instruments, vacuum engineering, development of heat-transfer equipment, and absorption of uranium hexafluoride and fluorine, 129 pages, $2.

Division III: Special Separations Project

The Theory of Isotope Separation, vol. 1B, by Karl Cohen, 1951, presents the theory of cascades as generally applicable to the problems of isotope separation. Different types of centrifuges and other methods of separation are also discussed, 165 pages, $2.50.

Spectroscopic Properties of Uranium Compounds, vol. 2, edited by G. H. Dieke and A. B. F. Duncan, 1949, presents data compiled from a comprehensive study of the absorption and fluorescence spectra of uranium compounds and describes the experimental techniques used in the studies, 290 pages, $4.25.

Physical Properties and Analysis of Heavy Water, vol. 4A, by I. Kirschenbaum. 1951, describes the physical properties of heavy water, chemical equilibria or exchange reactions and methods of isotopic analysis, 438 pages, $6.

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[1] Available from Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

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Bibliography of Research on Heavy Hydrogen Compounds, vol. 4C, compiled by A. H. Kimball, edited by H. C. Urey, and I. Kirschenbaum, 1949, contains about 2,000 references to published literature on research with heavy hydrogen. References are arranged by subject with an index of the hydrogen compounds and authors, 350 pages, $4.75.

Production of Heavy Water, vol. 4F, edited by G. M. Murphy, is being compiled from works of other authors. It will present laboratory pilot-plant studies for various separation processes investigated and engineering surveys of actual production plants with descriptions of their operations, 394 pages, $5.25.

Division IV: Plutonium Project

Optical Instrumentation, vol. 8, edited by G. S. Monk and W. H. McCorkle, 1954, contains useful and practical techniques and methods of optical instrumentations in nuclear research. It is a summary of the optics work carried out as part of the plutonium project, 262 pages, $3.75.

Radiochemical Studies: The Fission Products, vol. 9, edited by C. D. Coryell and N. Sugarman, 1951, presents 336 original research papers on the techniques and results of radiochemical studies of uranium and plutonium fission products, 2,086 pages (in 3 parts), $27.75.

The Actinide Elements, vol. 14A, edited by G. T. Seaborg and J. J. Katz, 1954, is a companion volume to vol. 14B, Division IV, NNES, *The Transuranium Elements*, published in 1949, and summarizes available information on the elements in the actinide series. Also included is an Index for the Transuranium Elements, 870 pages, $11.75.

The Transuranium Elements, Research Papers, vol. 14B, edited by G. T. Seaborg, J. J. Katz, and W. M. Manning, 1949, includes 163 research papers on neptunium, plutonium, americium, curium, and several of the heavy elements related to them, and historical summaries of transuranium element research, 1,733 pages (in 2 parts), $23.75.

The Chemistry and Metallurgy of Miscellaneous Materials; Thermodynamics, vol. 19B, edited by L. L. Quill, 1949, contains 10 research papers on the thermodynamic properties of the elements and several of their compounds, 329 pages, $4.50.

Industrial Medicine on the Plutonium Project, vol. 20, edited by R. S. Stone, 1951, describes the medical program established for the care and protection of workers on the plutonium project, 511 pages, $7.

Biological Effects of External X- and Gamma Radiation, part I, vol. 22B, edited by R. E. Zirkle, 1954, deals with radiological research and investigations performed at the National Cancer Institute of the effects of continuous X- and gamma irradiation on life span, weight, blood picture, and breeding behavior of small laboratory mammals, 530 pages, $7.25.

Biological Effects of External Beta Radiation, vol. 22E, edited by R. E. Zirkle, offers a collection of original reports on the effects of beta rays applied to the surface of the mammalian body, 242 pages, $3.50.

Histopathology of Irradiation from External and Internal Sources, vol. 22I, edited by W. Bloom, 1948, is an advanced treatise on the histopathological and cytological effects of total-body irradiation, 808 pages, $10.75.

Toxicology of Uranium, vol. 23, edited by A. Tannenbaum, 1950, describes the studies made on the distribution, accumulation, excretion, and chemical and physiological effects of uranium and uranium compounds in the animal body. 323 pages, $4.75.

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Division V: Los Alamos Project

Electronics: Experimental Techniques, vol. 1, edited by W. C. Elmore and M. L. Sands, 1948, describes a number of complete circuits and circuit elements developed at Los Alamos for making nuclear and other physical measurements, 417 pages, $5.50.

Ionization Chambers and Counters: Experimental Techniques, vol. 2, edited by B. Rossi and H. Staub, 1949, describes the physical principles of ionization chambers and counters, and includes previously unpublished project developments by scientists at the Los Alamos Laboratory, 243 pages, $3.25.

Miscellaneous Physical and Chemical Techniques of the Los Alamos Project, vol. 3, edited by A. C. Graves and D. K. Froman, describes a variety of laboratory techniques used at Los Alamos in early studies. Drawings and diagrams of the laboratory and apparatus are given, 323 pages, $4.25.

Division VI: University of Rochester Project

Pharmacology and Toxicology of Uranium Compounds, vol. 1, edited by C. Voegtlin and H. C. Hodge. Parts I and II, published in 1949, summarize the results of 3 years research on the toxicity of various uranium compounds and the mechanism of uranium poisoning, 1,084 pages (in 2 parts) $14.25.

Parts III and IV, published in 1953, continues from Parts I and II, with results of long-term studies, mainly on the chronic inhalation toxicity of uranium compounds. Major problems considered are bone deposition of uranium and carbohydrate metabolism. Bibliography, index. 1,381 additional pages (in 2 parts), $18.

Biological Effects of External Radiation, vol. 2, edited by Henry A. Blair, 1954, reports the studies made during the war period at the University of Rochester on the biological effects of X-radiation along with a collaborative study of the chronic effects of neutron irradiation made with the Biochemical Foundation, Newark, Del. Included in the volume are the effects of single doses of whole-body X-radiation, chronic X-radiation, and fractionated doses of fast neutrons, 508 pages, $7.00.

Biological Studies with Polonium, Radium, and Plutonium, vol. 3, edited by R. M. Fink, 1949, describes the studies made of the biological effects of these alpha-emitting elements in the animal body, air monitoring precautions, and equipment used in atomic energy laboratories where work with these elements is carried on, 411 pages, $5.50.

Division VII: Materials Procurement Project

Preparation, Properties, and Technology of Fluorine and Organic Fluoro Compounds, vol. 1, edited by C. Slesser and S. R. Schram, describes development in the large-scale manufacture of fluorine, and purifying and handling fluorine. It describes the preparation and the chemical and physical properties of various fluorocarbon compounds, 868 pages, $11.50.

The Metallurgy of Zirconium, vol. 4, edited by B. Lustman and F. Kerze, 1955, comprises contributions by participants in the Navy-AEC program on the development of zirconium for reactor applications, 780 pages, $10.00.

Division VIII: Manhattan Project Chemistry

Analytical Chemistry of the Manhattan Project, vol. 1, edited by C. J. Rodden, 1950, describes methods of analyzing the many different materials used in the atomic energy project—with emphasis on analytical methods for the determination of uranium and thorium, 748 pages, $10.00.

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Chemistry of Uranium. Part I. The Element, Its Binary and Related Compounds, vol. 5, by J. J. Katz and E. Rabinowitch, 1951, is a detailed discussion of the physical and chemical properties of uranium, its occurrence in nature and extraction from ores, and preparation and physical properties of its binary compounds, 609 pages, $8.25.

Medical Effects of the Atomic Bomb in Japan, edited by Ashley W. Oughterson and Shields Warren, is based upon the 6-volume report of the *Joint Commission for the Investigation of the Effects of the Atomic Bomb in Japan*. It presents a great mass of unique and authoritative information of importance to national defense, and is a valuable contribution to fundamental medical knowledge.

DEPOSITORY LIBRARIES

In order to make the nonclassified results of Commission research and development available to the public, the following libraries serve as depositories for essentially all the Commission's nonclassified reports. A number of other university and public libraries also receive copies of the reports that are sold by the Office of Technical Services.

CALIFORNIA
- Berkeley, University of California General Library
- Los Angeles, University of California Library
- Stanford, Stanford Research Institute

COLORADO
- Denver, Denver Public Library

CONNECTICUT
- New Haven, Yale University Library

DISTRICT OF COLUMBIA
- Washington, Library of Congress

FLORIDA
- Gainesville, University of Florida Library

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
- Cambridge, Massachusetts Institute of Technology Library

MICHIGAN
- Ann Arbor, University of Michigan Library
- Detroit, Detroit Public Library

MINNESOTA
- Minneapolis, University of Minnesota 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, Atomic Industrial Forum
- 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
- Toledo, University of Toledo Library

OKLAHOMA
- Stillwater, Oklahoma Agricultural and Mechanical College Library

OREGON
- Corvallis, Oregon State College Library

PENNSYLVANIA
- Philadelphia, University of Pennsylvania Library
- Pittsburgh, Carnegie Library of Pittsburgh
- University Park, Pennsylvania State University, Pattee Library

PUERTO RICO
- La Fortaleza, San Juan, University of Puerto Rico Library

SOUTH CAROLINA
- Columbia, University of South Carolina Library

TENNESSEE
- Knoxville, University of Tennessee Library
- Nashville, Joint University Libraries

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

INDUSTRIAL DEPOSITORIES

To provide industry with specialized industrial information materials and to facilitate inspection of such materials, the AEC has set up special depositories at the Atomic Industrial Forum, Inc., in New York City, at the John Crerar Library in Chicago, in the Stanford Research Institute, Stanford, Calif., and at the Georgia Institute of Technology Library, Atlanta, Ga. Industrial depository collections are comprised of a complete collection of unclassified "basic science" reports which have been found to contain technological developments of special value to American industry not directly connected with the U. S. Atomic Energy Program. Abstracts of these reports were published in a series of special bibliographies entitled, "Selected AEC Reports of Interest to Industry," which is also available at the depositories. A modest program for making unclassified engineering drawings available for inspection at industrial depositories has also been initiated.

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APPENDIX 7

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

Part 2—Rules of Practice

Pursuant to the Administrative Procedure Act, Public Law 404, 79th Congress, 2d session, the following rules are published as a document subject to codification, effective 30 days after publication in the Federal Register.

DESCRIPTION OF PART

Sec.
2.1 Scope.
2.2 Subparts.
2.3 Resolution of conflicts.
2.4 Definitions.

Subpart A—Procedure on Applications for Issuance, Amendment or Transfer of a License or Construction Permit and Renewal of a License

Sec.
2.100 Applicability of subpart.
2.101 Administrative examination of applications, notice to others, informal conferences.
2.102 Action on applications, hearings.
2.103 Effect of timely renewal applications.

Subpart B—Procedure for Imposing Requirements by Order, or for Modification, Suspension, or Revolution of a License or Construction Permit

Sec.
2.200 Applicability of subpart.
2.201 Notice of violation.
2.202 Order to show cause; temporary emergency action.
2.203 Recapture of material or entry in emergency revocation cases.

Subpart G—Rules of General Applicability

COMMON PROVISIONS

Sec.
2.700 Filing of papers; when complete.
2.701 Computation of time.
2.702 Extension of time.
2.703 Service of papers, methods, proof.
2.704 Representation.
2.705 Intervention.
2.706 Effect of intervention or denial thereof.
2.707 Consolidation.
2.708 Hearings, formal and informal.
2.709 Authority to issue oaths and affirmations.

INFORMAL HEARINGS

2.720 Informal hearing procedure.

FORMAL HEARINGS

2.730 Parties.
2.731 Limited appearances by persons not parties.
2.732 Designation of presiding officer, disqualification, unavailability.
2.733 Powers of presiding officers.
2.734 Separation of functions.
2.735 Notice of hearing.
2.736 Answer.
2.737 Reply.
2.738 Default.
2.739 Admissions.
2.740 Prehearing conferences.
2.741 Amendments.
2.742 Hearings, public.
2.743 Official reporter, transcript.
2.744 Subpenas.
2.745 Depositions.
2.746 Order of procedure.
2.747 Evidence.

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[1] Policies and regulations of the U. S. AEC announced prior to July 1956 can be found in the Federal Register and in the following semiannual reports: Fifth Report, Sixth Report, Ninth Report, Tenth Report, Eleventh Report, Twelfth Report, Thirteenth Report, Fourteenth Report, Fifteenth Report, Sixteenth Report, Seventeenth and Nineteenth Reports.

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Sec.
2.748 Interlocutory appeals to the Commission from rulings of presiding officers.
2.749 Proposed findings and conclusions.
2.750 Official notice.
2.751 Intermediate decisions and their effect.
2.752 Exceptions to intermediate decisions.
2.753 Briefs and oral arguments before the Commission.
2.754 Final decision.
2.755 Waiver of procedures or intermediate decisions.
2.756 Petition for reconsideration.

PUBLIC RULE MAKING

2.780 Scope of rule making.
2.781 Initiation, petition.
2.782 Petition for rule making.
2.783 Determination of petition.
2.784 Notice of proposed rule making.
2.785 Participation by interested persons.
2.786 Commission action.
2.787 Effective dates.

AVAILABILITY OF OFFICIAL RECORDS

2.790 Public inspection, exceptions, requests for withholding.

AUTHORITY: §§ 2.1 to 2.790 issued under sec. 161, 68 Stat. 948, 42 U. S. C. 2201.

DESCRIPTION OF PART

§ 2.1 *Scope.* This part governs the conduct of all proceedings before the Atomic Energy Commission involving licensing and licenses,[2] including patent licensing under section 153 of the Atomic Energy Act of 1954 but excluding all other patent matters.[3]

§ 2.2 *Subparts.* Each of the subparts which precedes Subpart G of this part sets forth special rules applicable to the type of proceeding described in the opening section of the subpart. Subpart G of this part sets forth general rules applicable to all types of proceedings and should be read in conjunction with the subpart governing the particular proceeding.

§ 2.3 *Resolution of conflicts.* In any conflict between a general rule in Subpart G of this part and a special rule in another subpart applicable to a particular type of proceeding, the special rule will govern.

§ 2.4 *Definitions.* In this part, words or phrases which are defined in the Atomic Energy Act of 1954 and in the several parts of this chapter to which this part applies, shall take the meaning defined in the act and the pertinent parts with the following exception and explanation:

(a) "Commission" means the commission of five members or a quorum thereof sitting as a body, as provided by section 21 of the Atomic Energy Act of 1954, or any officer or board to whom has been delegated, pursuant to section 161o of the act and as set forth in Part 1 of this chapter, final authority for making decisions in the course of adjudication or for issuing, amending, or rescinding rules in the course of rule making.

(b) "AEC" means the agency established by the Atomic Energy Act of 1954, comprising the members of the Commission and all officers, employees, and representatives authorized to act in the case or matter whether clothed with final authority or not.

[2] Part 30—Byproduct Material Licensing, Part 40—Source Material Licensing, Part 50—Licensing of Production and Utilization Facilities, Part 55—Licensing of Operators, Part 70—Special Nuclear Material Licensing.

[3] The specifications, pursuant to section 156 of the act, for patent licenses to use AEC held patents or those declared subject to licensing under section 153a of the act, are set forth in Part 81 of this chapter. The Patent Compensation Board proceedings under sections 157 and 173 of the act are governed by Part 81 of this chapter.

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SUBPART A—PROCEDURE ON APPLICATIONS FOR ISSUANCE, AMENDMENT OR TRANSFER OF A LICENSE OR CONSTRUCTION PERMIT AND RENEWAL OF A LICENSE

§ 2.100 *Applicability of subpart.* The provisions of this subpart prescribe the procedure covering applications for the issuance of a license, construction permit, amendment of a license or construction permit at the request of the holder, transfer of a license or construction permit, and renewal of a license. Reference should also be made to Subpart G of this part which sets forth the rules applicable to all types of proceedings.

§ 2.101 *Administrative examination of applications, notice to others, informal conferences.* Applications described in § 2.100 will be given a docket or other identifying number and routed to the appropriate AEC offices for administrative examination. AEC will give to others such notice of the filing of the application as is required under the applicable regulations of this chapter and such additional notices as it deems appropriate. The applicant may be required to submit additional information and may be requested to confer informally regarding the application.

§ 2.102 *Action on applications, hearings.* (a) The AEC will, upon request of the applicant or an intervener, and may upon its own initiative, direct the holding of a formal hearing prior to taking action on the application. If no prior formal hearing has been held and no notice of proposed action has been served as provided in paragraph (b) of this section, AEC will direct the holding of a formal hearing upon receipt of a request therefor from the applicant or an intervener within 30 days after the issuance of a license or other approval or a notice of denial.

(b) In such cases as it deems appropriate, AEC may cause to be served upon the applicant, and published, a notice of proposed action upon his application and shall cause copies thereof to be served upon interveners or others entitled to or requesting notification. The notice shall state the terms of the proposed action. If a formal hearing has not been held prior to issuance of the notice, AEC will direct the holding of a formal hearing upon the request of the applicant or an intervener received within fifteen days following the service of the notice.

§ 2.103 *Effect of timely renewal applications.* In the case of an application for renewal, if the licensee has made application for the renewal of a subsisting license at least 30 days prior to its expiration date, the license shall not be deemed to have expired until such application shall have been determined.

SUBPART B—PROCEDURE FOR IMPOSING REQUIREMENTS BY ORDER, OR FOR MODIFICATION, SUSPENSION, OR REVOCATION OF A LICENSE OR CONSTRUCTION PERMIT

§ 2.200 *Applicability of subpart.* The provisions of this subpart prescribe the procedure in cases initiated by AEC to impose requirements by order upon a licensee or holder of a construction permit or to modify, suspend, or revoke a license or construction permit. Reference should also be made to Subpart G of this part, which sets forth the rules applicable to all types of proceedings. The provisions of this subpart shall not apply to action taken pursuant to section 108 of the act.

§ 2.201 *Notice of violation.* (a) Prior to the institution of any proceeding for the suspension or revocation of a license or construction permit for alleged violation of any provision of the act, regulations, or conditions of the license or permit, the licensee or permit holder shall be served with a written notice calling the facts to his attention and requesting a written explanation or statement in reply. Within 15 days of the receipt of such notice, or such other reasonable period as may be

specified in the notice, the licensee or permit holder shall send his reply to the AEC office designated in the notice. If the notice relates to conditions or conduct which may be susceptible of correction or of being brought into full compliance by action of the licensee or permit holder, he shall state in his reply the corrective steps taken or to be instituted in achieving correction and preventing further violations, and the date when such correction and full compliance will be achieved.

(b) Where in the opinion of AEC the public health, interest, or safety requires, or the failure to be in compliance is wilful, the notice provided for in this section may be omitted.

§ 2.202 *Orders to show cause; conditional orders.* (a) (1) In any case described in § 2.200, and after notice if any as required by § 2.201, AEC may issue to the licensee or permit holder an order directing him to show cause why the proposed action should not be taken. There will be included a notice of formal hearing. The time for hearing specified shall not be less than 20 days after issuance of the order except that, where the public interest or safety requires, AEC may provide in the order for a shorter period.

(2) Where in the opinion of AEC the public health, interest and safety requires, the proposed action may be made temporarily effective prior to the time for hearing.

(b) In cases initiated by AEC to impose requirements by order upon a licensee or holder of a construction permit, the AEC may (in lieu of following the procedures provided in paragraph (a) of this section) issue such order to be effective at a time specified therein. The order will designate also a period of time, not less than 15 days from the date of issuance of the order, within which the licensee or permit holder may file a written request for formal hearing. The timely filing of a request for formal hearing with respect to any order, or any part of an order, issued pursuant to this paragraph shall stay the order, or such part of the order, pending determination of the issues by the Commission.

§ 2.203 *Recapture of material or entry in emergency revocation cases.* In cases found by the Commission to be of extreme importance to the common defense and security or to the health and safety of the public, the Commission may without prior notice or hearing recapture any special nuclear material held by the licensee or enter upon and operate the licensed facility, provided that as promptly as possible and not later than 10 days from the recapture or entry, AEC will serve upon the licensee or permit holder an appropriate order to show cause why the license or construction permit should not be revoked and notice of formal hearing, or will initiate steps to restore the material or facility of which the licensee or permit holder has been deprived.

SUBPART G—RULES OF GENERAL APPLICABILITY

COMMON PROVISIONS

§ 2.700 *Filing of papers; when complete.* Unless otherwise specified, papers required to be filed with AEC shall be filed with the Atomic Energy Commission, 1901 Constitution Avenue, NW., Washington 25, D. C. Papers required to be filed with AEC shall be deemed filed upon actual receipt by AEC at the place specified accompanied by proof of service upon parties required to be served. Upon actual receipt the filing, when by mail or telegraph, shall be deemed complete as of the date of deposit in the mail or with the telegraph company as provided in paragraph (d) of § 2.703.

§ 2.701 *Computation of time.* In computing any period of time prescribed or allowed by any applicable statute, rule, notice, or order, the day of the act, event, or default after which the designated period of time begins to run is not to be included. The last day of the period so computed is to be included, unless it is a Saturday, Sunday, or a legal holiday, in which event the period runs until the end of the next day which is

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either a Saturday, Sunday, nor a holiday. When the period of time prescribed or allowed is less than seven days, intermediate Saturdays, Sundays, and holidays shall be excluded in the computation.

§ 2.702 *Extension of time.* Unless discretion is denied by statute, extensions of time for filing or performing any act required or allowed to be done, and continuances of any proceeding or hearing, may be granted in the discretion of AEC upon application and good cause shown by any party, or upon the initiative of AEC or stipulation of all the parties. Where a presiding officer has been designated for hearing, the discretion in granting extensions of time and continuances in matters relating to the hearing shall rest with the presiding officer.

§ 2.703 *Service of papers, methods, proof.* (a) Except for subpenas, service of which is governed by § 2.744, AEC will serve all orders, notices, and other papers issued by it when service thereof is required, together with any other papers which it is required by law to serve. Every other paper requiring service, such as answers, petitions, motions, briefs, exceptions, and notices, shall be served by the party filing it upon all parties entitled to service thereof; and proof of service shall accompany the paper when it is tendered for filing. Where there are numerous parties to a proceeding the Commission may, upon motion or its own initiative, make special provision regarding the service of papers.

(b) Service shall be made upon the parties or their designated representatives.

(c) Service of papers may be made by personal delivery, by first class, certified or registered mail including airmail, by telegraph, or by publication when publication is authorized by statute, rule, or order.

(d) Service upon parties shall be regarded as complete:

(1) By personal delivery, upon handing the paper to the individual, or leaving it at his office with his clerk or other person in charge thereof or, if there is no one in charge, leaving it in a conspicuous place therein or, if the office is closed or the person to be served has no office, leaving it at his usual place of residence with some person of suitable age and discretion then residing therein;

(2) By mail, upon deposit in the United States mail properly stamped and addressed;

(3) By telegraph, when deposited with a telegraph company properly addressed and with charges prepaid;

(4) By publication, when due notice shall have been given in the publication for the time and in the manner provided by statute, rule, or order.

Service by mail or telegraph shall be made at the principal place of business of the individual or party to be served or at his usual residence.

(e) Proof of service of any document may consist of: (1) A certificate describing the service by the person mailing, telegraphing, or making personal service of the paper or causing its publication; or (2) an acknowledgment of service signed by the individual receiving service personally.

§ 2.704 *Representation.* (a) Except as provided in paragraph (b) of this section, any person appearing before AEC may do so in person or by a representative. Any person transacting business with AEC in a representative capacity may be required to show his authority to act in that capacity.

(b) In a formal hearing, a person may appear in person or be represented by an attorney at law in good standing admitted to practice before any court of the United States, the District of Columbia, or the highest court of any state, territory or possession of the United States. Presiding officers may permit qualified individuals having scientific training or experience to participate on behalf of a party in the presentation of evidence.

§ 2.705 *Intervention.* (a) Any person whose interest may be affected by

a proceeding may file a petition to intervene, describing his interest, how it may be affected by AEC action, and the position he is taking in the matter. Service of copies of the petition shall be made upon all parties to the proceeding. The licensee or applicant upon prompt notice and motion, and other parties by leave, may contest the right of the petitioner to intervene.

(b) As soon as is practicable after filing of a petition and the hearing of argument, if any, the Commission will issue and serve an order either permitting or denying intervention. If the order is a denial of intervention, it shall contain a statement of the grounds. If a petition is filed after a notice of hearing has been issued, the designated presiding officer will act upon the petition. An order permitting intervention may be conditioned upon such terms as the Commission or presiding officer may direct.

§ 2.706 *Effect of intervention or denial thereof.* (a) A person permitted to intervene becomes a party to the proceeding.

(b) Where a notice of hearing has been issued or a hearing has begun, the admission thereafter of an intervener shall not of itself enlarge or alter the issues without amendment as provided in § 2.741.

(c) An order denying intervention will be without prejudice to any proposed limited appearance by the petitioner as one who is not a party for the purposes provided in § 2.731.

§ 2.707 *Consolidation.* Upon motion and good cause shown or upon its own initiative, the Commission may contemporaneously consider or consolidate for hearing or for other purposes two or more proceedings if it finds that such action will be conducive to the proper dispatch of its business and to the ends of justice.

§ 2.708 *Hearings, formal and informal.* Hearings will be either formal or informal. Formal hearings will be held in cases of adjudication, as that term is used in the Administrative Procedure Act, unless the parties otherwise agree, and in such other cases as may specifically be directed. Informal hearings will normally be held for the purposes of obtaining necessary or useful information, and affording participation by interested persons, in the formulation, amendment, or rescission of rules and regulations.

§ 2.709 *Authority to administer oaths and affirmations.* Any oath or affirmation required by or pursuant to the regulations in this Chapter may be administered by any person authorized to administer oaths for general purposes by the laws of the United States, or the laws of any state, territory or possession of the United States, or of the District of Columbia, or the Commonwealth of Puerto Rico, wherein such oath or affirmation is administered, or by any consular officer of the United States. This section shall not be construed as an exclusive enumeration of the persons who may administer such oaths or affirmations.

INFORMAL HEARINGS

§ 2.720 *Informal hearing procedure.* The procedure to be followed in informal hearings shall be such as will best serve the purpose of the hearing. For example, an informal hearing may consist of the submission of written data, views, or arguments with or without oral argument, or may partake of the nature of a conference, or may assume some of the aspects of a formal hearing in which the subpena of witnesses and the production of evidence may be permitted or directed.

FORMAL HEARINGS

§ 2.730 *Parties.* The parties to a formal hearing shall be AEC, the licensee or applicant as the case may be, and any person permitted to intervene pursuant to § 2.705.

§ 2.731 *Limited appearances by persons not parties.* With the consent of the presiding officer, limited appearances may be entered without request for or grant of permission to intervene

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by persons who are not parties to a hearing. With the consent of the presiding officer, and on due notice to the parties, such persons may make oral or written statements of their position on the issues involved in the proceeding, but may not otherwise participate in the hearing.

§ 2.732 *Designation of presiding officer, disqualification, unavailability.* (a) There will be designated to preside at hearings one or more members of the Commission, or an officer or board to whom has been delegated final authority in the matter with which the hearing is concerned, or a hearing examiner appointed pursuant to section 11 of the Administrative Procedure Act. To the extent practicable, the name of the presiding officer designated will be included in the notice of hearing or, if omitted from the notice, made known to the parties or public as soon as is possible thereafter, prior to the holding of the hearing.

(b) Whenever a presiding officer deems himself disqualified he shall notify the Commission and withdraw from the hearing. Any party shall have 7 days, but not beyond expiration of the hearing unless further extended for good cause shown, after notice or knowledge of the designation of the presiding officer in which to file a request that the presiding officer withdraw on the ground of personal bias or other disqualification. The request shall be accompanied by an affidavit setting forth the facts alleged to constitute the ground for disqualification. The presiding officer may file a response thereto. If the presiding officer believes himself not disqualified, he may so rule and proceed with the hearing; and in such case, the Commission will determine the matter only as a part of the decision in the case where exceptions are filed to the presiding officer's intermediate decision. The presiding officer may, in his discretion,, certify the question to the Commission for consideration and disposition, and suspend the hearing until the Commission has ruled on the question.

(c) Whenever a presiding officer becomes unavailable in the course of a hearing another presiding officer will be designated. If the presiding officer becomes unavailable after the taking of evidence at a hearing has been concluded, in lieu of designating another presiding officer the Commission may direct that the record be forwarded to it for decision.

§ 2.733 *Powers of presiding officers.* From the date of his designation in a case until transfer of the case to the Commission, or expiration of the time for filing exceptions to his intermediate decision, a presiding officer shall have authority in the case to:

(a) Administer oaths and affirmations;

(b) Examine witnesses;

(c) Rule upon offers of proof and receive evidence;

(d) Issue subpenas authorized by law;

(e) Take or cause depositions to be taken;

(f) Regulate the course of the hearing;

(g) Hold appropriate conferences before or during the hearing;

(h) Dispose of procedural requests or similar matters;

(i) Within his discretion or upon direction of the Commission, certify questions to the Commission for its consideration and disposition;

(j) Make the intermediate decision in conformity with § 2.751;

(k) Take any other action consistent with the rules of the Commission, the Administrative Procedure Act, and the Atomic Energy Act of 1954.

§ 2.734 *Separation of functions.* (a) Hearing examiners appointed pursuant to section 11 of the Administrative Procedure Act shall perform no duties inconsistent with their duties and responsibilities as presiding officers, and shall not be responsible to or subject to the supervision or direction of any officer or employee engaged in the performance

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of investigative or prosecuting functions for AEC.

(b) In any case of adjudication other than initial licensing,

(1) The presiding officer, unless he is a member of the Commission or officer having final authority in the case, may not consult any person or party on any fact in issue except upon notice and opportunity for all parties to participate, save to the extent required for the disposition of ex parte matters as authorized by law;

(2) No officer or employee of AEC, other than a member of the Commission or officer having final authority in the case, who has engaged in the performance of any investigative or prosecuting function in the case or a factually related case may participate or advise in the intermediate or final decision, except as witness or counsel in the formal hearing.

§ 2.735 *Notice of hearing.* (a) Whenever a hearing is granted, AEC will give timely notice of the hearing to all parties and to other persons, if any, entitled to notice. Such notice will state the time, place, and nature of the hearing; the legal authority and jurisdiction under which the hearing is to be held; the matters of fact and law asserted or to be considered, which will be identified as the "Specification of issues"; and a request for an answer. The time and place for hearing will be fixed with due regard for the convenience and necessity of the parties or their representatives.

(b) The notice of hearing may be a separate notice or when appropriate may be embodied in an order to show cause or other order.

(c) The procedure for issuance of the notice of hearing and specifying of the issues by AEC shall not affect the burden of proof.

§ 2.736 *Answer.* (a) Within the time allowed by the notice of hearing for filing and serving an answer, and as required, the answer of a licensee or applicant shall fully advise AEC and any other parties as to the nature of the defense or other position of the answering party, the items of the specification of issues he proposes to controvert, and those he does not controvert, and whether or not he proposes to appear and present evidence. If facts are alleged in the specification of issues the answer shall admit or deny specifically each allegation of fact; or where knowledge is lacking, the answer may so state and the statements shall operate as a denial. Allegations of fact not denied shall be deemed to be admitted. Matters alleged as affirmative defenses or positions shall be separately stated and identified and, in the absence of a reply, shall be deemed to be controverted. The answer of an intervener shall fully advise AEC and other parties of his position and whether or not he proposes to appear and present evidence.

(b) If a party does not oppose any order or proposed action of AEC embodied in or accompanying the notice of hearing or does not wish to appear and give evidence at the hearing, the answer shall so state. In lieu of appearing, the party may if he chooses submit a statement of reasons why the proposed order or sanction should not be issued or should be different than proposed, and the Commission will attribute such weight as it deems deserving to the written reasons.

§ 2.737 *Reply.* In appropriate cases AEC may file and serve a reply to the answer or, if the answer affects other parties to the proceeding, may permit such parties to file and serve a reply.

§ 2.738 *Default.* Failure of a party to file and serve an answer within the time provided in the notice of hearing or as prescribed in this part or to appear at a hearing, shall be deemed to authorize the Commission, in its discretion, as to such party (a) to find the facts alleged in the specification of issues to be true and to enter such finding or order as may be appropriate, without further notice or hearing; or (b) to proceed to take proof, without further notice, on the allegations or issues set forth in the specification of issues.

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§ 2.739 *Admissions.* After answer has been filed, any party may file and serve upon the opposing side a written request for the admission of the genuineness and authenticity of any relevant documents described in or attached to the request or for the admission of the truth of any relevant matters of fact stated in the request. Each matter for which an admission is requested shall be deemed admitted unless within the time designated in the request, but not less than 10 days after service thereof or such further time as the presiding officer may allow upon motion and notice, the party to whom the request is directed serves upon the requesting party a sworn statement either denying the matters upon which the admission is requested or setting up the reasons why he cannot truthfully admit or deny such matters.

§ 2.740 *Prehearing conferences.* (a) In order to provide opportunity for the settlement of a proceeding or any of the issues therein, or for agreement upon procedural and other matters, there may be held at any time prior to or during a hearing, upon due notice of the time and place given to all parties, such conferences of the parties as, in the discretion of the presiding officer, time, the nature of the proceeding, and the public interest may permit.

(b) Action taken at a prehearing conference may be recorded for appropriate use at the hearing in the form of a written stipulation among the parties setting the matters upon which there has been agreement. The stipulation shall be binding upon the parties hereto.

§ 2.741 *Amendments.* At any time prior to the time fixed for hearing but not later than five days prior, the party responsible for the specification of issues, answer, or reply, respectively, may amend the same by filing an amendment and serving it upon the parties. At any time thereafter, amendments may be permitted in the discretion of the presiding officer upon such terms as he shall prescribe.

§ 2.742 *Hearings public.* Except as may be required pursuant to section 181 of the act, hearings shall be public.

NOTE: Provisions with respect to parallel procedures pursuant to section 181 of the Act will be published at an early date.

§ 2.743 *Official reporter, transcript.* Hearings shall be reported under the supervision of the presiding officer, stenographically or by other means, by an official reporter, who may be designated from time to time by AEC or may be a regular employee of AEC. The transcript of the report shall be part of the record and the sole official transcript of the proceeding. Except as limited pursuant to section 181 of the act or order of the Commission, the transcript will be open for inspection at AEC offices and copies may be obtained from the official reporter upon payment of the charges fixed therefor. Errors in the transcript may be corrected by order of the presiding officer following a notice of motion to correct filed and served on the affected parties within 10 days after notice that the completed transcript has been received by AEC, or as otherwise agreed upon by the parties and approved by the presiding officer.

§ 2.744 *Subpenas.* (a) Upon application by any party to a hearing, the designated presiding officer or, if he is not available, a member of the Commission or other designated officer will issue to such party subpenas requiring the attendance and testimony of witnesses or the production of evidence in the hearing. In his discretion, the officer to whom application is made may require from the requesting party a showing of general relevance of the testimony or evidence sought and may withhold issuance of the subpena if such showing is not made; but such officer shall not attempt to determine the admissibility of evidence in passing upon an application for subpena.

(b) Every subpena shall bear the name of the Commission, the name and office of the issuing officer, and the title of the hearing, and shall command the

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person to whom it is directed to attend and give testimony or produce specified data at a designated time and place. The subpena shall also contain a statement advising of the existence of the quashing procedure provided in paragraph (f) of this section.

(c) Unless the service of a subpena is acknowledged on its face by the witness, it shall be served by a person who is not a party to the hearing and is not less than 18 years of age, but may in any case be served by an officer or employee of AEC. Service of a subpena upon a person named therein shall be made by delivering a copy of the subpena to such person and by tendering him the fees for one day's attendance and the mileage allowed by law. When the subpena is issued on behalf of AEC, fees and mileage may but need not be tendered, and the subpena may be served by registered mail.

(d) Witnesses summoned before AEC shall be paid by the party at whose instance they appear the same fees and mileage that are paid to witnesses in the district courts of the United States.

(e) The person serving the subpena shall make proof of service by filing the subpena and the required return, affidavit, or acknowledgment of service with the officer before whom the witness is required to testify or produce evidence or with AEC. Failure to make proof of service shall not affect the validity of the service.

(f) Upon motion made promptly, and in any event at or before the time specified in the subpena for compliance, by the person to whom the subpena is directed, and upon notice to the party to whom the subpena was issued, the presiding officer or, if he is unavailable, the Commission may (1) quash or modify the subpena if it is unreasonable or requires evidence not relevant to any matter in issue, or (2) condition denial of the motion upon just and reasonable terms.

(g) Upon application and for good cause shown, AEC will seek judicial enforcement of a subpena issued to a party and which has not been quashed.

§ 2.745 *Depositions.* (a) Upon application and good cause shown, the designated presiding officer or, if he is unavailable, the Commission may order that the testimony of any person, including a party, be taken by deposition upon oral examination or written interrogatories for use as evidence in the hearing. The attendance of witnesses may be compelled by the use of a subpena.

(b) The application shall be in writing and shall be served upon the parties and filed, giving reasonable notice of the proposed time and place for taking the deposition, the name and address of each person to be examined, if known, or if the name is not known a general description sufficient to identify him or the class or group to which he belongs, and the reasons why such deposition should be taken. If good cause is shown, an order will be issued authorizing the deposition, and specifying the time, place, and manner of taking of the deposition, any limitations imposed for the benefit of witnesses or parties, and the number of copies of the deposition to be supplied. The order shall be served upon all parties by the person proposing to take the deposition a reasonable period in advance of the time fixed for taking testimony.

(c) Within the United States, depositions shall be taken before any officer authorized to administer oaths by the laws of the United States or of the place where the examination is held. Outside the United States, depositions shall be taken before a secretary of an embassy or legation, consul general, vice consul, or consular agent of the United States, or a person authorized to administer oaths designated by AEC or agreed upon by the parties by stipulation in writing filed with AEC.

(d) Unless the order provides otherwise, the deponent may be examined regarding any matter not privileged, which is relevant to the subject matter involved in the hearing. He shall

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sworn or shall affirm before any questions are put to him. Examination and cross-examination shall proceed as at a hearing. Each question propounded shall be recorded and the answer taken down in the words of the witness. Objections on questions of evidence shall be noted in short form without the arguments. However, the officer shall not decide on the competency, materiality, or relevancy of evidence but shall record the evidence subject to objection. Objections to questions or evidence not made before the officer shall not be deemed waived unless the ground of the objection is one which might have been obviated or removed if presented at the time.

(e) When the testimony is fully transcribed, the deposition shall be submitted to the deponent for examination and signed by him, unless he is ill or cannot be found or refuses to sign. The officer shall certify to the deposition, and if not signed by the deponent shall certify to the reasons therefor, and shall promptly forward the deposition by registered mail to AEC. The party taking the deposition shall give prompt notice of its filing to all other parties.

(f) Where the deposition is to be taken upon written interrogatories, the party proposing the deposition shall serve upon each of the parties and file a copy of the proposed interrogation showing each interrogatory separately and consecutively numbered, the name and address of the person who is to answer them, and the name, descriptive title, and address of the officer before whom they are to be taken. Within 7 days after service any party may serve cross-interrogatories upon the party proposing to take the deposition. Objections to interrogatories or cross-interrogatories shall be made promptly after service and will be settled by the presiding officer or the Commission, as the case may be; provided that objections to form, unless made before the order for taking the deposition is issued, shall be deemed waived. Except as the parties otherwise agree, the deposition upon written interrogatories shall be taken only with the deponent, the officer, and the reporter or stenographer present during the interrogation, to which fact the officer shall certify. The interrogatories, cross-interrogatories, and the answers shall be recorded and signed, and the deposition certified, returned, and filed as in the case of a deposition upon oral examination.

(g) A deposition will not become a part of the record in the hearing until and unless received in evidence by the presiding officer, upon his own motion or the motion of any party. If only part of a deposition is offered in evidence by a party, any other party may require him to introduce all of it which is relevant to the part introduced, and any party may introduce any other parts. A party shall not be deemed to make a person his own witness for any purpose by taking his deposition. Any party may rebut any relevant evidence contained in a deposition whether introduced by him or by any other party.

(h) Deponents whose depositions are taken and the officers taking depositions shall be entitled to the same fees as are paid for like services in the district courts of the United States to be paid by the party at whose instance the depositions are taken.

§ 2.746 *Order of procedure.* The presiding officer or the Commission, as the case may be, will designate the order of procedure at hearings including the order in which interveners will be heard. Normally, at hearings for the grant, amendment or transfer of a license or construction permit or the renewal of a license, the applicant will open and close; and at hearings for the revocation, suspension, or AEC initiated modification of a license or construction permit, AEC will open and close.

§ 2.747 *Evidence.* (a) Every party to the hearing shall have the right to present such oral or documentary evi-

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dence and rebuttal evidence and conduct such cross-examination as may be required for a full and true disclosure of the facts. The parties shall be encouraged to present evidence in written form.

(b) The presiding officer shall exclude all irrelevant, immaterial, or unduly repetitious evidence.

(c) Objections to the admission or exclusion of evidence shall state the grounds of objections. The transcript shall include the objections, the grounds, and the rulings, but not the argument of the grounds unless ordered by the presiding officer.

(d) Any offer of proof made in connection with an objection taken to the ruling of the presiding officer, excluding or rejecting proffered oral testimony, shall consist of a statement of the substance of the evidence which the party contends would be adduced by such testimony. If the excluded material is documentary or written, a copy of such material shall be marked for identification and shall constitute the offer of proof.

(e) Unless the presiding officer permits otherwise, written exhibits will not be received in evidence unless offered in duplicate. In addition, a copy of each such exhibit must be furnished each of the parties at the hearing, unless the parties have previously been furnished with copies or the presiding officer directs otherwise. The presiding officer shall fix a time for the exchange of exhibits. The presiding officer may permit a party to replace with a true copy an original document admitted as evidence.

(f) An official record of a governmental agency or an entry in such record, when admissible, may be evidenced by an official publication thereof or by a copy attested as a true copy by the officer having legal custody of the record, or by his deputy, and accompanied by a certificate that such officer has the custody.

§ 2.748 *Interlocutory appeals to the Commission from rulings of presiding officers.* Except as may be otherwise specifically provided, the rulings of a presiding officer may not be appealed from during the time the proceeding is pending before him, except in extraordinary circumstances where in the judgment of the presiding officer prompt decision by the Commission is necessary to prevent detriment to the public interest or unusual delay or expense. In such instances the matter shall be referred for determination forthwith by the presiding officer to the Commission.

§ 2.749 *Proposed findings and conclusions.* At the close of the reception of evidence, or within a reasonable time thereafter as fixed by the presiding officer, the parties may file for consideration proposed findings and conclusions with supporting reasons, briefs, or memoranda of law. Such proposals shall contain exact references to the record and authorities relied on.

§ 2.750 *Official notice.* (a) With or without prior request or notice, the presiding officer or the Commission, as the case may be, may take official notice of any fact which might be judicially noticed by the courts of the United States or of any technical and scientific fact within the knowledge of AEC as an expert body.

(b) Any party may controvert a request or a suggestion that official notice be taken of a fact at the time the request or suggestion is made, if it be made orally, or by a pleading, brief, or notice. If any decision is stated to rest in whole or in part upon official notice of a fact which the parties have not had a prior opportunity to controvert, any party may controvert such fact by appropriate exception if an intermediate decision is involved or by a petition for reconsideration if a final decision is involved. The controversion shall concisely and clearly set forth the sources, authority, and other data relied upon to show the existence or nonexistence of the fact assumed or denied in the decision.

§ 2.751 *Intermediate decisions and their effect.* (a) After hearing, the presiding officer will ordinarily render an intermediate decision, which decision

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shall become final unless exceptions are taken in accordance with § 2.752 or the Commission has directed that the record be certified to it for final decision.

(b) However, in any case involving an application for an initial license the Commission may direct that the presiding officer certify the record to it without an intermediate decision. In such case the Commission may:

(1) Direct a responsible officer to prepare an intermediate decision which will not become final until the Commission acts upon it; or

(2) Prepare its own intermediate decision, which shall become final unless exceptions are taken in accordance with § 2.752; or

(3) Omit an intermediate decision upon a finding on the record that due and timely execution of the Commission's functions imperatively and unavoidably so requires.

(c) Each intermediate decision shall be in writing and shall contain:

(1) Findings and conclusions, with the reasons or basis therefor upon all material issues of fact, law, or discretion presented on the record;

(2) The ruling upon each proposed finding or conclusion filed by a party;

(3) All facts officially noticed pursuant to § 2.750, relied upon in the decision;

(4) The appropriate rule, order, sanction, relief, or denial thereof, with the effective date;

(5) The time within which exceptions to the decision may be filed, the time in which briefs in support of or in opposition to the exceptions may be filed and, in the case of an intermediate decision which may become final unless exceptions are filed, the date when such decision will become final in the absence of exceptions thereto.

(d) The intermediate decision, other than an oral decision, shall be served upon all parties to the proceeding. In the case of an oral decision, the presiding officer shall apprise the parties before its pronouncement of his intention, and the time when he proposes, to render an oral decision.

(e) Intermediate decisions shall become a part of the record.

§ 2.752 *Exceptions to intermediate decisions.* Within 20 days after service of any intermediate decision, or such longer period as may be fixed therein, any party to a hearing may file exceptions to the decision with the Commission, and shall serve copies of such exceptions on all other parties to the hearing. Each exception shall be separately numbered, shall identify the part of the intermediate decision to which objection is made, shall designate by specific reference the portions of the record relied upon in support of the objections, and shall state the grounds for the exception including the citation of authorities in support thereof. Any objection to a ruling, finding, or conclusion which is not made part of the exceptions shall be deemed to have been waived, and the Commission need not consider such objections.

§ 2.753 *Briefs and oral arguments before the Commission.* (a) Within such period after service of an intermediate decision as may be fixed therein, any party to a proceeding may file a brief before the Commission in support of his exceptions to the decision or in opposition to the exceptions filed by any other party.

(b) In its discretion the Commission may allow oral argument upon the request of a party made in his exceptions or brief, or upon its own initiative.

§ 2.754 *Final decision.* (a) Upon submission of a case to the Commission for final decision, the Commission will normally consider the whole record. But when reviewing an intermediate decision, the Commission may limit the issues to be reviewed, and give consideration only to those findings and conclusions to which exceptions have been filed.

(b) The final decision shall be in writing and shall contain:

(1) A statement of findings and conclusions, with the reasons or basis there-

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for, upon all the material issues of fact, law, or discretion presented;

(2) All facts officially noticed pursuant to § 2.750, relied upon in this decision;

(3) The ruling on each relevant and material exception filed;

(4) The appropriate rule, order, sanction, relief, or denial thereof, with the effective date.

(c) The decision shall be served upon all parties to the proceeding.

§ 2.755 *Waiver of procedures or intermediate decisions.* The parties to any hearing may agree to waive any one or more of the procedural steps or intermediate decisions which would otherwise precede the reaching of a final decision by the Commission.

§ 2.756 *Petition for reconsideration.* A petition for reconsideration of a final decision after hearing may be filed by any party to the hearing, within 10 days after the decision has been issued and served. However, no petition may be filed with respect to an intermediate decision which has become final through failure to file exceptions thereto. The petition for reconsideration shall state specifically wherein the matter determined is claimed to be erroneous, the grounds relied upon, and the relief sought. Within 7 days after a petition for reconsideration has been filed, any party to the hearing may file an answer in opposition to or support of the petition. Neither the filing nor the granting of the petition shall operate as a stay of the decision unless so ordered by the Commission.

PUBLIC RULE MAKING

§ 2.780 *Scope of rule making.* The procedure described in this subpart as rule making or public rule making relates to the issuance, amendment, or rescission of substantive rules in which participation by interested persons is prescribed under section 4 of the Administrative Procedure Act.

§ 2.781 *Initiation, petition.* Rule making will be initiated by AEC, upon its own motion, upon the recommendation of another agency of the government, or upon the petition of any other interested person as hereinafter provided.

§ 2.782 *Petition for rule making.* Any interested person may petition the Commission to issue, amend, or rescind any rule or regulation of the Commission within the score of § 2.780. The petition shall state the substance or text of any proposed rule or regulation, or amendment thereof, or shall specify the rule or regulation the rescission of which is desired, and shall state the basis for the request. The petition will be given a docket or other identifying number and will become a matter of public record, except as may otherwise be required pursuant to section 181 of the act or order of the Commission.

§ 2.783 *Determination of petition.* No hearing will be held directly on the petition unless the Commission deems it advisable. If the Commission determines that the petition discloses sufficient reasons to justify the relief requested, the Commission will issue an appropriate notice of proposed rule making. If the Commission determines that the petition does not disclose sufficient reasons to justify instituting the public rule making procedure, the Commission will so notify the petitioner with a simple statement of the grounds.

§ 2.784 *Notice of proposed rule making.* A general notice of proposed rule making will be published in the Federal Register unless all persons subject to the proposed rule making are named and either personally served with notice or otherwise have actual notice in accordance with law. The notice, whether published or personally served, shall include: (a) A statement of the time, place, and nature of the public rule making hearing; (b) reference to the authority under which the rule is proposed; (c) either the terms or substance of the proposed rule or a description of the subjects and issues involved. The publication or service of notice shall be made not less than 15 days prior to the time fixed for the hearing, provided

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that a lesser time may be prescribed upon good cause found and incorporated, with a brief statement of the reasons, in the notice.

§ 2.785 *Participation by interested persons.* After notice required by § 2.784, the Commission will afford interested persons an opportunity to participate in the rule making through the submission of data, views, or arguments in such informal hearing, pursuant to § 2.720, as the notice provides. The opportunity to participate may include an opportunity to comment upon or respond to the data, views, or arguments submitted by others. Where additional time may be needed for this purpose the Commission may, upon the request of an interested person, grant an additional reasonable period of time for the submission of data, views, or arguments in reply.

§ 2.786 *Commission action.* After consideration of all relevant matters presented, the Commission will incorporate in any rule adopted a concise general statement of its basis and purpose and will cause the rule to be published in the Federal Register or served upon the affected parties.

§ 2.787 *Effective dates.* The rule will specify its effective date. Publication or service of the rule, other than one granting or recognizing exemption or relieving restriction, shall be made not less than 30 days prior to the effective date thereof unless the Commission may provide otherwise upon good cause found and published with the rule.

AVAILABILITY OF OFFICIAL RECORDS

§ 2.790 *Public inspection, exceptions, requests for withholding.* (a) Except as provided in paragraph (b) of this section or as required to protect Restricted Data or defense information, matters of official record in any proceeding subject to this part (including applications for licenses, licenses, rules, regulations, orders, transcripts of hearings, exhibits received in evidence, and decisions) will be made available for public inspection.

(b) The AEC may withhold any document or part thereof from public inspection if disclosure of its contents is not required in the public interest and would adversely affect the interest of a person concerned. Such withholding from public inspection shall not, however, affect the right of persons properly and directly concerned to inspect the document.

(c) Persons requesting that documents or information therein be withheld from public disclosure shall make prompt application identifying the material and giving the reasons. Where the applicant is responsible for the preparation of the document, he shall insofar as is possible segregate in a separate paper the information for which the special treatment is requested. The AEC may honor the request upon a finding that public inspection is not required in the public interest and would adversely affect the interest of the person concerned. If the request is denied, the applicant will be notified thereof with a statement of the reasons.

Dated at Washington, D. C., this 31st day of January 1956.

K. E. FIELDS,
General Manager.

PART 4—CRITERIA AND PROCEDURES FOR DETERMINING ELIGIBILITY FOR SECURITY CLEARANCE

Effective upon publication in the FEDERAL REGISTER, Part 4 is hereby amended to read as follows:

GENERAL PROVISIONS

Sec.
4.1 Purpose.
4.2 Scope.
4.3 Reference.
4.4 Policy.

CRITERIA FOR DETERMINING ELIGIBILITY FOR SECURITY CLEARANCE

4.10 Application of the criteria.
4.11 Derogatory information.

PROCEDURES

4.20 Purpose of the procedures.
4.21 Suspension of clearance.

Sec.
4.22 Notice to individual.
4.23 Additional information.
4.24 Failure of individual to request a hearing.
4.25 Appointment of Boards.
4.26 Appointment of Counsel to Personnel Security Boards.
4.27 Conduct of proceedings.
4.28 Recommendation of the Board.
4.29 New evidence.
4.30 Actions on the recommendations.
4.31 Recommendations of the AEC Personnel Security Review Board.
4.32 Action by the General Manager.
4.33 Reconsideration of cases.

MISCELLANEOUS

4.34 Washington area cases.
4.35 Modification of procedure.

AUTHORITY: §§ 4.1 to 4.35 issued under sec. 161, 68 Stat. 948; 42 U. S. C. 2201.

GENERAL PROVISIONS

§4.1 *Purpose.* This part establishes the criteria, procedures, and methods for resolving questions concerning the eligibility of an individual for security clearance pursuant to the Atomic Energy Act of 1954. The appropriate provisions of this part are also to be used to the extent the Commission has responsibilities under Executive Order 10450, as amended.

§ 4.2 *Scope.* The criteria and procedures outlined in this part shall be used in those cases in which there are questions of eligibility for AEC security clearance, involving:

(a) Employees (including consultants) of, and applicants for employment with, the Atomic Energy Commission;

(b) Those employees (including consultants) of, and those applicants for employment with, contractors and agents of the Atomic Energy Commission;

(c) Access permittees and licensees of the AEC and their employees (including consultants) and applicants for employment; and

(d) Those other persons designated by the General Manager of the Atomic Energy Commission.

§ 4.3 *Reference.* The pertinent sections of the Atomic Energy Act of 1954 are as follows:

SEC. 141. *Policy.* It shall be the policy of the Commission to control the dissemination and disclosure of Restricted Data in such a manner as to assure the common defense and security * * *

SEC. 145. *Restriction.* (a) No arrangement shall be made under section 31, no contract shall be made or continued in effect under section 41, and no license shall be issued under section 103 or 104, unless the person with whom such arrangement is made, the contractor or prospective contractor, or the prospective licensee agrees in writing not to permit any individual to have access to Restricted Data until the Civil Service Commission shall have made an investigation and report to the Commission on the character, associations, and loyalty of such individual, and the Commission shall have determined that permitting such person to have access to Restricted Data will not endanger the common defense and security.

(b) Except as authorized by the Commission or the General Manager upon a determination by the Commission or General Manager that such action is clearly consistent with the national interest, no individual shall be employed by the Commission nor shall the Commission permit any individual to have access to Restricted Data until the Civil Service Commission shall have made an investigation and report to the Commission on the character, associations, and loyalty of such individual, and the Commission shall have determined that permitting such person to have access to Restricted Data will not endanger the common defense and security.

(c) In the event an investigation made pursuant to subsections (a) and (b) of this section develops any data

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indicating 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.

(d) 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 subsections (a) and (b) of this section to be made by the Federal Bureau of Investigation instead of by the Civil Service Commission.

(e) Notwithstanding the provisions of subsections (a) and (b) of this section, a majority of the members of the Commission shall certify those 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 instead of by the Civil Service Commission.

(f) The Commission shall establish standards and specifications in writing as to the scope and extent of investigations to be made by the Civil Service Commission pursuant to subsections (a) and (b) of this section. Such standards and specifications shall be based on the location and class or kind of work to be done, and shall, among other considerations, take into account the degree of importance to the common defense and security of the Restricted Data to which access will be permitted;

SEC. 161. *General provisions.* In the performance of its functions the Commission is authorized to:

(a) Establish advisory boards to advise with and make recommendations to the Commission on the legislation, policies, administration, research and other matters: *Provided*, That the Commission issues regulations setting forth the scope, procedure, and limitations of the authority of each such board.

(b) Make such studies and investigations, obtain such information, and hold such meetings or hearings as the Commission may deem necessary or proper to assist it in the administration or enforcement of this act, or any regulations or orders issued thereunder. For such purposes the Commission is authorized to administer oaths and affirmations, and by subpoena to require any person to appear and testify, or to appear and produce documents, or both, at any designated place. No person shall be excused from complying with any requirements under this paragraph because of his privilege against self-incrimination, but the immunity provisions of the Compulsory Testimony Act of February 11, 1893, shall apply with respect to any individual who specifically claims such privilege. Witnesses subpoenaed under this subsection shall be paid the same fees and mileage as are paid witnesses in the district courts of the United States.

§ 4.4 *Policy.* It is the policy of the Atomic Energy Commission to carry out its responsibility for the security of the atomic energy program in a manner consistent with traditional American concepts of justice. To this end, the Commission has established criteria for determining eligibility for security clearance and will afford those individuals described in § 4.2 the opportunity for administrative review of questions concerning their eligibility for security clearance.

CRITERIA FOR DETERMINING ELGIBILITY FOR SECURITY CLEARANCE

§ 4.10 *Application of the criteria.* (a) The decision as to security clearance is a comprehensive, commonsense judgment, made after consideration of all the revelant information, favorable or unfavorable, as to whether or not the granting of security clearance would endanger the common defense and security. If it is determined that the common defense and security will not be endangered, security clearance will

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be granted; otherwise, security clearance will be denied.

(b) To assist in making these determinations, on the basis of all the information in a particular case, there are set forth in this part a number of specific types of derogatory information. These criteria are not exhaustive but contain the principal types of derogatory information which create a question as to the individual's eligibility for security clearance. While there must necessarily be adherence to such criteria, the Commission is not limited thereto, nor precluded from exercising its judgment that information or facts in a case under its cognizance are derogatory although at variance with, or outside the scope of, the stated categories. These criteria are subject to continuing review and may be revised from time to time as experience and circumstances may make desirable.

(c) When the reports of investigation of an individual contain information reasonably tending to establish the truth of one or more of the items in the criteria, such information shall be regarded as substantially derogatory and shall create a question as to his eligiblity for security clearance. However, when such information involves association with organizations or individuals, which is the result of, and is limited to, normal business or professional activity or chance or casual meetings, Managers of Operations may determine whether such information is substantially derogatory. Managers of Operations shall refer cases involving substantially derogatory information to the Director, Division of Security, AEC. The Director, Division of Security, AEC, may authorize the granting of security clearance on the basis of the existing record, or may authorize the conduct of an interview with the individual and, on the basis of such interview and such other investigation as he deems appropriate, may authorize the granting of security clearance. Otherwise, a question concerning the eligibility of an individual for security clearance shall be resolved in accordance with the procedures set forth in §§ 4.20 et seq. of this part.

(d) In resolving a question concerning the eligibility of an individual for security clearance, the following principles shall be applied by Personnel Security Boards:

(1) Where there are grounds sufficient to establish a reasonable belief as to the truth of one or more of the items in Category "A," this shall create a presumption of security risk which, if not satisfactorily rebutted by the individual, shall result in an adverse recommendation.

(2) Where there are grounds sufficient to establish a reasonable belief as to the truth of one or more of the items in Category "B," the extent of activities, the period in which such activities occurred, the length of time which has since elapsed, and the attitudes and convictions of the individual shall be considered in determining whether the recommendation will be adverse or favorable.

§ 4.11 *Derogatory information*—(a) *Category "A" derogatory information.* Category "A" includes those cases in which the individual or his spouse has:

(1) Committed or attempted to commit, or aided, or abetted another who committed or attempted to commit, any act of sabotage, espionage, treason or sedition;

(2) Knowingly established an association with espionage or sabotage agents of a foreign nation; with individuals reliably reported as suspected of espionage or sabotage; with representatives of foreign nations whose interests may be inimical to the interests of the United States, with traitors, seditionists, anarchists, or revolutionists.

(3) Held membership in any organization or group designated by the Attorney General pursuant to Executive Order 10450, as amended, provided the individual did not withdraw from such membership when the organization was so identified, or did not otherwise establish his rejection of its subversive aims; or, prior to the declaration by the At-

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torney General, participated in the activities of such an organization in a capacity where he should reasonably have had knowledge as to the subversive aims of the organization and did not establish his rejection of its subversive aims. (If an organization has been removed from the Attorney General's list, membership in the organization after such removal shall not be considered as Category "A" derogatory information but may be considered as Category "B" derogatory information.)

(4) Publicly or privately advocated revolution by force or violence to overthrow the Government of the United States or the alteration of the form of Government of the United States by unconstitutional means;

Category "A" also includes those cases in which the individual has:

(5) Deliberately omitted significant information from or falsified his Personnel Security Questionnaire or Personal History Statement concerning a significant matter;

(6) Wilfully violated or disregarded security regulations to a degree which would endanger the common defense and security; or intentionally disclosed classified information to any person not authorized to receive it;

(7) Any mental illness of a nature which in the opinion of competent medical authority may cause significant defect in the judgment or reliability of the individual;

(8) Being convicted of crimes indicating habitual criminal tendencies;

(9) Been, or is, a user of drugs habitually, without adequate evidence of rehabilitation.

(b) *Category "B" derogatory information.* In evaluating items under this category, the extent of the activities, the period in which such activities occurred, the length of time which has since elapsed, and the attitudes and convictions of the individual shall be considered. Category "B" includes those cases in which the individual or his spouse has:

(1) Advocated Totalitarian, Fascist, Communist or other subversive political ideologies and has not subsequently established his rejection of them.

(2) Associated with persons falling within the provisions of Category "B"–1, subparagraph (1) of this paragraph, when the individual himself did not establish his rejection of such ideologies. (Ordinarily this will not include chance or casual meetings nor contacts limited to normal business or official relations.)

(3) Affiliated with any organization or group designated in Category "A," paragraph (a) 3, of this section, provided the individual did not discontinue such affiliation when the organization was so identified or did not otherwise establish his rejection of its subversive aims;

(4) Associated with any person falling within the provisions of Category "A," paragraph (a) 3, of this section, provided the individual did not discontinue such association when the organization was so identified or did not otherwise establish his rejection of its subversive aims. (Ordinarily this will not include chance or casual meetings nor contacts limited to normal business or official relations.)

(5) Parent(s), brother(s), sister(s), spouse, or offspring residing in a nation whose interests may be inimical to the interests of the United States, or in satellites or occupied areas thereof (to be evaluated in the light of the risk that pressure applied through such close relatives could force the individual to reveal sensitive information or perform an act of sabotage);

Category "B" also includes those cases in which the individual:

(6) Refuses to serve in the Armed Forces when such refusal cannot be clearly shown to be due to religious convictions;

(7) Has been grossly careless in failing to protect or safeguard any Restricted Data or other classified information;

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(8) Has abused trust, has been dishonest, or has engaged in infamous, immoral, or notoriously disgraceful conduct;

(9) Is a sexual pervert or homosexual;

(10) Is a user of alcohol habitually and to excess, or has been such without adequate evidence of rehabilitation;

(11) Refuses, upon the ground of constitutional privilege against self-incrimination, to testify before a Congressional Committee regarding charges of his alleged disloyalty or other misconduct.

PROCEDURES

§ 4.20 *Purpose of the procedures.* These procedures establish methods for the conduct of personnel security board hearings and administrative review of questions concerning an individual's eligibility for security clearance pursuant to the Atomic Energy Act of 1954, when it has been determined that such questions cannot be favorably resolved by informal interview or other investigation.

§ 4.21 *Suspension of clearance.* In those cases where information is received which raises a question concerning the continued eligibility of an individual for AEC security clearance, the Manager of the office concerned shall forward to the General Manager, via the Director, Division of Security, AEC, his recommendation as to whether the individual's clearance should be suspended pending the final determination resulting from the operation of the procedures provided in this part. In making this recommendation the Manager shall consider such factors as the seriousness of the derogatory information developed, the possible access of the individual to classified information, and the individual's opportunity by reason of his position to commit acts adversely affecting the national security. The clearance of an individual shall not be suspended except by direction of the General Manager.

§ 4.22 *Notice to individual.* A notification letter, approved by the Director of Security, AEC, and the Office of the General Counsel, and signed by the Manager of Operations, shall be presented to each individual whose eligibility for clearance is in question. Where practicable, such letter shall be presented to the individual in person. The letter shall state:

(a) That information in possession of the Commission has created a question concerning the individual's eligibility for security clearance;

(b) The information, in as much detail and as specifically as considerations of security permit, which creates a question regarding the individual's eligibility for security clearance;

(c) That within twenty days of the date of receipt of the notification letter the individual must indicate in writing to the Manager from whom he received such letter whether he wishes a hearing before a Personnel Security Board;

(d) That within twenty days of the date of receipt of the notification letter, the individual is requested to file with the Manager from whom he received such letter his written answer to the matters contained therein;

(e) That, if the individual so requests, a hearing will be scheduled before a Personnel Security Board at a mutually convenient time and place for the purpose of eliciting information to assist in determining the eligibility of the individual for security clearance;

(f) That, if the individual requests a hearing, he will be notified in writing of the membership of a Personnel Security Board when it is appointed by the Manager;

(g) That the individual will have the right to appear personnally before a Personnel Security Board, and present evidence in his own behalf, through witnesses, or by documents, or both, and subject to the limitations set forth in § 4.26 (d) and (m), be present during the entire hearing and be represented by counsel of his own choosing;

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fore a Personnel Security Board, in accordance with (c) of this section, will be considered as a relinquishment by him of the opportunity of availing himself of the privileges accorded to him under the hearing and review procedure provided in this part, and that in such event a recommendation as to the final action to be taken will be made by the Manager of Operations and submitted to the General Manager for his decision on the basis of the existing record without reference to a Personnel Security Board;

(i) His clearance status until further notice;

(j) The name of the designated AEC official to contact for any further information desired.

§ 4.23 *Additional information.* A copy of this part shall be given to the individual with the notification letter.

§ 4.24 *Failure of individual to request a hearing.* (a) In the event the individual fails, within the prescribed time, to file a written request for a hearing before a Personnel Security Board, a recommendation as to the final action to be taken shall be made by the Manager of Operations to the General Manager on the basis of the existing record;

(b) The Manager of Operations may for good cause, at the request of the individual, extend the time for filing a written request for a hearing or for filing a written answer to the matters contained in the notification letter.

§ 4.25 *Appointment of Boards.* (a) Upon receipt from the individual of his written answer to the notification letter, signifying his desire to appear before a Personnel Security Board, the Manager shall forthwith appoint a Board consisting of three members, one to be designated as the Chairman;

(b) The personnel of the Board, when practicable as determined by the Manager, shall consist of at least one member who is an attorney and one member who is familiar with the general field of work of the individual;

(c) The personnel shall be selected from a panel of individuals possessing the highest degree of integrity, ability, and good judgment. Such panels may include employees of the AEC or its contractors but no AEC employees shall serve on a Board hearing the case of an AEC employee, or applicant for AEC employment, and no employee of an AEC contractor shall serve on a Board hearing the case of an employee of, or an applicant for employment with, that contractor;

(d) All persons serving as members of Personnel Security Boards shall have an AEC "Q" security clearance;

(e) No person shall serve as a member of a Personnel Security Board who has prejudged the case to be heard; who possesses information that would make it embarrassing to render an impartial recommendation; or who for bias or prejudice generated for any reason would be unable to render a fair and impartial recommendation;

(f) Immediately upon the appointment of a Personnel Security Board, the Manager will notify the individual of the identity of the members of the Board and of his right to challenge any member for cause, such challenge or challenges, accompanied by the reasons therefore, to be submitted to the Manager within seventy-two hours of the receipt of the notice;

(g) In the event that the individual challenges a member or members of the Board, the justification of the action of the individual shall be determined by the Manager. Where the challenge of the individual is sustained, the Manager shall forthwith appoint such new members to the Board as will constitute a full Board and notify the individual. The individual shall have the right to challenge such new members for cause and such challenge shall be dealt with in the same manner as an original challenge. The Manager shall also notify the individual of his rejection of any challenge. The Board shall convene as soon as is reasonably practicable;

(h) The Manager of Operations shall notify the individual in writing, at least one week in advance, of the date, hour, and place the Board will convene. In the event the individual fails to appear at the time and place specified, a recommendation as to the final action to be taken shall be made by the Manager of Operations to the General Manager on the basis of the existing record. However, the Manager of Operations may for good cause, at the request of the individual, permit the individual to appear before a Personnel Security Board at a newly-scheduled date, hour, and place.

§ 4.26 *Appointment of Counsel to Personnel Security Boards.* (a) Managers of Operations shall appoint an attorney to serve as counsel to the Board; such attorney shall possess the highest degree of integrity, ability, and good judgment and shall have an AEC "Q" clearance. Counsel to the Board may be an employee of the AEC, or he may be an attorney specifically retained to serve as Counsel to a Board.

(b) Counsel to the Board shall not be a member of the Board; shall not participate in the deliberations of the Board, and shall express no opinion to the Board concerning the merits of the case. He shall advise the Board concerning the meaning and application of the procedures. He shall also advise the individual of his rights under these procedures when the individual is not represented by Counsel of his own choosing.

(c) Counsel to the Board shall not participate in any deliberations with the Manager of Operations or members of the Manager's staff concerning the latter's recommendation to the General Manager with respect to the granting or denial of security clearance.

§ 4.27 *Conduct of proceedings.* (a) The proceedings shall be presided over by the Chairman of the Board and shall be conducted in an orderly and decorous manner with every effort made to protect the interests of the Government and of the individual and to arrive at the truth. In no case will undue delay be tolerated nor will the individual be hampered by unduly restricting the time necessary for proper preparation and presentation. In performing their duties, the members of the Board shall avoid the attitude of a prosecutor and shall always bear in mind and make clear to all concerned that the proceeding is an administrative hearing and not a trial;

(b) The proceedings shall be open only to duly authorized representatives of the staff of the Atomic Energy Commission, the individual, his counsel, and such persons as may be officially authorized by the Board. Witnesses shall not testify in the presence of other witnesses.

(c) Counsel to the Board shall examine and cross-examine witnesses and otherwise assist the Board in such a manner as to bring out a full and complete disclosure of all facts, both favorable and unfavorable, having a bearing on the issues before the Board. In performing his duties, he shall avoid the attitude of a prosecutor and shall always bear in mind that the proceeding is an administrative hearing and not a trial.

(d) The Board shall ask the individual, AEC representatives, and other witnesses any supplemental questions which the Board deems appropriate to assure the fullest possible disclosure of relevant and material facts. The proponent of a witness shall conduct the direct examination of that witness;

(e) During the course of the proceedings the Chairman shall rule in open session on all questions presented to the Board for its determination, subject to the objection of any member of the Board. In the event of an objection by any member of the Board, a majority vote of the Board shall be determinative and constitute the ruling of the Chairman. Voting may be either in open or closed session on all questions except recommendations to grant or

any security clearance, which shall be in closed session;

(f) In the event that it appears in the course of the hearing that Restricted Data or other classified information may be disclosed, it shall be the duty of the Chairman to assure that disclosure is not made to persons who are not authorized to receive it;

(g) The Board shall not engage in argument with either the individual, his witnesses, or his counsel, nor shall the Board permit any person to argue from the witness stand;

(h) The Board shall admit in evidence any matters either oral or written which, in the minds of reasonable men, are of probative value in determining the issues involved, including the testimony of responsible persons concerning the integrity of the individual. The utmost latitude shall be permitted with respect to relevancy, materiality, and competency. Every reasonable effort shall be made to obtain the best evidence available. Hearsay evidence shall be admitted without regard to technical rules of admissibility and accorded such weight as the circumstances warrant;

(i) Testimony of the individual and witnesses shall be given under oath or affirmation, and witnesses shall be subject to cross-examination. Attention of the witness shall be invited to 18 U. S. C. 1001 and 18 U. S. C. 1621;

(j) The individual shall be afforded the opportunity of testifying in his own behalf. His failure to testify may be considered by the Board in reaching its recommendation;

(k) The Board shall endeavor to obtain all the facts that are reasonably available in order for it to arrive at its recommendations. If, prior to or during the proceeding, in the opinion of the Board the allegations in the notification letter are not sufficient to cover all matters into which inquiry should be directed, the Board shall suggest to the Manager concerned that, in order to give fuller notice to the individual, the notification letter should be amended. Any amendment shall be made with the concurrence of the Director, Division of Security, AEC, and the Office of the General Counsel. If, in the opinion of the Board, the circumstances of such an amendment may involve an undue hardship to the individual, because of limited time to answer the new allegations in the notification letter, an appropriate adjournment shall be granted upon the request of the individual;

(l) The reports of investigation shall not be disclosed to the individual or his representatives;

(m) Boards are encouraged to request the presence of witnesses whose testimony is important to the resolution of material issues. When the presence of a witness is deemed by the Board to be necessary or desirable to a proper determination of the issues before it, the Board shall request the Manager to make arrangements, if possible, for such witness to appear, be confronted by the individual, and be subject to examination and cross-examination. Upon receipt of such request the Manager shall make every effort through proper administrative channels to comply with the Board's request. In the event the witness is unavailable, such unavailability, together with any reasons which may be advanced therefor, shall be considered by the Board in arriving at its determination. Because of the confidential nature of the sources of information or for other reasons, confrontation of witnesses by the individual may not always be possible. In such cases, the Board may request the Manager to make arrangements through the Director, Division of Security, for such witness to testify privately and be subject to thorough questioning by the Board and its Counsel, and portions of the transcript involving testimony of such witnesses shall not be furnished to the individual;

(n) The Board may request the Manager to arrange for additional investigation on any points which are material to the deliberations of the Board and which the Board believes need ex-

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tension or clarification. In this event, the Board shall set forth in writing those issues upon which more evidence is requested, identifying where possible persons or sources from which evidence should be sought. The Manager shall make every effort through appropriate sources to obtain additional information upon the matters indicated by the Board;

(o) A written transcript of the entire proceedings shall be made by a person possessing appropriate AEC clearance and, except for portions containing Restricted Data or other classified information or testimony referred to in the last sentence of paragraph (m) of this section, a copy of such transcript shall be furnished the individual without cost.

§ 4.28 *Recommendation of the Board.* (a) The Board shall carefully consider all material before it, including the reports of investigation, the testimony of all witnesses, the evidence presented by the individual, and the standards set forth herein. In considering the material before the Board, the members of the Board, as practical men of affairs, shall be guided by the same considerations that would guide them in making a sound decision in the administration of their own lives. In reaching its determination the Board shall consider the manner in which the witnesses have testified before the Board, their demeanor on the witness stand, the probability or likelihood of their testimony, their credibility, the authenticity and accuracy of documentary evidence, or the lack of evidence upon some material points in issue. If the individual is, or may be, handicapped by the nondisclosure to him of confidential information or by lack of opportunity to cross-examine confidential informants, the Board shall take that fact into consideration. The Board shall also consider other information available to the Commission, such as his past record with the atomic energy program, and the nature and sensitivity of the job he is or may be expected to perform. Possible impact of the loss of the individual's services upon the AEC program shall not be considered by the Board.

(b) The Board shall make specific findings as to whether each of the allegations contained in the notification letter is true or false and the significance which the Board attaches to such allegations. These findings shall be supported fully by a statement of reasons which constitute the basis for such findings;

(c) The recommendation of the Board shall be predicated upon its findings. If, after considering all the factors in the light of the criteria set forth in this part, the Board is of the opinion that it will not endanger the common defense and security to grant security clearance to the individual, it shall make a favorable recommendation; otherwise, it shall make an adverse recommendation;

(d) The recommendation of the Board shall be determined by a majority vote. In the event of a dissent from the majority, the recommendation of the minority member shall be made a matter of record together with a statement of the reasons leading to his conclusions. The recommendation of the Board shall be submitted to the Manager accompanied by a statement of the reasons leading to the Board's conclusions.

§ 4.29 *New evidence.* (a) In the event of the discovery of new evidence by the individual prior to final determination by the General Manager of the individual's eligibility for security clearance, such evidence shall be submitted by the individual or his representative to the Manager of Operations from whom he received his notification letter.

(b) The Manager of Operations shall review the application for the presentation of new evidence to ascertain its materiality and relevancy and further, that the individual or his representative is without fault in failing to present the evidence before. In the event it is determined that the new evidence should

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received, the Manager of Operations shall:

(1) Refer the matter to the Personnel Security Board which had been appointed in the individual's case when the Manager of Operations has not yet forwarded his recommendation to the General Manager. The Personnel Security Board receiving the application for the presentation of new evidence shall determine the form in which it shall be received, whether by testimony before the Board, by deposition, or by affidavit;

(2) In those cases where the Manager of Operations has forwarded his recommendations to the General Manager, the application for presentation of new evidence shall be referred to the General Manager with appropriate comment and recommendations. In the event the General Manager determines that the new evidence should be received, he shall determine the form in which it shall be received, whether by testimony before a Personnel Security Board, by deposition, or by affidavit.

§ 4.30 *Actions on the recommendations.* (a) The recommendations of the Board and any dissent therefrom shall be written out, signed by all of the members of the Board, and, together with the record of the case, shall be transmitted with the least practicable delay to the Manager of Operations concerned;

(b) Upon receipt of the recommendation of the Board and the record of the case, the Manager shall forthwith review the entire record. In making his recommendation to grant or deny security clearance, the Manager shall be guided by the standards set forth herein, shall make specific findings as to whether each of the allegations contained in the notification letter is true or false, and shall set forth in writing his recommendation to the General Manager, through the Director, Division of Security. In those cases where denial of security clearance is recommended, the Manager of Operations shall include, in his recommendation, a statement concerning the effect which denial of security clearance would have upon the atomic energy program;

(c) The General Manager may return the case to the Manager for further proceedings by the Personnel Security Board with respect to specific matters designated by the General Manager;

(d) (1) In the event of a recommendation by the Manager for a denial of security clearance, the individual shall be immediately notified in writing of that fact by the Manager and shall be furnished a copy of the Manager's specific findings as to whether each of the allegations contained in the notification letter is true or false. This letter shall also notify the individual of his right to request a review of his case by the AEC Personnel Security Review Board and of his right to submit a brief in support of his contentions. The request for a review shall be submitted to the Manager within five days after the receipt of the notice. The brief shall be filed with the Manager not later than 20 days after receipt of such notice;

(2) Where the individual requests a review of the adverse recommendation, the Manager shall forthwith send the entire record of the proceedings, with all findings and recommendations, to the Personnel Security Review Board through the Director, Division of Security, AEC;

(3) In the event the individual fails to request a review by the AEC Personnel Security Review Board of an adverse recommendation within the prescribed time, the case shall be promptly referred to the General Manager through the Director, Division of Security, AEC, for disposition on the basis of existing record;

(e) (1) Where the Manager has made a recommendation favorable to the individual and the General Manager proposes to transmit the entire record to the Personnel Security Review Board for its recommendation, the General Manager shall immediately cause the individual to be notified of that fact and of those matters contained in the notification letter concerning which he de-

sires the advice of the Personnel Security Review Board. He shall further inform the individual that he may submit a brief concerning such matters for the consideration of the Personnel Security Review Board. Such brief shall be filed not later than twenty days from the receipt of the notice by the individual. The brief shall be forwarded to the General Manager through the Director, Division of Security, AEC, for transmission to the Personnel Security Review Board;

(2) The General Manager shall submit the entire record to the AEC Personnel Security Review Board.

§ 4.31 *Recommendations of the AEC Personnel Security Review Board.* (a) The AEC Personnel Security Review Board shall make its deliberations upon the entire record, supplemented by such brief as the individual submits. The Personnel Security Review Board may request such additional briefs as it deems appropriate. In any case where the AEC Personnel Security Review Board determines that additional evidence or further proceedings are necessary, it may return the case to the General Manager with a recommendation that the case be remanded to the Manager of Operations for appropriate action;

(b) In its deliberations, the AEC Personnel Security Review Board shall make its findings and recommendations as to the eligibility of an individual for a security clearance on the entire record supplemented by additional testimony or briefs, as determined by the Board. When additional testimony is taken by the Personnel Security Review Board a verbatim transcript of such testimony shall be made part of the record;

(c) The Personnel Security Review Board shall not concern itself with the possible impact of the loss of the individual's services upon the AEC program;

(d) After its deliberations, the AEC Personnel Security Review Board shall make its recommendations in writing to the General Manager for his decision.

§ 4.32 *Action by the General Manager.* (a) The General Manager, on the basis of the entire record accompanied by all recommendations, shall then make a final determination whether security clearance shall be granted or denied;

(b) In making his determination as to whether clearance shall be granted or denied, the General Manager shall give due recognition to the favorable as well as the unfavorable information concerning the individual and shall take into account the value of the individual's services to the atomic energy program and the operational consequences of denial of clearance. In making his determination, the mature viewpoint and responsible judgment of Commission staff members, and of the contractor concerned, are available for consideration by the General Manager;

(c) As soon as practicable, the General Manager shall notify the Manager of Operations of his decision for transmittal to the individual.

§ 4.33 *Reconsideration of cases.* (a) Where, pursuant to the procedures set forth in §§ 4.20 to 4.33, inclusive, the General Manager has made a determination granting security clearance to an individual, the individual's eligibility for clearance shall be reconsidered only when, subsequent to the time of the prior hearing, there is new substantially derogatory information or a significant increase in the scope or sensitivity of the Restricted Data to which the individual has or will have access;

(b) Where, pursuant to these procedures, the General Manager has made a determination denying security clearance to an individual, the individual's eligibility for clearance may be reconsidered when there is a bona fide offer of employment requiring access to Restricted Data and either material and relevant new evidence, which the individual and his representative are without fault in failing to present before, or convincing evidence of reformation or

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rehabilitation. Requests for reconsideration shall be submitted in writing to the General Manager through the Manager of Operations having jurisdiction over the position for which clearance is required. Such requests shall be accompanied by an affidavit setting forth in detail the information referred to above. The General Manager shall advise the individual to be notified as to whether his eligibility for clearance will be reconsidered and, if so, the method by which such reconsideration will be accomplished;

(c) Where security clearance has been granted to an individual by a Manager of Operations without recourse to the procedures set forth in §§ 4.20 to 4.31, inclusive, the individual's eligibility for clearance shall be reconsidered only in a case where, subsequent to the granting of the security clearance, new substantially derogatory information has been received or there is a significant increase in the scope of sensitivity of the Restricted Data to which the individual has, or will have access, and in any other case only with the specific prior approval of the Director, Division of Security, AEC.

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§ 4.34 *Washington area cases.* In those cases which may arise involving individuals within the Washington Area of AEC operations, an Assistant General Manager designated by the General Manager shall discharge the functions and responsibilities assigned to Managers of Operations in these procedures.

§ 4.35 *Modification of procedure.* These procedures may be modified by the General Manager as experience and circumstances may make desirable.

Dated at Washington, D. C., this 7th day of May 1956.

R. W. COOK,
Deputy General Manager.

PART 8—INTERPRETATIONS

A new part is hereby added to the regulations in Title 10, Chapter 1, CFR, to contain interpretations of the Atomic Energy Act of 1954 (68 Stat. 919) and of regulations of the Atomic Energy Commission issued thereunder.

§ 8.1 *Interpretation of section 152 of the Atomic Energy Act of 1954; opinion of the General Counsel.* (a) Inquiries have been received as to the applicability of the provisions of section 152 of the Atomic Energy Act of 1954 (68 Stat. 944) to inventions or discoveries made or conceived in the course of activities under licenses issued by the Atomic Energy Commission.

(b) In my opinion a license issued by the Atomic Energy Commission is not a "contract, subcontract, arrangement or other relationship with the Commission" as those terms are used in section 152 of the act. Hence, the mere fact that an invention or discovery is made by a licensee in the course of activities authorized by a license would not give the Commission rights under section 152 with respect to such invention or discovery. On the other hand, if a licensee has entered into a "contract, subcontract, arrangement or other relationship with the Commission," inventions or discoveries made or conceived by the licensee under the contract or other relationship would come within the purview of section 152.

(c) As used in this section, "license" means a license issued pursuant to Chapter 6 (Special Nuclear Material), 7 (Source Material), 8 (Byproduct Material) or 10 (Atomic Energy Licenses) of the Atomic Energy Act of 1954, or a construction permit issued pursuant to section 185 of the act.

Dated: February 1, 1956.

WILLIAM MITCHELL,
General Counsel.
U. S. Atomic Energy Commission.

PART 25—ACCESS TO RESTRICTED DATA

In view of the fact that the Atomic Energy Commission has received a substantial number of applications and has issued a substantial number of access permits in accordance with procedures set forth in the notice of proposed rule

making published in the Federal Register on May 19, 1955 (20 F. R. 3634), and because interested persons will not be adversely affected, the Commission has found that good cause exists why the regulations in this part should be made effective without the customary 30-day period of notice.

Pursuant to the Administrative Procedure Act, Public Law 404, 79th Cong., 2d sess., the following rules are published as a document subject to codification, to be effective upon publication in the Federal Register.

GENERAL PROVISIONS

Sec.
25.1 Purpose.
25.2 Applicability.
25.3 Definitions.
25.4 Interpretations.
25.5 Communications.
25.6 Categories of available information.

APPLICATIONS

25.11 Applications.
25.12 Non-eligibility.
25.13 Additional information.
25.14 Public inspection of applications.
25.15 Requirements for approval of applications.

PERMITS

25.21 Issuance.
25.22 Scope of permit.
25.23 Terms and conditions of access.
25.24 Administration.
25.25 Term and renewal.
25.26 Assignment.
25.27 Amendment.
25.28 Commission action on application to renew or amend.
25.29 Modification and revocation of permits.
25.30 Exceptions and additional requirements.
25.31 Effective date; amendment of permits previously issued.

AUTHORITY: §§ 25.1 to 25.31 issued under sec. 161, 68 Stat. 948; 42 U. S. C. 2201.

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GENERAL PROVISIONS

§ 25.1 *Purpose.* The regulations in this part establish procedures and criteria for permitting persons to have access to Confidential or Secret Restricted Data relating to civilian uses of atomic energy.

§ 25.2 *Applicability.* The regulations in this part apply to any person within or under the jurisdiction of the United States who desires access to Restricted Data for use in his business, profession or trade.

§ 25.3 *Definitions.* As used in this part:

(a) "Act" means the Atomic Energy Act of 1954 (68 Stat. 919), including any amendments thereto.

(b) "Category" means a category of Restricted Data designated in Appendix A to the regulations in this part.

(c) "Commission" means the Atomic Energy Commission or its duly authorized representatives.

(d) "Permittee" means the holder of a permit issued pursuant to the regulations in this part.

(e) "Person" means (1) any individual, corporation, partnership, firm, association, trust, estate, public or private institution, group, Government agency other than the Commission, any state or any political subdivision of, or any political entity within a state, or other entity; and (2) any legal successor, representative, agent, or agency of the foregoing.

(f) "Restricted Data" means all data concerning (1) design, manufacture or utilization of atomic weapons; (2) the production of special nuclear material; or (3) the use of special nuclear material in the production of energy, but shall not include data declassified or removed from the Restricted Data category pursuant to section 142 of the act.

§ 25.4 *Interpretations.* Except as specifically authorized by the Commission in writing, no interpretation of the meaning of the regulations in this part by any officer or employee of the Commission other than a written interpretation by the General Counsel will be rec-

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(c) Any partnership not including among the partners one or more citizens of the United States; or any other unincorporated association not including one or more citizens of the United States among its principal officers.

(d) Any organization which is owned, controlled or dominated by the Government of, a citizen of, or an organization organized under the laws or a country or area listed as a Subgroup A country or destination in § 371.3 (15 CFR 371.3) of the Comprehensive Export Schedule of the United States Department of Commerce.

§ 25.13 *Additional information.* The Commission may, at any time after the filing of the original application and before the termination of the permit, require additional information in order to enable the Commission to determine whether the permit should be granted or denied or whether it should be modified or revoked.

§ 25.14 *Public inspection of applications.* Applications and documents submitted to the Commission in connection with applications may be made available for public inspection in accordance with the regulations contained in Part 2 of this chapter.

§ 25.15 *Requirements for approval of applications.* (a) An application for access to Confidential Restricted Data in all the categories set forth in Appendix A, will be approved only if the application demonstrates that the applicant has a potential use or application for such data in his business, trade or profession.

(b) An application for access to Secret Restricted Data in any of the categories will be approved only if the application demonstrates that the applicant has a need for such data in his business, trade or profession. Such need must be demonstrated as to each of the categories to which such access is requested.

PERMITS

§ 25.21 *Issuance.* (a) Upon a determination that an application meets the requirements of this regulation, the Commission will issue to the applica an access permit on Form AEC 379.

NOTE: An Access Permit is not a se curity clearance. It does not authori any individual not having an appropr ate AEC security clearance to receiv Restricted Data. See § 25.24 and Part 95 of this chapter.

§ 25.22 *Scope of permit.* (a) All ac cess permits will as a minimum, autho ize access, subject to personnel security clearances, to Confidential Restricted Data in all of the categories set forth in Appendix A.

(b) In addition, access permits may authorize access, subject to personnel security clearances, to such Secret Re stricted Data as is included within the particular category or categories specified in the permit.

§ 25.23 *Terms and conditions of ac cess.* (a) Neither the United States nor the Commission, nor any person acting on behalf of the Commission makes any warranty or other representation, express or implied, (1) with re spect to the accuracy, completeness or usefulness of any information made available pursuant to an access permit, or (2) that the use of any such information may not infringe privately owned rights.

(b) The Commission hereby waives such rights with respect to any invention or discovery as it may have pursuant to section 152 of the act by reason of such invention or discovery having been made or conceived in the course of, in connection with, or resulting from ac cess to Restricted Data received under the terms of an access permit.

(c) Each permittee shall:

(1) Comply with all applicable provisions of the Atomic Energy Act of 1954 and with Part 95 of this chapter and with all other applicable rules, regulations and orders of the Commission;

(2) Be deemed to have waived all claims for damages under section 183 of title 35 U. S. Code by reason of the imposition of any secrecy order on any patent application, and all claims for

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compensation under section 173 of the Atomic Energy Act of 1954, with respect to any invention or discovery made or conceived in the course of, in connection with, or under the terms of the access permit;

(3) Be deemed to have waived any and all claims against the United States, the Commission and all persons acting on behalf of the Commission that might arise in connection with the use, by the applicant, of any and all information supplied by them pursuant to the access permit;

(4) Shall obtain and preserve in his files written agreements from all individuals who will have access to Restricted Data under the access permit to give effect to subparagraphs (2) and (3) of this paragraph.

§ 25.24 *Administration.* With respect to each permit issued pursuant to the regulations in this part, the Commission will designate an office, usually an Operation Office, to:

(a) Process all personnel security clearances requested in connection with the permit;

(b) Review the procedures submitted by the Applicant, in accordance with Part 95 of this chapter, for the safeguarding of Restricted Data; and

(c) Provide information to the permittee with respect to the sources and locations of Restricted Data available under his permit.

§ 25.25 *Term and renewal.* (a) Each access permit will be issued for a two year term, unless otherwise stated in the permit.

(b) Applications for renewal of an access permit shall be on Application Form AEC 378. In any case in which a permittee has filed a properly completed application for renewal more than thirty (30) days prior to the expiration of his existing permit, such existing permit shall not expire until the application for a renewal has been finally acted upon by the Commission.

§ 25.26 *Assignment.* An access permit is non-transferable and non-assignable.

§ 25.27 *Amendment.* An access permit may be amended from time to time upon application by the permittee. An application for amendment shall be filed in accordance with § 25.11 and shall specify the nature of and the grounds for the amendment requested.

§ 25.28 *Commission action on application to renew or amend.* In considering an application by a permittee to renew or amend his permit, the Commission will apply the criteria set forth in § 25.15.

§ 25.29 *Modification and revocation of permits.* The Commission may revoke, suspend or modify any access permit for any material false statement in the application or in any report submitted to the Commission pursuant to the regulations in this part or because of conditions or facts which would have warranted a refusal to grant the permit in the first instance, or for violation of any of the terms and conditions of the Atomic Energy Act of 1954 or Commission rules, regulations or orders issued pursuant thereto.

§ 25.30 *Exceptions and additional requirements.* Notwithstanding any other provision in the regulations in this part, the Commission may deny an application for an access permit or suspend, modify or revoke any access permit, or incorporate additional conditions or requirements in any access permit, upon finding that such denial, revocation or the incorporation of such conditions and limitations is necessary or appropriate in the interest of the common defense and security.

§ 25.31 *Effective date; amendment of permits previously issued.* (a) The regulations in this part are effective upon publication in the FEDERAL REGISTER.

(b) Each access permit heretofore issued by the Commission shall be deemed to have been amended, effective upon publication of this part in the FEDERAL REGISTER, by deleting those provisions of the permit, and of the application therefor, which grant to the Commission for governmental purposes

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a license in, and which require the permit holder to report to the Commission, any invention or discovery resulting from access to Secret Restricted Data under the access permit.

NOTE: The reporting requirements contained herein have been approved by the Bureau of the Budget in accordance with the Federal Reports Act of 1942.

APPENDIX A

CATEGORIES OF RESTRICTED DATA AVAILABLE (INCLUDING SCOPE NOTES FOR EACH CATEGORY)

C–4 *Chemistry; general.* This category includes such information as the relatively unspecialized and fundamental chemistry of elements and their compounds through element 92. It includes such information as the following:

1. Chemical properties, reactions, and corrosion studies.
2. Laboratory scale preparations and purification.
3. Physical chemistry including chemical thermodynamics, chemical kinetics, and crystal structure.
4. Analytical methods, including mass spectroscopy.
5. General chemical engineering theory, design, construction and/or testing of laboratories and equipment of interest to chemists and chemical engineers.

See also categories C–7, C–10, C–16, C–55 for specialized applications.

C–7 *Chemistry; radiation and radiochemistry.* This category includes information on:

1. The chemical effects of radiation on matter.
2. The production of radioisotopes.
3. The chemical isolation and purification of radioisotopes and their compounds.
4. The chemistry of radioactive substances, including fission products.
5. The preparation of labeled compounds.
6. Tracer chemistry.
7. Effect of radiation on chemical reactions. See also categories C–4, C–10, and C–16.

C–10 *Chemistry; separation processes for plutonium and uranium.* This category includes information on:

1. The chemistry and chemical engineering of processes for the separation, decontamination, and processing of plutonium and uranium from materials or solutions containing real or simulated fission products.
2. The separation of U–233 from irradiated thorium, including the decontamination and purification of the U–233 and irradiated thorium.
3. Development work, chemical engineering problems, and pilot plant runs pertaining to the program of recovery of uranium from Hanford and Oak Ridge National Laboratory process solutions remaining after plutonium removal.

See also categories C–25, C–47, C–55, C–68 and C–78.

C–16 *Chemistry; transuranic elements.* This category includes information on:

The chemistry of the transuranic elements and their compounds.

C–20 *Controlled thermonuclear processes.* This category includes information on the theory, design, development, and operation of experiments relating to the controlled release of energy from thermonuclear reactions. Information relating to thermonuclear weapons is specifically excluded.

C–46 *Criticality hazards.* This category includes information on:

1. Critical mass experiments.
2. Safety precautions in conducting critical mass experiments.
3. Safe processing and storage of special nuclear materials.

This category does not include information on reactor hazards or critical experiments in support of reactor design (see categories C–42, C–80, and C–81).

C–41 *Health and safety.* This category includes information on biological

and medical studies
to the health and s
including such topi
erance and maxima
trations, clinical te
injury, industrial
measures and safety
nel decontaminatio
measures with res
active and other to
C–22 *Isotope sep*
gory includes inform
1. Any method (
fusion) of separati
topes of an element
isotopes of that ele
2. Design, constru
of the electrom
process.
3. Production an
isotopes.
4. Special metho
the separation of
isotopes.
See also categori
C–37 *Instrume*
gory includes infor
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struction, testing,
struments of all ty
only classified info
gory is that which
applications.
C–25 *Metallurg*
category includes i
1. Metallurgy, in
metal, of non-fiss
thorium, uranium
mixtures of uraniu
238.
2. Ceramics and
do not directly or e
plutonium technol
C–55.)
3. Corrosion st
metal, alloys, and
4. Design and r
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nium reactor fuel
those for productio
5. Laboratory-sc
sition of high-puri

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medical studies applicable directly the health and safety of personnel, luding such topics as toxicities, tol- ance and maximal allowable concen- ations, clinical tests and criteria of ury, industrial diseases, protective asures and safety procedures, person- decontamination, and therapeutic asures with respect both to radio- ive and other toxic agents.

C-22 *Isotope separation.* This cate- gory includes information on:

1. Any method (except gaseous dif- sion) of separating one or more iso- pes of an element from a mixture of topes of that element.
2. Design, construction, and operation the electromagnetic separation cess.
3. Production and isolation of stable topes.
4. Special methods such as those for separation of boron and hydrogen topes.

See also categories C–28 and C–34.

C-37 *Instrumentation.* This cate- gory includes information primarily re- ing to the design, development, con- uction, testing, or evaluation of in- uments of all types. In general the classified information in this cate- gory is that which describes classified lications.

C-25 *Metallurgy and ceramics.* This egory includes information on:

1. Metallurgy, including reduction to al, of non-fissionable substances, ium, uranium 233, and all isotopic tures of uranium 235 and uranium
2. Ceramics and refractories which not directly or exclusively pertain to nium technology. (See category
3. Corrosion studies on uranium al, alloys, and reactor elements.
4. Design and methods of manufac- coating, canning, and testing ura- reactor fuel elements, including for production reactors.
5. Laboratory-scale electrolytic depo- of high-purity uranium.
6. Laboratory-scale pyrometallurgi- cal studies toward separation of ura- nium and fission products.

See also category C–40.

C–26 *Metallurgy; raw materials.* This category includes information on:

1. Uranium, thorium, zirconium, beryllium ore and mineral beneficiation.
2. Design, development, and equip- ment relating to raw materials tech- nology.
3. Analytical procedures pertaining to ore beneficiation.
4. Chemical research directed toward the solution of raw materials processing problems.
5. Pilot plant, semi-works, or larger scale process design and flow sheets for beneficiation and concentration.

C–28 *Particle accelerators and high voltage machines.* This category in- cludes information on the design, de- velopment, construction, and operation of high-voltage machines and particle accelerators, including Van de Graaff generators, linear accelerators, cyclo- trons, synchrotons, bevatrons, X-ray machines, etc.

C–34 *Physics and mathematics.* This category is intended to cover basic phy- sics and mathematics and includes, but is not limited to, the following:

1. Nuclear characteristics of all ele- ments.
2. General theory of neutron diffusion and fundamental reactor theory.
3. Basic theory of shielding design and construction problems.
4. Mathematical theory and methods.
5. Mechanics, sound, and shock.
6. General heat-transfer and fluid- flow studies.
7. Basic theory of thermal diffusion, gaseous diffusion, and electromagnetic methods of isotope separation.
8. High-voltage break-down in vac- uum, insulation in vacuum, etc.
9. Experimental data on ion cross sections for electrons, ions, secondary emissions, etc.
10. The general phenomena of dis- charges in magnetic fields.

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C–40 *Radiation effects on reactor materials.* This category includes information on the effects of radiation on reactor components, for example: Wigner effect, blisterings, etc., and reports on the effects of radiation on plastics, lubricants, etc.

See also category C–7.

C–42 *Reactors; production.* This category includes information on:

1. Theory, design, construction and operation of Hanford and Savannah River production reactors, and any reactor proposed for large-scale production or special nuclear materials.

2. The effects of radiation on graphite and other structural materials which clearly relate to production reactors.

C–80 *Reactors; research and testing.* This category includes information on:

1. Theory, design, construction, and operation of nuclear reactors used primarily as a source of neutrons for the purpose of conducting experimental studies on neutron or other particle interactions with matter, or medical or biological research and application.

2. Fundamental shielding studies.

3. Basic nuclear research with reactors.

4. The production of nonfissionable isotopes.

5. Fundamental studies in breeding.

This category does not include:

1. Power reactors or experimental power reactors. (See category C–81.)

2. Classified defense information on reactors for military purposes.

C–81 *Reactors; power.* This category includes information on:

1. Theory, design, construction, and operation of nuclear reactors (including experimental power reactors) whose primary purpose is the production of power.

2. Economic, fundamental feasibility, development and design aspects of power reactors or experimental power reactor components.

3. Reactor technology and closely related topics pertaining to military reactors which are dissociated from military utilization systems.

This category does not include:

1. Classified defense information on nuclear power plants for military purposes.

2. Information concerning reactors for research or testing purposes.

3. Theory, design, and construction of production reactors.

4. Critical mass experiments or other physics data not related to specific power reactor design.

C–47 *Technology; feed materials.* This category includes information on:

1. Chemical research and development directed toward large-scale production of intermediate and feed materials, e. g., UO_2, UO_3, UF_4, UF_6, ThO_2, ThF_4, etc.

2. Refinery process development work for uranium ores and concentrates.

3. Uranium recovery procedures for scrap materials, residues, and effluents.

4. Quality control procedures pertinent to production of high-purity uranium compounds.

5. Designs, construction, and operational procedures for pilot-plant equipment.

See also category C–25.

C–66, 67, 68 *Technology; Hanford processes.* These categories include information in the design, construction, operation, and technology of present or proposed Hanford processes and reactors which is not included in categories C–25, C–42 and C–10 because it reveals operating levels, rates, and other production data.

C–66 Fuel element technology. (See category C–25.)

C–67 Reactor technology. (See category C–42.)

C–68 Separations process technology. (See category C–10.)

C–55 *Technology; plutonium.* This category includes information not involving weapons data on:

1. Reduction of plutonium compounds to metal.

2. Metallurgy of plutonium and its alloys.

3. Chemistry involved in final purification of plutonium compounds, pla

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ium metal production, and fabrica-

4. Special analytical techniques re-ired to determine the purity of pon grade plutonium.

5. Procedures for recovery of pluto-um from scrap materials, residues,

See also categories C–10, C–16.

C-76, 77, 78 *Technology; Savannah er processes.* These categories con-in information on the design, con-ction, operation and technology of ent or proposed Savannah River cesses and reactors which is not in-ed in categories C–25, C–42 and C–10 use it reveals operating levels, es, and other production data.

C-76 Fuel element technology. (See egory C–25.)

C-77 Reactor technology. (See cate-y C–42.)

C-78 Separations process technol-. (See category C–10.)

C-56 *Technology; tritium.* The pe note for this category is classified fidential. It will be sent upon re-st to properly cleared persons pur-nt to access permits.

C-70 *Radioactive waste.* This cate-y includes research and develop-nt information on:

1. Chemical and chemical engineering blems incidental to the storage and posal of waste radioactive materials, h natural and artificial.

2. Decontamination measures for cess equipment and other contami-ed surfaces.

3. Meteorological and geological in-mation applied to problems of radio-ve waste disposal or storage.

4. Air cleaning, control and disposal radioactive effluents.

Dated at Washington, D. C., this h day of January 1956.

R. W. Cook,
Acting General Manager.

Part 30—Licensing of Byproduct Material

This amendment to Title 10 CFR, t 30, Radioisotope Distribution, is published for the purpose of bringing it into conformity with the Atomic Energy Act of 1954 (68 Stat. 919) and to establish a simplified and less restrictive procedure relating to the export of byproduct material. In addition, changes have been incorporated in §§ 30.71 and 30.72 to permit the distribution of certain additional types of sealed sources and quantities and types of byproduct material to persons who do not hold specific licenses.

Except as required to accomplish the foregoing purposes, the changes effected by this revision are designed to simplify and clarify provisions of the existing regulations and not to effect substantial changes in the Commission's procedures and requirements relating to the licensing of byproduct material. In light of these considerations, the Atomic Energy Commission has found that general notice of proposed rule-making and public procedure thereon are unnecessary and would be contrary to the public interest.

The Commission has under consideration further amendments to Part 30 which will be published in accordance with procedures designed to afford the customary opportunity for public participation.

All interested persons who desire to submit written comments and suggestions relating to the following amendment should send them to the U. S. Atomic Energy Commission, Washington 25, D. C., Attention of the Director, Division of Civilian Application.

Effective thirty days after publication in the Federal Register, Part 30, Title 10, CFR, "Radioisotope Distribution Regulation" is hereby amended to read as follows:

General provisions

Sec.
30.1 Purpose.
30.2 Scope.
30.3 License requirements.
30.4 Definitions.
30.5 Interpretations.

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EXEMPTIONS

Sec.
30.6 Persons operating Commission-owned facilities.
30.7 Carriers.
30.8 Other exemptions.

GENERAL LICENSES—APPLICATIONS FOR LICENSES

30.20 Types of licenses.
30.21 General licenses.
30.22 Applications for specific licenses.
30.23 General requirements for issuance of specific licenses.
30.24 Special requirements for issuance of specific licenses.

LICENSES

30.31 Issuance of specific licenses for use of byproduct material.
30.32 Terms and conditions of licenses.
30.33 Exports of byproduct material.
30.34 Expiration.
30.35 Renewal of license.
30.36 Amendment of licenses at request of licensee.
30.37 Commission action on applications to renew or amend.
30.38 Inalienability of licenses.
30.39 Persons possessing byproduct material on effective date of regulations in this part.

RECORDS, REPORTS AND INSPECTIONS

30.41 Records.
30.42 Reports of exports.
30.43 Inspection.
30.44 Tests

MODIFICATION AND REVOCATION OF LICENSES

30.51 Modification and revocation of licenses.
30.52 Right to withhold or recall byproduct material.

ENFORCEMENT

30.61 Violations.

SCHEDULES

30.71 Schedule A.
30.72 Schedule B.

AUTHORITY: §§ 30.1 to 30.72 issued under sec. 161, 68 Stat. 948; 42 U. S. C. 2201. Interpret or apply secs. 81, 82, 182, 183, 68 Stat. 935, 953, 954, 42 U. S. C. 2111, 2112, 2232, 2233. For the purposes of sec. 223, 68 Stat. 958; 42 U. S. C. 2273, §§ 30.21 (b) and 30.22 (a) issued under sec. 161b, 68 Stat. 948; 42 U. S. C. 2201 (b) and §§ 30.41, 30.42 and 30.43 issued under sec. 161p, 68 Stat. 950; 42 U. S. C. 2201p.

GENERAL PROVISIONS

§ 30.1 *Purpose.* The regulations in this part are promulgated by the Atomic Energy Commission, pursuant to the Atomic Energy Act of 1954 (68 Stat. 919), to provide for the licensing of byproduct material.

§ 30.2 *Scope.* Except as provided in §§ 30.6 to 30.8, the regulations in this part apply to all persons in the United States.

§ 30.3 *License requirements.* No person subject to the regulations in this part shall manufacture, produce, transfer, receive, acquire, own, possess, use, import or export byproduct material except as authorized in a specific or general license issued pursuant to the regulations in this part.

§ 30.4 *Definitions.* As used in this part:

(a) "Act" means the Atomic Energy Act of 1954, including any amendments thereto;

(b) "Byproduct material" means any radioactive material (except special nuclear material) yielded in or made radioactive by exposure to the radiation incident to the process of producing or utilizing special nuclear material;

(c) "Commission" means the Atomic Energy Commission and its duly authorized representatives;

(d) "Curie" means that amount of radioactive material which disintegrates at the rate of 37 billion atoms per second;

(e) "Human use" means the internal or external administration of byproduct material, or the radiation therefrom, to human beings;

(f) "License," except where otherwise specified means a license issued pursuant to the regulations in this part;

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per second;
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(g) "Microcurie" means that amount of radioactive material which disintegrates at the rate of 37 thousand atoms per second;

(h) "Person" means (1) any individual, corporation, partnership, firm, association, trust, estate, public or private institution, group, Government agency other than the Commission, any State or any political subdivision of, or any political entity within a State, any foreign government or nation or any political subdivision of any such government or nation, or other entity; and (2) any legal successor, representative, agent, or agency of the foregoing;

(i) "Physician" means an individual licensed by a state or territory of the United States, the District of Columbia or the Commonwealth of Puerto Rico to dispense drugs in the practice of medicine;

(j) "Production facility" means production facility as defined in the regulations contained in Part 50 of this chapter;

(k) "Research and development" means (1) theoretical analysis, exploration, or experimentation; or (2) the extension of investigative findings and theories of a scientific or technical nature into practical application for experimental and demonstration purposes, including the experimental production and testing of models, devices, equipment, materials and processes. "Research and development" as used in this part does not include the internal or external administration of byproduct material, or the radiation therefrom, to human beings;

(l) "Sealed source" means any byproduct material that is encased in, and is to be used in, a container in a manner intended to prevent leakage of the byproduct material;

(m) "Source material" means source material as defined in the regulations contained in Part 40 of this chapter;

(n) "Special nuclear material" means special nuclear material as defined in the regulations contained in Part 70 of this chapter;

(o) "United States," when used in a geographical sense, includes all territories and possessions of the United States, the Canal Zone and Puerto Rico.

(p) "Utilization facility" means a utilization facility as defined in the regulations contained in Part 50 of this chapter;

(q) Other terms defined in section 11 of the act shall have the same meaning when used in the regulations in this part.

§ 30.5 *Interpretations.* Except as specifically authorized by the Commission in writing, no interpretation of the meaning of the regulations in this part by any officer or employee of the Commission other than a written interpretation by the General Counsel will be recognized to be binding upon the Commission.

EXEMPTIONS

§ 30.6 *Persons operating Commission-owned facilities.* Any person is exempt from the requirements for a license set forth in section 81 or 82 of the act and from the regulations in this Part to the extent that such person operates Commission-owned plants and laboratories on behalf of the Commission. In any such case, such person's obligations with respect to the byproduct material are covered by the applicable contract between such person and the Commission.

§ 30.7 *Carriers.* Common and contract carriers and the United States Post Office Department are exempt from the regulations in this part and the requirements for a license set forth in section 81 of the act to the extent that they transport byproduct material in the regular course of their business as carriers.

§ 30.8. *Other exemptions.* The Commission may upon the application of any interested person, or upon its own initiative, exempt certain classes or quantities of byproduct material or kinds of uses or users from the requirements for a license set forth in section

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81 of the act and in the regulations in this part, when it makes a finding that the exemption of such classes or quantities of such material or such kinds of uses or users will not constitute an unreasonable risk to the common defense and security and to the health and safety of the public.

GENERAL LICENSES; APPLICATIONS FOR LICENSES

§ 30.20 *Types of licenses.* (a) Licenses for byproduct material are of two types: general and specific. The general licenses provided in § 30.21 are effective without the filing of applications with the Commission or the issuance of licensing documents to particular persons. Specific licenses are issued to named persons upon applications filed pursuant to the regulations in this part.

§ 30.21 *General licenses.* (a) A general license is hereby issued:

(1) To transfer, receive, acquire, own, possess and use byproduct material incorporated in a device or equipment which is listed in § 30.71 and has been manufactured pursuant to a specific license issued by the Commission.

(2) To transfer, receive, acquire, own, possess, use and import the quantities of byproduct materials listed in § 30.72, provided that no person shall at any one time possess or use, pursuant to the general licensing provisions of this paragraph, more than a total of ten such scheduled quantities.

(b) The general licenses provided in this section are subject to the provisions of §§ 30.32 to 30.72, inclusive of the regulations in this part and are subject to the regulations contained in Part 20 of this chapter. In addition, persons who transfer, receive, acquire, own, possess, use or import scheduled items and quantities of byproduct material pursuant to the general licenses provided in paragraph (a) of this section.

(1) Shall not effect an increase in the radioactivity of said scheduled items or quantities by adding other radioactive material thereto, by combining byproduct material from two or more such items or quantities, or by altering them in any other manner so as to increase thereby the rate of radiation therefrom;

(2) Shall not administer externally or internally, or direct the administration of, said scheduled items or quantities or any part thereof to a human being for any purpose, including, but not limited to, diagnostic, therapeutic, and research purposes.

(3) Shall not add, or direct the addition of, said scheduled items or quantities or any part thereof to any food, beverage, cosmetic, drug, or other product designed for ingestion or inhalation by, or application to, a human being;

(4) Shall not include said scheduled items or quantities or any part thereof in any device, instrument, apparatus (including components parts and accessories thereto) intended for use in diagnosis, treatment or prevention of disease in human beings or animals or otherwise intended to affect the structure or any function of the body of human beings or animals.

§ 30.22 *Applications for specific licenses.* (a) Applications for specific licenses shall be filed on Form AEC 313, "Application for By-Product Material License", with the United States Atomic Energy Commission, Post Office Box E, Oak Ridge, Tennessee, Attention: Isotopes Division, and shall set forth the information called for by the form. Information contained in previous applications, statements or reports filed with the Commission may be incorporated by reference, provided that such references are clear and specific.

(b) The Commission may at any time after the filing of the original application, and before the expiration of the license, require further statements in order to enable the Commission to determine whether the application should be granted or denied or whether a license should be modified or revoked.

(c) Each application shall be signed under oath or affirmation by the applicant or licensee or a person duly authorized to act for and on his behalf.

(d) An appli
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(d) An application for license filed pursuant to the regulations in this part will be considered also as an application for licenses authorizing other activities for which licenses are required by the act, provided that the application specifies the additional activities for which licenses are requested and complies with regulations of the Commission as to applications for such licenses.

§ 30.23 *General requirements for issuance of specific licenses.* An application for a specific license will be approved if:

(a) The application is for a purpose authorized by the act; and

(b) The applicant's proposed equipment and facilities are adequate to protect health and minimize danger to life or property; and

(c) The applicant is qualified by training and experience to use the material for the purpose requested in such manner as to protect health and minimize danger to life or property; and

(d) The applicant satisfies any applicable special requirements contained in § 30.24.

§ 30.24 *Special requirements for issuance of specific licenses*—(a) *Human use in institutions.* An application by an institution for a specific license for human use will be approved if:

(1) The applicant satisfies the general requirements specified in § 30.23; and

(2) The applicant has appointed a medical isotopes committee of at least three members to evaluate all proposals for research, diagnosis, and therapeutic use of radioisotopes within that institution. Membership of the committee should include physicians expert in internal medicine, hematology, therapeutic radiology, and a person experienced in assay of radioisotopes and protection against ionizing radiations; and

(3) The applicant possesses adequate facilities for the clinical care of patients; and

(4) The physician designated on the application as the individual user has substantial experience in the proposed use, the handling and administration of radioisotopes and, where applicable, the clinical management of radioactive patients; and

(5) If the application is for a license to use unspecified quantities or multiple types of byproduct material, the applicant has previously received a reasonable number of licenses for a variety of byproduct materials for a variety of human uses.

(b) *Licensing of individual physicians for human use.* An application by an individual physician for a specific license for human use will be approved if the applicant:

(1) Satisfies the general requirements specified in § 30.23;

(2) The applicant has access to a hospital possessing adequate facilities to hospitalize and monitor the applicant's radioactive patients whenever it is advisable; and

(3) The applicant has extensive experience in the proposed use, the handling and administration of radioisotopes, and where applicable, the clinical management of radioactive patients. (The physician shall furnish suitable evidence of such experience with his application. A statement from the medical isotope committee in the institution where he acquired his experience, indicating its amount and nature, may be submitted as evidence of such experience.)

(c) *"Human use" of sealed sources.* An application for a specific license for use of a sealed source for human use will be approved if:

(1) The applicant satisfies the general requirements specified in § 30.23; and

(2) The applicant or, if the application is made by an institution, the individual user (i) has specialized training in the theapeutic use of the radioactive device considered (teletherapy unit, beta applicator, etc.) or has experience equivalent to such training; and (ii) is a physician.

(d) *Multiple quantities or types of byproduct material for use in research*

and development. An application for a specific license for multiple quantities or types of byproduct material for use in research and development will be approved if:

(1) The applicant satisfies the general requirements specified in § 30.23; and

(2) The applicant has received a reasonable number of licenses for a variety of radioisotopes for a variety of research and development uses; and

(3) The applicant has established an isotope committee (composed of such persons as a radiological safety officer, a representative of the business office, and one or more persons trained or experienced in the safe use of radioactive materials) which will review and approve, in advance of purchase of radioisotopes, proposals for such uses; and

(4) The applicant has appointed a radiological safety officer who will advise on or be available for advice and assistance on radiological safety problems.

(e) *Multiple quantities or types of byproduce material for use in processing.* An application for a specific license for multiple quantities or types of byproduct material for use in processing for distribution to other authorized persons will be approved if:

(1) The applicant satisfies the general requirements specified in § 30.23; and

(2) The applicant has received a reasonable number of licenses for processing and distribution of a variety of radioisotopes; and

(3) The applicant has appointed a radiological safety officer who will advise on or be available for advice and assistance on radiological safety problems.

LICENSES

§ 30.31 *Issuance of specific licenses for use of byproduct material.* (a) Upon a determination that an application meets the requirements of the Act and the regulations of the Commission, the Commission will issue a specific license authorizing the possession and use of byproduct material (Form AEC 374, "Byproduct Material License").

(b) The Commission may incorporate in any license at the time of issuance, or thereafter by appropriate rule, regulation or order, such additional requirements and conditions with respect to the licensee's receipt, possession, use and transfer of byproduct material as it deems appropriate or necessary in order to:

(1) Promote the common defense and security;

(2) Protect health or to minimize danger to life or property;

(3) Protect restricted data;

(4) Require such reports and the keeping of such records, and to provide for such inspections of activities under the license as may be necessary or appropriate to effectuate the purposes of the act and regulations thereunder.

§ 30.32 *Terms and conditions of licenses.* (a) Each license issued pursuant to the regulations in this part shall be subject to all the provisions of the act, now or hereafter in effect, and to all valid rules, regulations and orders of the Commission.

(b) Neither the license nor any right under the license shall be assigned or otherwise transferred in violation of the provisions of the act.

(c) Each person licensed by the Commission pursuant to the regulations in this part shall confine his possession and use of byproduct material to the locations and purposes authorized in the license. Except as otherwise provided in the license, a license issued pursuant to the regulations in this part shall carry with it the right to receive, acquire, own, possess and import byproduct material and to transfer such material to other licensees within the United States authorized to receive such material.

(d) Each license issued pursuant to the regulations in this part shall be deemed to contain the provisions set forth in section 183a.-d., inclusive, of the act, whether or not said provisions are expressly set forth in the license.

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§ 30.33 *Exports of byproduct material.* (a) No licensee shall export byproduct material from the United States except as authorized pursuant to this section.

(b) Any licensee may export byproduct material covered by his license to any foreign country except countries or areas now or hereafter listed as Subgroup A countries or destinations in § 371.3 of the Comprehensive Export Schedule of the United States Department of Commerce (15 CFR 371.3): *Provided*, That the authority conferred by this paragraph shall apply only to byproduct material having an atomic number from 3 to 83, inclusive.

(c) The Commission may upon application by an interested person issue a license authorizing the export of byproduct material to a country or area listed as a Subgroup A country or destination in § 371.3 of the Comprehensive Export Schedule of the United States Department of Commerce (15 CFR 371.3), or the export of byproduct material not having an atomic number from 3 to 83, inclusive: *Provided*, That the Commission will not issue a license authorizing such export if, in the opinion of the Commission, the proposed export would be inimical to the common defense and security.

§ 30.34 *Expiration.* Except as provided in § 30.35 (b), each specific license shall expire at the end of the day, on the month and year stated therein.

§ 30.35 *Renewal of license.* (a) Applications for renewal of a specific license shall be filed in accordance with § 30.22.

(b) In any case in which a licensee, not less than thirty (30) days prior to expiration of his existing license, has filed an application in proper form for renewal or for a new license, such existing license shall not expire until the application for a renewal has been finally determined by the Commission.

§ 30.36 *Amendment of licenses at request of licensee.* Applications for amendment of a license shall be filed in accordance with § 30.22 and shall specify the respects in which the licensee desires his license to be amended and the grounds for such amendment.

§ 30.37 *Commission action on applications to renew or amend.* In considering an application by a licensee to renew or amend his license the Commission will apply the applicable criteria set forth in §§ 30.23 and 30.24.

§ 30.38 *Inalienability of licenses.* No license issued or granted pursuant to the regulations in this part shall be transferred, assigned or in any manner disposed of, either voluntarily or involuntarily, directly or indirectly, through transfer of control of any license to any person, unless the Commission shall, after securing full information, find that the transfer is in accordance with the provisions of this act, and shall give its consent in writing.

§ 30.40. *Persons possessing byproduct material on effective date of regulations in this part.* (a) Any person who on the effective date of the regulations in this part possesses byproduct material pursuant to an authorization heretofore issued by the Commission shall be deemed to possess such material pursuant to a license issued under the regulations in this part which shall expire ninety days after receipt from the Commission of a notice of expiration of such license. Such license shall be deemed to include all terms and conditions incorporated in such authorization which are not inconsistent with or otherwise provided for in the regulations in this part.

(b) Any authorization heretofore issued pursuant to the regulations in this part shall be deemed to be a valid license during the period prior to the expiration date set forth in said authorization. Such license shall be deemed to include all terms and conditions incorporated in such authorization which are not inconsistent with or otherwise provided for in the regulations in this part.

RECORDS, REPORTS AND INSPECTIONS

§ 30.41 *Records.* (a) Each person who receives byproduct material pursuant to a license issued pursuant to the

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regulations in this part shall keep records showing the receipt, transfer, export and disposal of such byproduct material.

§ 30.42 *Reports of exports.* Each licensee who exports byproduct material from the United States shall, within 90 days from the date of such export, submit a report to the United States Atomic Energy Commission, Post Office Box E, Oak Ridge, Tennessee, Attention: Isotopes Division, containing his name and address, the name and address of the consignee, the name and quantity of the byproduct material involved, and the date of shipment.

§ 30.43 *Inspection.* (a) Each licensee shall afford to the Commission at all reasonable times opportunity to inspect byproduct material and the premises and facilities wherein byproduct material is used or stored.

(b) Each licensee shall make available to the Commission for inspection, upon reasonable notice, records kept by him pursuant to the regulations in this chapter.

§ 30.44 *Tests.* Each licensee shall perform, or permit the Commission to perform, such tests as the Commission deems appropriate or necessary for the administration of the regulations in this part, including tests of:

(a) Byproduct material,

(b) Facilities wherein byproduct material is utilized or stored,

(c) Radiation detection and monitoring instruments, and

(d) Other equipment and devices used in connection with the utilization or storage of byproduct material.

MODIFICATION AND REVOCATION OF LICENSES

§ 30.51 *Modification and revocation of licenses.* (a) The terms and conditions of each license shall be subject to amendment, revision or modification by reason of amendments to the act, or by reason of rules, regulations and orders issued in accordance with the terms of the act.

(b) Any license may be revoked, suspended or modified, in whole or in part, for any material false statement in the application or any statement of fact required under section 182 of the act, or because of conditions revealed by such application or statement of fact or any report, record or inspection or other means which would warrant the Commission to refuse to grant a license on an original application, or for violation of, or failure to observe any of the terms and provisions of the act or of any rule, regulation or order of the Commission.

(c) Except in cases of wilfulness or those in which the public health, interest or safety requires otherwise, no license shall be modified, suspended or revoked unless, prior to the institution of proceedings therefor, facts or conduct which may warrant such action shall have been called to the attention of the licensee in writing and the licensee shall have been accorded an opportunity to demonstrate or achieve compliance with all lawful requirements.

§ 30.52 *Right to withhold or recall byproduct material.* The Commission may withhold, recall or order the withholding or recall of byproduct material from any licensee who is not equipped to observe or fails to observe such safety standards to protect health as may be established by the Commission, or who uses such materials in violation of law or regulation of the Commission, or in a manner other than as disclosed in the application therefor or approved by the Commission.

ENFORCEMENT

§ 30.61 *Violations.* An injunction or other court order may be obtained prohibiting any violation of any provision of the act or any regulation or order issued thereunder. Any person who wilfully violates any provision of the act or any regulation or order issued thereunder may be guilty of a crime and upon conviction, may be punished by

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Arsenic 77 (As 77
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Beryllium (Be 7
Cadmium 109-
(CdAg 109)
Calcium 45 (Ca
Carbon 14 (C 14)
Cerium 144—P
(CePr 144)
Cesium—Bariun
137)
Chlorine 36 (Cl
Chromium 51 (C
Cobalt 60 (Co 6
Copper 64 (Cu 6
Europium 154 (
Fluorine 18
Gallium 72 (Ga
Germanium 71 (
Gold 198 (Au 19
Gold 199 (Au 19
Hydrogen 3 (Tr

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...or imprisonment or both, as pro-...ed by law.

SCHEDULES

§ 30.71 *Schedule A.* The following ...vices and equipment incorporating ...product material, when manufac-...ed, tested and labeled by the manu-...turer in accordance with the manu-...turing, testing and labeling specifi-...tions contained in a specific license is-...ed to him pursuant to the regulations ...this part, are generally licensed pur-...ant to § 30.21 (a) (1).

(a) *Static elimination device.* De-...es designed for use as static elimina-...rs which contain byproduct material ...sisting of not more than 500 micro-...ries of polonium 210.

(b) *Spark gap and electronic tubes.* ...ark gap tubes and electronic tubes ...hich contain byproduct material con-...sting of not more than 5 microcuries of ...sium 137 or Nickel 63 per tube, or not ...re than one microcurie of Cobalt 60 ...r tube.

§ 30.72 *Schedule B.* The following ...antities of byproduct material are ...nerally licensed pursuant to § 30.21 ...) (2).

Byproduct material	Column No. I Not as a sealed source (microcuries)	Column No. II As a sealed source (microcuries)
...mony (Sb 124)	1	10
...nic 76 (As 76)	10	10
...nic 77 (As 77)	10	10
...um 140—Lanthanum 140 (BaLa 140)	1	10
...yllium (Be 7)	50	50
...mium 109—Silver 109 (CdAg 109)	10	10
...um 45 (Ca 45)	10	10
...bon 14 (C 14)	50	50
...um 144—Praseodymium (CePr 144)	1	10
...um—Barium 137 (CeBa 137)	1	10
...orine 36 (Cl 36)	1	10
...omium 51 (Cr 51)	50	50
...balt 60 (Co 60)	1	10
...per 64 (Cu 64)	50	50
...opium 154 (Eu 154)	1	10
...orine 18	50	50
...lium 72 (Ga 72)	10	10
...rmanium 71 (Ge 71)	50	50
...d 198 (Au 198)	10	10
...d 199 (Au 199)	10	10
...rogen 3 (Tritium) (H 3)	250	250
Indium 114 (In 114)	1	10
Iodine 131 (I 131)	10	10
Iridium 192 (Ir 192)	10	10
Iron 55 (Fe 55)	50	50
Iron 59 (Fe 59)	1	10
Lanthanum 140 (La 140)	10	10
Manganese 52 (Mn 52)	1	10
Manganese 56 (Mn 56)	50	50
Molybdenum 99 (Mo 99)	10	10
Nickel 59 (Ni 59)	1	10
Nickel 63 (Ni 63)	1	10
Niobium 95 (Nb 95)	10	10
Palladium 109 (Pd 109)	10	10
Palladium 103—Rhodium 103 (PdRh 103)	50	50
Phosphorus 32 (P 32)	10	10
Polonium 210 (Po 210)	0.1	1
Potassium 42 (K-42)	10	10
Praseodymium 143 (Pr 143)	10	10
Promethium 147 (Pm 147)	10	10
Rhenium 186 (Re 186)	10	10
Rhodium 105 (Rh 105)	10	10
Rubidium 86 (Rb 86)	10	10
Ruthenium 106—Rhodium 106 (RuRh 106)	1	10
Samarium 153 (Sm 153)	10	10
Scandium 46 (Sc 46)	1	10
Silver 105 (Ag 105)	1	10
Silver 111 (Ag 111)	10	10
Sodium 22 (Na 22)	10	10
Sodium 24 (Na 24)	10	10
Strontium 89 (Sr 89)	1	10
Strontium 90—Yttrium 90 (SrY)	0.1	1
Sulfur 35 (S 35)	50	50
Tantalum 182 (Ta 182)	10	10
Technetium 96 (Tc 96)	1	10
Technetium 99 (Tc 99)	1	10
Tellurium 127 (Te 127)	10	10
Tellurium 129 (Te 129)	1	10
Thallium 204 (Tl 204)	50	50
Tin 113 (Sn 113)	10	10
Tungsten 185 (W 185)	10	10
Vanadium 48 (V 48)	1	10
Yttrium 90 (Y 90)	1	10
Yttrium 91 (Y 91)	1	10
Zinc 65 (Zn 65)	10	10

NOTE: The reporting and record-keeping requirements contained herein have been approved by the Bureau of the Budget in accordance with The Federal Reports Act of 1942.

Dated at Washington, D. C., this 28th day of December 1955.

K. E. FIELDS,
General Manager.

PART 50—LICENSING OF PRODUCTION AND UTILIZATION FACILITIES

Effective 30 days after publication in the FEDERAL REGISTER, Part 50, 10 CFR, "Control of Facilities for the Production of Fissionable Material," is hereby amended to read as follows:

GENERAL PROVISIONS

Sec.
50.1 Basis and purpose.
50.2 Definitions.
50.3 Interpretations.

REQUIREMENT OF LICENSE, EXCEPTIONS

50.10 License required.
50.11 Exceptions and exemptions from license.
50.12 Specific exemptions.

CLASSIFICATION AND DESCRIPTION OF LICENSES

50.20 Two classes of licenses.
50.21 Class 104 licenses; for medical therapy and research and development facilities.
50.22 Class 103 licenses; for commercial and industrial facilities.
50.23 Construction permits.

APPLICATIONS FOR LICENSES, FORM, CONTENTS, INELIGIBILITY OF CERTAIN APPLICANTS

50.30 Applications for licenses, oath or affirmation.
50.31 Combining applications.
50.32 Elimination of repetition.
50.33 Contents of applications; general information.
50.34 Contents of applications; technical information hazards summary report.
50.35 Extended time for providing technical information.
50.36 Designation of technical specifications.
50.37 Agreement limiting access to Restricted Data.
50.38 Ineligibility of certain applicants.
50.39 Public inspection of applications.

STANDARDS FOR LICENSES AND CONSTRUCTION PERMITS

50.40 Common standards.
50.41 Additional standards for class 104 licenses.
50.42 Additional standards for class 103 licenses.
50.43 Additional standards and provisions affecting class 103 licenses for commercial power.
50.44 Standards for licenses authorizing export only.
50.45 Standards for construction permits.

ISSUANCE, LIMITATIONS, AND CONDITIONS OF LICENSES AND CONSTRUCTION PERMITS

50.50 Issuance of licenses and construction permits.
50.51 Duration of license, renewal.
50.52 Combining licenses.
50.53 Jurisdictional limitations.
50.54 Conditions of licenses.
50.55 Conditions of construction permits.
50.56 Conversion of construction permit to license; or amendment of license.

ALLOCATION OF SPECIAL NUCLEAR MATERIAL

50.60 Allocation of special nuclear material.

INSPECTIONS, RECORDS, REPORTS

50.70 Inspections.
50.71 Maintenance of records, making of reports.

TRANSFER OF LICENSES-CREDITORS' RIGHTS; SURRENDER OF LICENSES

[§§50.80 to 50.89 reserved]

AMENDMENT OF LICENSE OR CONSTRUCTION PERMIT AT REQUEST OF HOLDER

50.90 Application for amendment of license or construction permit.
50.91 Issuance of amendment.

REVOCATION, SUSPENSION, MODIFICATION, AMENDMENTS OF LICENSES AND CONSTRUCTION PERMITS, EMERGENCY OPERATIONS BY THE COMMISSION

50.100 Revocation, suspension, modification of licenses and construction permits for cause.
50.101 Retaking possession of special nuclear material.

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sec.
50.102 Commission operation after revocation.
50.103 Suspension and operation in war or national emergency.

ENFORCEMENT

50.110 Violations.

AUTHORITY: §§ 50.1 to 50.110 issued under sec. 103, 68 Stat. 936, sec. 104, 68 Stat. 937, sec. 161, 68 Stat. 948, sec. 182, 68 Stat. 953, sec. 183, 68 Stat. 954; 42 U. S. C. 2133, 2134, 2201, 2232, 2233. For the purposes of sec. 223, 68 Stat. 958; 42 U. S. C. 2273, § 50.54 (i) issued under sec. 161i, 68 Stat. 949; 42 U. S. C. 2201, and § 50.70 to 50.71 issued under sec. 161p, 68 Stat. 950; 42 U. S. C. 2201.

GENERAL PROVISIONS

§ 50.1 *Basis purpose, and procedures applicable.* The regulations in this part are promulgated by the Atomic Energy Commission, pursuant to the Atomic Energy Act of 1954 (68 Stat. 919), to provide for the licensing of production and utilization facilities.

§ 50.2 *Definitions.* As used in this part,

(a) "Production facility" means:

(1) Any nuclear reactor designed or used primarily for the formation of plutonium or uranium 233; or

(2) Any facility designed or used for the separation of the isotopes of uranium or the isotopes of plutonium, except laboratory scale facilities designed or used for experimental or analytical purposes only; or

(3) Any facility designed or used for the processing of irradiated materials containing special nuclear material, except laboratory scale facilities designed or used for experimental or analytical purposes only.

(b) "Utilization facility" means any nuclear reactor other than one designed or used primarily for the formation of plutonium or U-233.

NOTE: Pursuant to sections 11p and 11r, respectively, of the Act, the Commission may from time to time add to, or otherwise alter, the foregoing definitions of production and utilization facility. It may also include as a facility an important component part especially designed for a facility, but has not at this time included any component parts in the definitions.

(c) "Act" means the Atomic Energy Act of 1954 (68 Stat. 919) including any amendments thereto.

(d) "Agreement for cooperation" means any agreement with another nation or regional defense organization, authorized or permitted by sections 54, 57, 64, 82, 103, 104, or 144 of the act, and made pursuant to section 123 of the act.

(e) "Atomic energy" means all forms of energy released in the course of nuclear fission or nuclear transformation.

(f) "Atomic weapon" means any device utilizing atomic energy, exclusive of the means for transporting or propelling the device (where such means is a separable and divisible part of the device), the principal purpose of which is for use as, or for development of, a weapon, a weapon prototype, or a weapon test device.

(g) "By-product material" means any radioactive material (except special nuclear material) yielded in or made radioactive by exposure to the radiation incident to the process of producing or utilizing special nuclear material.

(h) "Commission" means the Atomic Energy Commission or its duly authorized representatives.

(i) "Common defense and security" means the common defense and security of the United States.

(j) "Government agency" means any executive department, commission, independent establishment, corporation, wholly or partly owned by the United States of America which is an instrumentality of the United States, or any board, bureau, division, service, office, officer, authority, administration, or other establishment in the executive branch of the Government.

(k) "Nuclear reactor" means an apparatus, other than an atomic weapon,

designed or used to sustain nuclear fission in a self-supporting chain reaction.

(l) "Person" means (1) any individual, corporation, partnership, firm, association, trust, estate, public or private institution, group, Government agency other than the Commission, any State or any political subdivision of, or any political entity within a State, any foreign government or nation or any political subdivision of any such government or nation, or other entity; and (2) any legal successor, representative, agent, or agency of the foregoing.

(m) "Produce," when used in relation to special nuclear material, means (1) to manufacture, make, produce, or refine special nuclear material; (2) to separate special nuclear material from other substances in which such material may be contained; or (3) to make or to produce new special nuclear material.

(n) "Research and development" means (1) theoretical analysis, exploration, or experimentation; or (2) the extension of investigative findings and theories of a scientific or technical nature into practical application for experimental and demonstration purposes, including the experimental production and testing of models, devices, equipment, materials, and processes.

(o) "Restricted Data" means all data concerning (1) design, manufacture, or utilization of atomic weapons; (2) the production of special nuclear material; or (3) the use of special nuclear material in the production of energy, but shall not include data declassified or removed from the Restricted Data category pursuant to section 142 of the act.

(p) "Source material" means source material as defined in section 11s of the act and in the regulations contained in Part 40 of this chapter.

(q) "Special nuclear material" means (1) plutonium, uranium 233, uranium enriched in the isotope 233 or in the isotope 235, and any other material which the Commission, pursuant to the provisions of section 51 of the act, determines to be special nuclear material, but does not include source material; or (2) any material artificially enriched by any of the foregoing, but does not include source material.

(r) "United States," when used in a geographical sense, includes all Territories and possessions of the United States, the Canal Zone, and Puerto Rico.

§ 50.3 *Interpretations.* Except as specifically authorized by the Commission in writing, no interpretation of the meaning of the regulations in this part by any officer or employee of the Commission other than a written interpretation by the General Counsel will be recognized to be binding upon the Commission.

REQUIREMENT OF LICENSE, EXCEPTIONS

§ 50.10 *License required.* Except as provided in § 50.11, no person within the United States shall transfer or receive in interstate commerce, manufacture, produce, transfer, acquire, possess, use, import, or export any production or utilization facility except as authorized by a license issued by the Commission.

§ 50.11 *Exceptions and exemptions from license.* Nothing in this part shall be deemed to require a license for:

(a) The manufacture, production, or acquisition by the Department of Defense of any utilization facility authorized pursuant to section 91 of the act, or the use of such facility by the Department of Defense or by a person under contract with and for the account of the Department of Defense;

(b) The processing, fabricating, or refining of special nuclear material, or the separation of special nuclear material, or the separation of special nuclear material from other substances, under contract with and for the account of the Commission;

(c) The construction or operation of production or utilization facilities under contract with and for the account of the Commission; or

(d) The transportation or possession of any production or utilization facility by a common or contract carrier

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or warehouseman in the regular course of carriage for another or storage incident thereto.

§ 50.12 *Specific exemptions.* The Commission may, upon application by any interested person, grant such exemptions from the requirements of the regulations in this part as it determines are authorized by law and will not endanger life or property or the common defense and security and are otherwise in the public interest.

CLASSIFICATION AND DESCRIPTION OF LICENSES

§ 50.20 *Two classes of licenses.* Licenses will be issued to named persons applying to the Commission therefor, and will be either class 104 or class 103.

§ 50.21 *Class 104 licenses; for medical therapy and research and development facilities.* A class 104 license will be issued, to an applicant who qualifies, for any one or more of the following: to transfer or receive in interstate commerce, manufacture, produce, transfer, acquire, possess, use, import, or export under the terms of an agreement for cooperation:

(a) A utilization facility for use in medical therapy; or

(b) A production or utilization facility involved in the conduct of research and development activities leading to the demonstration of the practical value of the facility for industrial or commercial purposes; or

(c) A production or utilization facility, which is useful in the conduct of research and development activities of the types specified in section 31 of the act, and which is not a facility of the type specified in subparagraph (b) of this section.

§ 50.22 *Class 103 licenses; for commercial and industrial facilities.* A class 103 license will be issued, to an applicant who qualifies, for any one or more of the following: to transfer or receive in interstate commerce, manufacture, produce, transfer, acquire, possess, use, import, or export under the terms of an agreement for cooperation, a production or utilization facility which is of a type found in writing by the Commission, to have been sufficiently developed to be of practical value for industrial or commercial purposes.

§50.23 *Construction permits.* A construction permit for the construction of a production or utilization facility will be issued prior to the issuance of a license if the application is otherwise acceptable, and will be converted upon due completion of the facility and Commission action into a license as provided in § 50.56. A construction permit for the alteration of a production or utilization facility will be issued prior to the issuance of an amendment of a license, if the application for amendment is otherwise acceptable, as provided in § 50.91.

APPLICATION FOR LICENSES, FORM, CONTENTS, INELIGIBILITY OF CERTAIN APPLICANTS

§ 50.30 *Applications for licenses, oath or affirmation.* Each application for a license, including whenever appropriate a construction permit, should be filed in sextuplicate with the Commission at 1901 Constitution Avenue, Washington 25, D. C., Attention: Division of Civilian Application. Each application shall be signed by the applicant or duly authorized officer thereof under oath or affirmation.

§ 50.31 *Combining applications.* An applicant may combine in one his several applications for different kinds of licenses under the regulations in this chapter.

§ 50.32. *Elimination of repetition.* In his application, the applicant may incorporate by reference information contained in previous applications, statements or reports filed with the Commission: *Provided,* That such references are clear and specific.

§ 50.33. *Contents of applications; general information.* Each application shall state:

(a) Name of applicant;

(b) Address of applicant;

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(c) Description of business or occupation of applicant;

(d) (1) If applicant is an individual, state citizenship.

(2) If applicant is a partnership, state name, citizenship and address of each partner and the principal location where the partnership does business.

(3) If applicant is a corporation or an unincorporated association, state:

(i) The state where it is incorporated or organized and the principal location where it does business;

(ii) The names, addresses and citizenship of its directors and of its principal officers;

(iii) Whether it is owned, controlled, or dominated by an alien, a foreign corporation, or foreign government, and if so, give details.

(4) If the applicant is acting as agent or representative of another person in filing the application, identify the principal and furnish information required under this paragraph with respect to such principal.

(e) The class of license applied for, the use to which the facility will be put, the period of time for which the license is sought, and a list of other licenses, except operator's licenses, issued or applied for in connection with the proposed facility.

(f) The financial qualification of the applicant to engage in the proposed activities in accordance with the regulations in this chapter. If the application is also for special nuclear material license pursuant to the regulations in Part 70 of this chapter, information should be included with respect to the applicant's financial qualification to assume responsibility for the payment of Commission charges for special nuclear material.

(g) The technical qualifications of the applicant to engage in the proposed activities in accordance with the regulations in this chapter.

(h) If the applicant proposes to construct or alter a production or utilization facility, the application shall state the earliest and latest dates for completion of the construction or alteration.

(i) If the proposed activity is the generation and distribution of electric energy under a class 103 license, a list of the names and addresses of such regulatory agencies as may have jurisdiction over the rates and services of the proposed activity, and of those municipalities, private utilities, public bodies, and cooperatives, which are within transmission distance and which are authorized to engage in the distribution of electric energy within the area.

(j) If the application contains Restricted Data or other defense information, it shall be prepared in such manner that all Restricted Data and other defense information are separated from the unclassified information.

§ 50.34 *Contents of applications; technical information hazards summary report.* Each application shall state the following technical information:

(a) A description of the chemical, physical, metallurgical, or nuclear process to be performed, and a statement of the kind and quantity of any radioactive effluent expected to result from the process. The description of the process should be sufficiently detailed to permit evaluation of the radioactive hazards involved. The magnitude of the proposed operation should be indicated in terms of the amount and radioactivity of source, special nuclear, or by-product material to be handled per unit of time, and thermal power to be generated if any.

(b) A description of the facility. The description should be based on the design criteria for the facility as a whole and for those major component parts which are essential to the safe operation of the facility, and should be presented in sufficient detail to allow an evaluation of the adequacy of the various means proposed to minimize the probability of danger from radioactivity to persons both on and off-site. The description should also cover any activities, other than those subject to license, proposed to be carried on in the build-

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(c) A description of the site on which facility is to be located. This should clude a map of the area showing the ation of the site and indicating the to which the surrounding land is i. e., industrial, commercial, agricultural, residential; location of sources potable or industrial water supply, atershed areas and public utilities; d a scale plot plan of the site showing proposed location of the facility.

(d) A description of proposed procedures for: routine and non-routine erations, start-up and shut-down, aintenance, storage, training of mployees, minimizing operational misaps (such as locked controls, checkists, and close supervision), investigat- unusual or unexpected incidents; d a description of such other details may be useful in evaluating the exstence and effectiveness of safeguards ainst the radioactive hazards in the eration of the facility.

(e) A description of plans or prosals in the event that acts or accidents cur which would create radioactive azards. The description should relate e various operational procedures, the otective devices, and the pertinent atures of the site, to such happenings s operational mistakes, equipment or strument failure or malfunction, fire, ectric power failure, flood, earthake, storm, strike, and riot.

(f) Meteorological, hydrological, geogical, and seismological data necesary for evaluating the measures proosed for protecting the public against ossible radioactive hazards.

(g) An evaluation of the proposed measures and devices to prevent acts or ccidents which would create radioctive hazards or to protect against the consequences should such acts or accidents occur.

(h) A description of procedures for disposal of radioactive solid waste and the final disposal of liquid waste effluent.

(i) A description of means provided to sample atmosphere discharges through stacks where such stacks may emit byproduct material or special nuclear material.

§ 50.35 *Extended time for providing technical information.* Where, because of the nature of a proposed project, an applicant is not in a position to supply initially all of the technical information otherwise required to complete the application, he shall indicate the reason, the items or kinds of information omitted, and the approximate times when such data will be produced. If the Commission is satisfied that it has information sufficient to provide reasonable assurance that a facility of the general type proposed can be constructed and operated at the proposed location without undue risk to the health and safety of the public and that the omitted information will be supplied, it may process the application and issue a construction permit on a provisional basis without the omitted information subject to its later production and an evaluation by the Commission that the final design provides reasonable assurance that the health and safety of the public will not be endangered.

§ 50.36 *Designation of technical specifications.* (a) The Commission will indicate, by notice to the applicant, which of the provisions of his hazards summary report or any supplement thereto will be deemed to be technical specifications that become part of the license or construction permit. In giving such notice, the Commission will afford the applicant reasonable opportunity to amend or revise the technical information supplied before proceeding further to process the application.

(b) The Commission may require the applicant to designate those provisions of his hazards summary report or any supplement thereto, which he proposes be incorporated as technical specifications in the construction permit or license.

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§ 50.37 *Agreement limiting access to Restricted Data.* As part of his application and in any event prior to the receipt of Restricted Data or the issuance of a license or construction permit, the applicant shall agree in writing that he will not permit any individual to have access to Restricted Data until the Civil Service Commission shall have made an investigation and report to the Commission on the character, associations, and loyalty of such individual, and the Commission shall have determined that permitting such person to have access to Restricted Data will not endanger the common defense and security. The agreement of the applicant in this regard shall be deemed part of the license or construction permit, whether so stated therein or not.

§ 50.38 *Ineligibility of certain applicants.* Any person who is a citizen, national, or agent of a foreign country, or any corporation, or other entity which the Commission knows or has reason to believe is owned, controlled, or dominated by an alien, a foreign corporation, or a foreign government, shall be ineligible to apply for and obtain a license except a license authorizing export only pursuant to an agreement for cooperation.

§ 50.39 *Public inspection of applications.* Applications and documents submitted to the Commission in connection with applications may be made available for public inspection in accordance with the provisions of the regulations contained in Part 2 of this chapter.

STANDARD FOR LICENSES AND CONSTRUCTION PERMITS

§ 50.40 *Common standards.* In determining that a license will be issued to an applicant, the Commission will be guided by the following considerations:

(a) The processes to be performed, the operating procedures, the facility and equipment, the use of the facility, and other technical specifications, or the proposals in regard to any of the foregoing collectively provide reasonable assurance that the applicant will comply with the regulations in this chapter, including the regulations in Part 20, and that the health and safety of the public will not be endangered.

(b) The applicant is technically and financially qualified to engage in the proposed activities in accordance with the regulations in this chapter.

(c) The issuance of a license to the applicant will not, in the opinion of the Commission, be inimical to the common defense and security or to the health and safety of the public.

§ 50.41 *Additional standards for class 104 licenses.* In determining that a class 104 license will be issued to an applicant, the Commission will, in addition to applying the standards set forth in § 50.40 be guided by the following considerations:

(a) The Commission will permit the widest amount of effective medical therapy possible with the amount of special nuclear material available for such purposes.

(b) The Commission will permit the conduct of widespread and diverse research and development.

(c) In the event that applications for special nuclear material for use in activities licensed by the Commission pursuant to section 104b of the act exceed the amount of special nuclear material available the Commission will give priority to those activities which will, in the opinion of the Commission, lead to major advances in the application of atomic energy for industrial purposes.

NOTE: The Commission has determined, in accordance with section 104b of the Atomic Energy Act of 1954, that the regulations and terms of license applicable to a production or utilization facility in the conduct of research and development activities leading to the demonstration of practical value of such facility for industrial or commercial purposes are compatible with the regulations and terms of license which will apply in the event that a class 103 license were later to be issued for that type of facility.

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§ 50.42 *Additional standards for class 103 licenses.* In determining whether a class 103 license will be issued to an applicant, the Commission will, in addition to applying the standards set forth in § 50.40, be guided by the following considerations:

(a) The proposed activities will serve a useful purpose proportionate to the quantities of special nuclear material or source material to be utilized.

(b) Due account will be taken of the advice provided by the Attorney General, pursuant to subsection 105c of the act. For this purpose, before issuing the license, the Commission will notify the Attorney General of the proposed license, and the terms and conditions thereof, and request the advice of the Attorney General as to whether or not the proposed license would tend to create or maintain a situation inconsistent with the antitrust laws, as specified in subsection 105a of the act: *Provided,* That this requirement will not apply with respect to the types of class 103 licenses which the Commission, with the approval of the Attorney General, may determine would not significantly affect the applicant's activities under the antitrust laws. Upon receipt of the Attorney General's advice, the Commission will cause such advice to be published in the Federal Register.

§ 50.43 *Additional standards and provisions affecting class 103 licenses for commercial power.* In addition to applying the standards set forth in §§ 50.40 and 50.42, in the case of a class 103 license for a facility for the generation of commercial power:

(a) The Commission will give notice in writing of each application of such regulatory agency as may have jurisdiction over the rates and services of the proposed activity, and to municipalities, private utilities, public bodies, and cooperatives which are within transmission distance and which are authorized to engage in distribution of electric energy; and the Commission will publish notice of the application once each week for four consecutive weeks in the FEDERAL REGISTER. No license will be issued by the Commission prior to the giving of such notices and until four weeks after the last publication in the FEDERAL REGISTER.

(b) If there are conflicting applications for a limited opportunity for such license, the Commission will give preferred consideration in the following order: First, to applications submitted by public or cooperative bodies for facilities to be located in high cost power areas in the United States; second, to applications submitted by others for facilities to be located in such area; third, to applications submitted by public or cooperative bodies for facilities to be located in other than high cost power areas, and, fourth, to all other applicants.

(c) The licensee who transmits electric energy in interstate commerce, or sells it at wholesale in interstate commerce, shall be subject to the regulatory provisions of the Federal Power Act.

(d) Nothing herein shall preclude any government agency, now or hereafter authorized by law to engage in the production, marketing, or distribution of electric energy, if otherwise qualified, from obtaining a license for the construction and operation of a utilization facility for the primary purpose of producing electric energy for disposition for ultimate public consumption.

§ 50.44 *Standards for licenses authorizing export only.* Where a license is sought solely to authorize the export of production or utilization facilities, the Commission will determine whether the issuance of the license to the applicant for the facility involved is within the scope of and consistent with the terms of an agreement for cooperation with the nation to which the facility is to be exported.

§ 50.45 *Standards for construction permits.* An applicant for a license or an amendment of a license who proposes to construct or alter a production or utilization facility will be initially granted a construction permit, if the application is in conformity with and

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acceptable under the criteria of §§ 50.31 through 50.38 and the standards of §§ 50.40 through 50.43.

ISSUANCE, LIMITATIONS, AND CONDITIONS OF LICENSES AND CONSTRUCTION PERMITS

§ 50.50 *Issuance of licenses and construction permits.* Upon determination that an application for a license meets the standards and requirements of the act and regulations, and that notifications, if any, to other agencies or bodies have been duly made, the Commission will issue a license, or if appropriate a construction permit, in such form and containing such conditions and limitations including technical specifications, as it deems appropriate and necessary.

§ 50.51 *Duration of license, renewal.* Each license will be issued for a fixed period of time to be specified in the license but in no case to exceed 40 years from the date of issuance. Where the operation of a facility is involved, the Commission will issue the license for the term requested by the applicant or for the estimated useful life of the facility if the Commission determines that the estimated useful life is less than the term requested. Where construction of a facility is involved, the Commission may specify in the construction permit the period for which the license will be issued if approved pursuant to § 50.56. Licenses may be renewed by the Commission upon the expiration of the period.

§ 50.52 *Combining licenses.* The Commission may combine in a single license the activities of an applicant which would otherwise be licensed severally.

§ 50.53 *Jurisdictional limitations.* No license under this part shall be deemed to have been issued for activities which are not under or within the jurisdiction of the United States except insofar as the export of production or utilization facilities is authorized.

§ 50.54 *Conditions of licenses.* Whether stated therein or not, the following shall be deemed conditions in every license issued:

(a) Title to all special nuclear material utilized or produced by facilities pursuant to the license shall at all times be in the United States.

(b) No right to the special nuclear material shall be conferred by the license except as may be defined by the license.

(c) Neither the license, nor any right thereunder, nor any right to utilize or produce special nuclear material shall be transferred, assigned, or disposed of in any manner, either voluntarily or involuntarily, directly or indirectly, through transfer of control of the license to any person, unless the Commission shall, after securing full information, find that the transfer is in accordance with the provisions of the act and give its consent in writing.

(d) The license shall be subject to suspension and to the rights of recapture of the material or control of the facility reserved to the Commission under section 108 of the act in a state of war or national emergency declared by Congress.

(e) The license shall be subject to revocation, suspension, modification, or amendment for cause as provided in the act and regulations, in accordance with the procedures provided by the act and regulations.

(f) The licensee will at any time before expiration of the license, upon request of the Commission submit written statements, signed under oath or affirmation, to enable the Commission to determine whether or not the license should be modified, suspended or revoked.

(g) The issuance or existence of the license shall not be deemed to waive, or relieve the license from compliance with, the antitrust laws, as specified in subsection 105a of the act. In the event that the licensee should be found by a court of competent jurisdiction to have violated any provision of such antitrust laws in the conduct of the licensed activity, the Commission may suspend

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(h) The license shall be subject to the provisions of the act now or hereafter in effect and to all rules, regulations, and orders of the Commission. The terms and conditions of the license shall be subject to amendment, revision, or modification, by reason of amendments of the act or by reason of rules, regulations, and orders issued in accordance with the terms of the act.

(i) The licensee shall not permit the manipulation of the controls of any production or utilization facility by anyone who is not a licensed operator as provided in Part 55 of this chapter.

(j) The licensee shall not, except as authorized pursuant to a construction permit, make any alteration in the facility constituting a change from the technical specifications previously incorporated in a license or construction permit pursuant to § 50.36.

§ 50.55 *Conditions of construction permits.* Each construction permit shall be subject to the following terms and conditions:

(a) The permit shall state the earliest and latest dates for completion of the construction or modification. If the construction or modification is completed before the earliest date specified, the holder of the permit shall promptly notify the Commission for the purpose of accelerating final inspection and any scheduled delivery of materials from the Commission.

(b) If the proposed construction or modification of the facility is not completed by the latest completion date, the permit shall expire and all rights thereunder shall be forfeited: *Provided, however,* That upon good cause shown the Commission will extend the completion date for a reasonable period of time. The Commission will recognize, among other things, developmental problems attributable to the experimental nature of the facility or fire, flood, explosion, strike, sabotage, domestic violence, enemy action, an act of the elements, and other acts beyond the control of the permit holder, as a basis for extending the completion date.

(c) Except as modified by this section, the construction permit shall be subject to the same conditions to which a license is subject.

(d) At or about the time of completion of the construction or modification of the facility, the applicant will file any additional information needed to bring the original application for license up to date.

§ 50.56 *Conversion of construction permit to license; or amendment of license.* Upon completion of the construction or alteration of a facility, in compliance with the terms and conditions of the construction permit and subject to any necessary testing of the facility for health or safety purposes, the Commission will, in the absence of good cause shown to the contrary issue a license of the class for which the construction permit was issued or an appropriate amendment of the license, as the case may be.

ALLOCATION OF SPECIAL NUCLEAR MATERIAL

§ 50.60 *Allocation of special nuclear material.* (a) In construction permits and licenses issued to applicants proposing to operate production or utilization facilities, the Commission may incorporate provisions designating the quantities of special nuclear material available for use by each such facility. Such provisions will normally be in the form of a statement that the Commission has allocated to the applicant, for use in connection with the operation of the particular facility involved, a designated quantity (or quantities) of special nuclear material. The statement will include an estimated schedule for a reasonable period of time of special nuclear material transfers to the applicant and of special nuclear material returns to the Commission.

(b) The request for incorporation of such provisions may be made simultaneously with the submission of an ap-

plication for construction permit or facility license or at any time thereafter. Such request should be accompanied by at least the following information:

(1) The applicant's financial qualifications to assume responsibility for payment of Commission charges for the materials, and to undertake and carry out the proposed use of special nuclear material for a reasonable period of time;

(2) The estimated date on which the applicant desires to receive the first shipment of special nuclear material and an estimated schedule, by years, for subsequent receipts;

(3) A schedule, by years, showing the estimated production, consumption and operating losses of special nuclear material; and

(4) An estimated schedule, by years, for the transfer of special nuclear material to the Commission or to other licenses.

Supporting data for the estimates required by subparagraphs (2), (3), and (4) of this paragraph shall be included.

(c) A request for the incorporation in a construction permit or license of provisions designating the amount of special material available for use by the facility will be approved by the Commission if:

(1) The quantities of special nuclear material are available for distribution under section 53 of the act; and

(2) The applicant appears to be financially qualified to assume responsibility for the payment of Commission charges for the material and to undertake and carry out the proposed use of special nuclear material for a reasonable period of time; and

(3) The estimated quantities and schedules submitted in response to paragraph (b) of this section are reasonable; and

(4) Approval of the request is consistent with the priority and preference provisions of the act, including sections 53f, 104b, and 182.

(d) The Commission may, in accordance with the procedures provided in Part 2 of this chapter, reduce the quantities of special nuclear material allocated to any permittee or licensee pursuant to this section, upon the ground that the quantities allocated exceed those reasonably required, or estimated to be required, for use by the facility involved. The expiration, revocation or other termination of a construction permit or license shall terminate all allocations incorporated in such permit or license.

NOTE: Quantities of special nuclear material allocated pursuant to the provisions of this section will not be distributed to the licensee until needed. At the time the allocation is made, however, the Commission will make appropriate entries in its special nuclear material inventory and accounting records to reflect such allocation.

INSPECTION, RECORDS, REPORTS

§ 50.70 *Inspections.* Each licensee and each holder of a construction permit shall permit inspection, by duly authorized representatives of the Commission, of his records, premises, activities, and of licensed materials in possession or use, related to the license or construction permit as may be necessary to effectuate the purposes of the act, including section 105 of the act.

§ 50.71 *Maintenance of records, making of reports.* Each licensee and each holder of a construction permit shall maintain such records and make such reports, in connection with the licensed activity, as may be required by the conditions of the license or permit or by the rules, regulations, and orders of the Commission in effectuating the purposes of the act, including section 105 of the act.

TRANSFER OF LICENSES-CREDITORS' RIGHTS; SURRENDER OF LICENSES

[Sections 50.80 to 50.89 reserved]

AMENDMENT OF LICENSE OR CONSTRUCTION PERMIT AT REQUEST OF HOLDER

§ 50.90 *Application for amendment of license or construction permit.* When

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ver a holder of a license or construction permit desires to amend the license or permit, application for an amendment shall be filed with the Commission, fully describing the changes desired, and following as far as applicable the form prescribed for original applications.

§ 50.91 *Issuance of amendment.* In determining whether an amendment to a license or construction permit will be issued to the applicant, the Commission will be guided by the considerations which govern the issuance of initial licenses or construction pemits, to the extent applicable and appropriate. If the application involves the material alteration of a licensed facility, a construction permit will be issued prior to the issuance of the amendment to the license.

REVOCATION, SUSPENSION, MODIFICATION, AMENDMENT OF LICENSES AND CONSTRUCTION PERMITS, EMERGENCY OPERATIONS BY THE COMMISSION

§ 50.100 *Revocation, suspension, modification of licenses and construction permits for cause.* A license or construction permit may be revoked, suspended, or modified, in whole or in part, for any material false statement in the application for license or in the supplemental or other statement of fact required of the applicant; or because of conditions revealed by the application for license or statement of fact or any report, record, inspection, or other means, which would warrant the Commission to refuse to grant a license on an original application (other than those relating to §§ 50.51, 50.42 (a), and 50.43 (b)); or for failure to construct or operate a facility in accordance with the terms of the construction permit or license, provided that failure to make timely completion of the proposed construction or alteration of a facility under a construction permit shall be governed by the provisions of § 50.55 (b); or for violation of, or failure to observe, any of the terms and provisions of the act, regulations, license, permit, or order of the Commission.

§ 50.101 *Retaking possession of special nuclear material.* Upon revocation of a license, the Commission may immediately retake possession of all special nuclear material held by the licensee.

§ 50.102 *Commission operation after revocation.* Whenever the Commission finds that the public convenience and necessity, or the production program of the Commission, requires continued operation of a production or utilization facility, the license for which has been revoked, the Commission may, after consultation with the appropriate federal or state regulatory agency having jurisdiction, order that possession be taken of such facility and that it be operated for a period of time as, in the judgment of the Commission, the public convenience and necessity or the production program of the Commission may require, or until a license for operation of the facility shall become effective. Just compensation shall be paid for the use of the facility.

§ 50.103 *Suspension and operation in war or national emergency.* (a) Whenever Congress declares that a state of war or national emergency exists, the Commission, if it finds it necessary to the common defense and security, may,

(1) Suspend any license it has issued.

(2) Order the recapture of special nuclear material distributed.

(3) Order the operation of any licensed facility.

(4) Order entry into any plant or facility in order to recapture special nuclear material or to operate the facility.

(b) Just compensation shall be paid for any damages caused by recapture of special nuclear material or by operation of any facility, pursuant to this section.

ENFORCEMENT

§ 50.110 *Violations.* An injunction or other court order may be obtained prohibiting any violation of any provision of the act or any regulation or order issued thereunder. Any person who wilfully violates any provision of the act or any regulation or order issued

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thereunder may be guilty of a crime and, upon conviction, may be punished by fine or imprisonment or both, as provided by law.

NOTE: The reporting and recordkeeping requirements contained herein have been approved by the Bureau of the Budget in accordance with The Federal Reports Act of 1942.

Dated at Washington, D. C., this 12th day of January 1956.

K. E. FIELDS,
General Manager.

PART 55—OPERATORS' LICENSES

Notice is hereby given that the Atomic Energy Commission has adopted the following rules. The regulations are to become effective 30 days after date of publication.

GENERAL PROVISIONS

Sec.
55.1 Purpose.
55.2 Scope.
55.3 Definitions.
55.4 Communications.
55.5 Interpretations.

APPLICATIONS

55.10 Contents of applications.
55.11 Requirements for the approval of application.
55.12 Re-examinations.

OPERATING TEST AND WRITTEN EXAMINATION

55.20 Scope.
55.21 Waiver.

LICENSES

55.30 Issuance of licenses.
55.31 Conditions of the licenses.
55.32 Expiration.
55.33 Renewal of licenses.

MODIFICATION AND REVOCATION OF LICENSES

55.40 Modification and revocation of licenses.
55.41 Notification of disability.

ENFORCEMENT

55.50 Violations.

CERTIFICATE OF MEDICAL EXAMINATION FOR OPERATOR'S LICENSE

55.60 Examination form.

AUTHORITY: §§ 55.1 to 55.60 issued under sec. 161, 68 Stat. 948; 42 U. S. C. 2201. Interpret or apply sec. 107, 68 Stat. 939; 42 U. S. C. 2137. For the purposes of sec. 223, 63 Stat. 958; 42 U. S. C. 2273, § 55.2 (b) issued under sec. 1611, 68 Stat. 948; 42 U. S. C. 2201 (i).

GENERAL PROVISIONS

§ 55.1 *Purpose.* The regulations in this part establish procedures and minimum criteria for the issuance of licenses to operators of production and utilization facilities licensed pursuant to the Atomic Energy Act of 1954 (68 Stat. 919); and establish and provide for the terms and conditions upon which the Commission will issue such licenses.

§ 55.2 *Scope.* (a) The regulations contained in this part apply to any individual who manipulates the controls of any facility licensed pursuant to Part 50 of this chapter.

(b) No individual shall manipulate the controls of any facility licensed pursuant to Part 50 of this chapter without a valid license issued pursuant to the regulations in this part.

§ 55.3 *Definitions.* As used in this part:

(a) "Act" means the Atomic Energy Act of 1954 (68 Stat. 919), including any amendments thereto;

(b) "Controls" means those controls of a production or utilization facility which by manipulation or failure to manipulate singly or in combination could result in the release of atomic energy or radioactive material in amounts determined by the Commission to be sufficient to cause danger to the health and safety of the public;

(c) "Commission" means the Atomic Energy Commission or its duly authorized representatives;

(d) "Facility" means any "production facility" or "utilization facility" as defined in Part 50 of this chapter.

(e) "Class of facility" means facilities determined by the Commission to

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sufficiently similar in design and operating characteristics to warrant licensing an individual to operate any of the facilities within the class;

(f) "Operator" is any individual who manipulates a control of a facility. An individual is not deemed to manipulate a control within the meaning of this definition if he manipulates the control only under the direction and in the presence of a licensed operator. An individual is deemed to manipulate a control if he directs another to manipulate a control in his presence.

§ 55.4 *Communications.* All communications concerning the regulations in this part, including applications for initial licenses and renewals thereof should be addressed to the United States Atomic Energy Commission, 1901 Constitution Avenue NW., Washington 25, D. C. Attention: Director, Division of Civilian Application.

§ 55.5 *Interpretations.* Except as specifically authorized by the Commission in writing, no interpretation of the meaning of the regulations in this part by any officer or employee of the Commission other than a written interpretation by the General Counsel will be recognized to be binding upon the Commission.

APPLICATIONS

§ 55.10 *Contents of applications.* (a) Each application shall contain the following information:

(1) The full name, citizenship, age, address, and present employment of the applicant;

(2) The education and experience of the applicant;

(3) Serial numbers of any operators' licenses issued by the Commission to the applicant, and whether such licenses are still in effect, have expired, or have been revoked, modified or suspended.

(4) The specific control or controls of the facility or class of facility for the manipulation of which the applicant seeks the license;

(5) The facility at which the applicant proposes to be tested for operating proficiency, and the written consent of the facilities licensee to the use of that facility for such test.

(6) Evidence that the applicant has learned to operate the control or controls in a competent and safe manner. Ordinarily the Commission will accept as proof of this a certification of a qualified instructor or supervisor responsible for the safe operation of the facility in which the applicant will be employed.

(b) The applicant shall also cause to be furnished a report of a medical examination by a licensed medical practitioner in the form prescribed in § 55.60.

(c) The Commission may at any time after the filing of the original application, and before the expiration of the license, require further statements in order to enable the Commission to determine whether the application should be granted or denied or whether a license should be revoked, modified, or suspended.

(d) Each application and statement shall contain complete and accurate disclosure as to all matters and things required to be disclosed. All applications and statements shall be signed by the applicant or licensee under oath of affirmation.

§ 55.11 *Requirements for the approval of application.* An application for a license pursuant to the regulations in this part will be approved upon a showing that:

(a) The physical condition and the general health of the applicant are not such as to be expected to cause operational errors which might endanger public health and safety;

(b) The applicant has passed an operating test and written examinations as prescribed by the Commission;

(c) The applicant has learned to operate the control or controls in a competent and safe manner.

§ 55.12 *Re-examinations.* (a) Any applicant who has failed an operating test or written examination may apply for a re-examination at any time after thirty days from the date the applicant

has been notified that his application is denied. Except where good cause is shown the applicant shall not be entitled to more than one re-examination per year from the date of the notice of his application.

(b) An applicant whose application has been disapproved because of his physical condition or general health may submit a further report of medical examination at any time.

OPERATING TEST AND WRITTEN EXAMINATION

§ 55.20 *Scope.* To the extent applicable, the operating test and written examination shall test:

(a) The applicant's understanding of and familiarity with the following aspects of the facility:

(1) The general design and operating characteristics;

(2) The control and safety mechanisms;

(3) All control-station instrumentation;

(4) Standard operating procedures;

(5) Emergency shutdown system and procedures;

(6) Such other aspects as may be important to the safe operation of the facility.

(b) The applicant's ability to read and interpret the control instrumentation of the facility and to manipulate the control equipment of the facility in a safe manner, and the applicant's knowledge of how to operate the facility, including operating under emergency conditions.

(c) The applicant's knowledge of the purpose and function of radiation monitoring equipment applicable to the operation for which he seeks a license.

§ 55.21 *Waiver.* (a) Upon written request, the Commission may waive any or all of the requirements of an operating test and written examination upon a showing that:

(1) The applicant has operated similar controls of a substantially similar facility, and

(2) Has discharged his responsibilities in a competent and safe manner and is capable of continuing in this manner. Ordinarily the Commission will accept as proof of this a certification of a supervisor responsible for the safe operation of the facility where the individual was previously employed.

(b) Where a waiver of the examination is requested by an applicant, the information to support such request should accompany the application for an operators' license.

LICENSES

§ 55.30 *Issuance of licenses.* Upon a determination that an application meets the requirements of the act and of the regulations of the Commission, the Commission will issue a license in such form and containing such conditions and limitations as it deems appropriate and necessary.

§ 55.31 *Conditions of the licenses.* Each license shall contain and be subject to the following conditions whether stated in the license or not:

(a) Neither the license nor any right under the license shall be assigned or otherwise transferred;

(b) The license is limited to the facility or class of facility for which it is issued.

(c) The license is limited to those controls of the facility or class of facility specified in the license;

(d) The license shall be subject to, and the licensee shall observe all applicable rules, regulations and orders of the Commission.

(e) Such other conditions as the Commission may impose to protect health or to minimize danger to life or property.

§ 55.32 *Expiration.* Each operator license shall expire two years after the date of its issuance.

§ 55.33. *Renewal of licenses.* (a) Application for renewal of a license shall be signed by the applicant under oath or

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mation and shall contain the following information:

(1) The full name, citizenship, address, and present employment of the applicant;

(2) The serial number of the license for which renewal is sought;

(3) The work experience of the applicant since the previous application;

(4) Evidence that the licensee has discharged his license responsibilities in a competent and safe manner. Ordinarily the Commission will accept as proof of this certification of a supervisor responsible for the safe operation of the facility where the licensee has been employed.

(b) The applicant shall cause to be furnished a report of a medical examination by a licensed medical practitioner in form prescribed in § 55.60.

(c) In any case in which a licensee has filed an application in proper form for renewal more than thirty (30) days prior to the expiration of his existing license, such existing license shall not expire until the application for a renewal has been finally acted upon by the Commission.

(d) The license will be renewed upon showing that:

(1) The physical condition and the general health of the licensee continues to be such that it is not expected to cause operational errors which might endanger public health and safety.

(2) The licensee has discharged his license responsibilities in a competent and safe manner and is capable of continuing in this manner. If the licensee has not been actively engaged as an operator under his license during the previous license period the Commission may require him to take an oral, written and operating test.

MODIFICATION AND REVOCATION OF LICENSES

§ 55.40 *Modification and revocation of licenses.* (a) The terms and conditions of all licenses shall be subject to amendment, revision, or modification by reason by amendments to the act, or by reason of rules, regulations or orders issued in accordance with the act or any amendments thereto.

(b) Any license may be revoked, modified, or suspended for any material false statement in the application or any statment of fact required under section 182 of the act, or because of conditions revealed by such application or statement of fact or any report, record, or inspection or other means which would warrant the Commission to refuse to grant a license on an original application, or for violation of, or failure to observe any of the terms and conditions of the act, or of any rule or regulation of the Commission.

(c) The Commission may revoke or suspend any license for violation of any applicable rule or regulation or any condition of the license or any personal behavior on the job deemed by the Commission to be a hazard to the safe operation of the facility.

§ 55.41 *Notification of disability.* The licensee shall within fifteen days after its occurrence notify the Commission of any disability which occurs and would have appeared on his medical examination form had the condition existed at the time the medical examination form was last submitted to the Commission.

ENFORCEMENT

§ 55.50 *Violations.* An injunction or other court order may be obtained prohibiting any violation of any provision of the act or any regulation or order issued by the Commission under the act. Any person who wilfully violates any provision of the act or of the regulations in this part may be guilty of a crime and, upon conviction, may be punished by fine or imprisonment or both.

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CERTIFICATE OF MEDICAL EXAMINATION FOR OPERATOR'S LICENSE

§ 55.60 *Examination form.*

1. (First name)	(Middle initial)	(Last)	2. Date of birth:	3. Sex:
Mr.				Male
Mrs.				Female
Miss				

4. Address .....

MEDICAL HISTORY

(To be completed by applicant)

Have you ever had or do you now have any of the following? If so, please write the listed number of the condition in the space below, including approximately year or age you had condition.

1. Rheumatic fever.
2. Frequent severe headaches.
3. Dizziness or fainting spells.
4. Severe eye trouble or injury.
5. Pain or pressure in chest.
6. High blood pressure.
7. Bone or joint deformity.
8. Painful or "trick" shoulder.
9. Painful or "trick" elbow.
10. Paralysis.
11. Fits or epilepsy.
12. Loss of memory.
13. Depression.
14. Severe emotional disturbance.
15. Ulcer of stomach.

Number																
Year or Age																

16. If you have not had or do not have any of the above conditions please state "none" here. .....

Please answer the following questions "yes" or "no".	Answer
(A) 17. Have you ever been rejected or rated up for insurance, rejected for employment, or rejected by the armed forces because of your physical condition? (B) Are you partially disabled in any way?	
18. Has your work ever had to be limited or restricted on account of your health?	
19. Please state details if answers to "17" or "18" are "yes".	

PHYSICAL EXAMINATION RECORD

(To be completed by examining physician)

1. Eyes:
   (A) Distant vision (snellen): without glasses: Right $\frac{20}{\ }$ Left $\frac{20}{\ }$ with glasses, if worn: Right $\frac{20}{\ }$ Left $\frac{20}{\ }$
   (B) Evidence of disease or injury:
   Right ..... Left .....
   (C) Color vision: Is color vision normal when Ishihara or equivalent color test is used?
   ..... Yes ..... No.

2. Ears: (Consider denominators indicated here as normal. Record as numerators the greatest distance heard.) Ordinary conversation: Right ear ..... 20 Ft. Left ear ..... 20 Ft.
   Evidence of disease or injury: Right ear ..... Left ear .....

3. Gastro-Intestinal ..... (A) History of Peptic Ulcer: ..... Yes ..... No.
   If "Yes" is Ulcer:
   ..... Active ..... Quiescent ..... Healed
   How long ..... Date of last X-ray .....

4. Heart and blood vessels: (A) Blood Pressure: Systolic ..... MM. HO. Diastolic .....
   (B) Is organic heart disease: (C) If organic heart disease is present, is it present? ..... Yes
   ..... No: fully compensated? ..... Yes ..... No.
   (D) Pulse rate:
   Sitting ..... Immediately after exercise .....
   Two minutes after exercise ..... Cardiac reserve .....
   (Good, Fair or Poor)

5. Lungs: Have X-ray made and give report
   Right ..... Left .....
   History of tuberculosis? ..... Yes ..... No. If "Yes," how long has the disease been arrested?

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Deformities, atrophies, and other abnormalities, disease not included above:

Nervous system: (A) Include symptoms and full history of any mental, nervous, or emotional abnormality (use additional sheets if necessary):
(B) Has applicant ever been hospitalized or treated for a mental illness? ..... Yes ..... No
(C) Where (name and location of hospital):
(D) Date or dates of hospitalization:
(E) Any history of epilepsy or fainting spells or drug addiction (including alcoholism)? ..... Yes ..... No. If so, give details under "Remarks."
(F) Are there any signs of nervous disease ..... Yes ..... No. If so, give details under "Remarks."

Remarks:
.....

The foregoing examination does not reveal any mental or physical disability or drug habit (including alcoholism) which might cause impaired judgment or motor coordination.
Date: .....
Signature of Examining Physician: ..... M. D.
Address of Examining Physician: .....

NOTE: This form should be mailed by the physician to the United States Atomic Energy Commission, 1901 Constitution Avenue, NW., Washington 25, D. C. Attention: Director, Division of Civilian Application.

NOTE: The reporting requirements contained herein have been approved by the Bureau of the Budget in accordance with the Federal Reports Act of 1942.

Dated at Washington, D. C., this 22d day of December 1955.

K. E. FIELDS,
General Manager.

PART 70—SPECIAL NUCLEAR MATERIAL

Effective 30 days after publication in the FEDERAL REGISTER, Part 70, Title 10, Chapter I, Code of Federal Regulations, entitled "Definition of Fissionable Material," is hereby amended to read as follows:

GENERAL PROVISIONS

Sec.
70.1 Purpose.
70.2 Scope.
70.3 License requirements.
70.4 Definitions.
70.5 Communications.
70.6 Interpretations.

EXEMPTIONS

70.11 Persons using special nuclear material under contract with and for the account of the Commission.
70.12 Carriers.
70.13 Department of Defense.
70.14 Specific exemptions.

LICENSE APPLICATIONS

70.21 Filing.
70.22 Contents of applications.
70.23 Requirements for the approval of applications.

LICENSES

Sec.
70.31 Issuance of licenses.
70.32 Conditions of licenses.
70.33 Renewal of licenses.
70.34 Amendment of licenses.
70.35 Commission action on applications to renew or amend.
70.36 Inalienability of licenses.
70.37 Disclaimer of warranties.
70.38 Reduction and termination of allocations.

ACQUISITION, USE, AND TRANSFER OF SPECIAL NUCLEAR MATERIAL

70.41 Authorized use of special nuclear material.
70.42 Transfer of special nuclear material.
70.43 Licensee's responsibility for special nuclear material.

RECORDS, REPORTS AND INSPECTIONS

70.51 Records.
70.52 Reports of accidental criticality or loss of special nuclear material.
70.53 Inspections.
70.54 Tests.

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MODIFICATION AND REVOCATION OF LICENSES

Sec.
70.61 Modification and revocation of licenses.
70.62 Suspension and operation in war or national emergency.

ENFORCEMENT

70.71 Violations.

AUTHORITY: §§ 70.1 to 70.71 issued under sec. 161, 68 Stat. 948; 42 U. S. C. 2201. Interpret or apply secs. 51, 53, 182, 183, 68 Stat. 929, 930, 953, 954. 42 U. S. C. 2071, 2073, 2232, 2233. For the purposes of sec. 223, 68 Stat. 958; 42 U. S. C. 2273, §§ 70.32 (a) (6) and 70.41 (a) issued under sec. 161b, 68 Stat. 948; 42 U. S. C. 2201 (b) and §§ 70.51 to 70.54, inclusive issued under sec. 161p, 68 Stat. 950, 42 U. S. C. 2201 (p).

GENERAL PROVISIONS

§ 70.1 *Purpose.* (a) The regulations in this part establish procedures and criteria for the issuance of licenses to receive, possess, use and transfer special nuclear material and for the distribution by the Commission of special nuclear material to licensees; and establish and provide for the terms and conditions upon which the Commission will issue such licenses and distribute special nuclear material.

(b) The regulations contained in this part are issued pursuant to the Atomic Energy Act of 1954 (68 Stat. 919).

§ 70.2 *Scope.* Except as provided in §§ 70.11 to 70.13, inclusive, the regulations in this part apply to all persons in the United States.

§ 70.3 *License requirements.* No person subject to the regulations in this part shall receive, possess, use or transfer special nuclear material except as authorized in a license issued by the Commission pursuant to these regulations.

§ 70.4 *Definitions.* As used in this part.

(a) "Act" means the Atomic Energy Act of 1954 (68 Stat. 919), including any amendments thereto;

(b) "Atomic energy" means all forms of energy released in the course of nuclear fission or nuclear transformation;

(c) "Atomic weapon" means any device utilizing atomic energy, exclusive of the means for transporting or propelling the device (where such means is a separable and divisible part of the device), the principal purpose of which is for use as, or for development of, a weapon, a weapon prototype, or a weapon test device;

(d) "Commission" means the Atomic Energy Commission or its duly authorized representatives;

(e) "Common defense and security" means the common defense and security of the United States;

(f) "Government agency" means any executive department, commission, independent establishment, corporation, wholly or partly owned by the United States of America which is an instrumentality of the United States, or any board, bureau, division, service, office, officer, authority, administration, or other establishment in the executive branch of the Government;

(g) "License," except where otherwise specified means a license issued pursuant to the regulations in this part;

(h) "Person" means (1) any individual, corporation, partnership, firm, association, trust, estate, public or private institution, group, Government agency other than the Commission, any State or any political subdivision of, or any political entity within a State, any foreign government or nation or any political subdivision of any such government or nation, or other entity; and (2) any legal successor, representative, agent or agency of the foregoing;

(i) "Produce," when used in relation to special nuclear material, means (1) to manufacture, make, produce, or refine special nuclear material; (2) to separate special nuclear material from other substances in which such material may be contained; or (3) to make or to produce new special nuclear material;

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(j) "Research and development" means (1) theoretical analysis, exploration, or experimentation; or (2) the extension of investigative findings and theories of a scientific or technical nature into practical application for experimental and demonstration purposes, including the experimental production and testing of models, devices, equipment, materials, and processes;

(k) "Restricted Data" means all data concerning (1) design, manufacture or utilization of atomic weapons; (2) the production of special nuclear material; or (3) the use of special nuclear material in the production of energy, but shall not include data declassified or removed from the Restricted Data category pursuant to section 142 of the act;

(l) "Source material" means source material as defined in section 11 s. of the act and in the regulations contained in part 40 of this chapter;

(m) "Special nuclear material" means (1) plutonium, uranium 233, uranium enriched in the isotope 233 or in the isotope 235, and any other material which the Commission, pursuant to the provisions of section 51 of the act, determines to be special nuclear material, but does not include source material; or (2) any material artifically enriched by any of the foregoing but does not include source material;

(n) "United States," when used in a geographical sense, includes all territories and possessions of the United States, the Canal Zone and Puerto Rico.

§ 70.5 *Communications.* All communications concerning the regulations in this part should be addressed to the Atomic Energy Commission, Washington 25, D. C., Attention: Division of Civilian Application.

§ 70.6 *Interpretations.* Except as specifically authorized by the Commission in writing, no interpretation of the meaning of the regulations in this part by any officer or employee of the Commission other than a written interpretation by the General Counsel will be recognized to be binding upon the Commission.

EXEMPTIONS

§ 70.11 *Persons using special nuclear material under contract with and for the account of the Commission.* The regulations in this part do not apply to any person to the extent that such person receives, possesses, uses or transfers special nuclear material under, and in accordance with, a contract with and for the account of the Commission. In any such case, such person's obligations with respect to the special nuclear material are governed by the applicable contract between such person and the Commission.

§ 70.12 *Carriers.* Common and contract carriers, warehousemen and the United States Post Office Department are exempt from the regulations in this part to the extent that they transport or store special nuclear material in the regular course of carriage for another or storage incident thereto.

§ 70.13 *Department of Defense.* The regulations in this part do not apply to the Department of Defense to the extent that the Department receives, possesses and uses special nuclear material in accordance with the direction of the President pursuant to section 91 of the act.

§ 70.14 *Specific exemptions.* The Commission may, upon application of any interested person, grant such exemptions from the requirements of the regulations in this part as it determines are authorized by law and will not endanger life or property or the common defense and security and are otherwise in the public interest.

LICENSE APPLICATIONS

§ 70.21 *Filing.* (a) Applications for licenses should be filed in triplicate with the United States Atomic Energy Commission, Washington 25, D. C., Attention: Division of Civilian Application.

(b) An application for license filed pursuant to the regulations in this part will be considered also as an application for licenses authorizing other activities for which licenses are required by the

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act, provided the application specifies the additional activities for which licenses are requested and complies with regulations of the Commission as to applications for such licenses.

(c) Any application which contains Restricted Data shall be prepared in such manner that all Restricted Data are separated from the unclassified information.

(d) Applications and documents submitted to the Commission in connection with applications may be made available for public inspection in accordance with the provisions of the regulations contained in Part 2 of this chapter.

(e) In his application, the applicant may incorporate by reference information contained in previous applications, statements or reports filed with the Commission: *Provided*, That such references are clear and specific.

§ 70.22 *Contents of applications.* (a) Each application shall contain the following information:

(1) The full name, address, age (if an individual), and citizenship of the applicant and the names and addresses of three personal references. If the applicant is a corporation or other entity, it shall indicate the State where it was incorporated or organized, the location of the principal office, the names, addresses, and citizenship of its principal officers and shall include information known to the applicant concerning the control or ownership, if any, exercised over the applicant by any alien, foreign corporation, or foreign government.

(2) The activity for which the special nuclear material is requested, or in which special nuclear material will be produced, the place at which the activity is to be performed and the general plan for carrying out the activity;

(3) The period of time for which the license is requested;

(4) The name, amount, and specifications (including the chemical and physical form and, where applicable, isotopic content) of the special nuclear material the applicant proposes to use or produce;

(5) To the extent applicable to the applicaton,

(i) The estimated date on which the applicant desires to receive the first shipment of special nuclear material and an estimated schedule, by years, for subsequent receipts;

(ii) A schedule, by years, showing the estimated production, consumption and operating losses of special nuclear material, and

(iii) An estimated schedule, by years, for the transfer of special nuclear material to the Commission or to other licensees. Supporting data for such estimates shall be included.

(6) The technical qualifications, including training and experience of the applicant and members of his staff to engage in the proposed activities in accordance with the regulations in this chapter.

(7) A description of equipment and facilities which will be used by the applicant to protect health and minimize danger to life or property (such as handling devices, working areas, shields, measuring and monitoring instruments, devices for the disposal of radioactive effluent and wastes, storage facilities, etc.).

(8) Proposed procedures to protect health and minimize danger to life or property, including procedures to avoid accidental conditions of criticality and procedures for personnel monitoring and waste disposal.

NOTE: Where the quantity of material requested, or the nature of the proposed activities, is such as to require consideration of the following factors, the Commission will request the applicant to submit information with respect to his financial qualifications (1) to engage in the proposed activities in accordance with the regulations in this chapter, (2) to assume responsibility for the payment of Commission charges for use, consumption or loss of special nuclear material and (3) to undertake and carry out the proposed use of spe-

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al nuclear material for a reasonable eriod of time. Consideration of such actors will normally not be involved the consideration of applications r small quantities of special nuclear aterial for use in research and evelopment.

(b) The Commission may at any time fter the filing of the original applica- n, and before the expiration of the ense, require further statements in rder to enable the Commission to de- rmine whether the application should granted or denied or whether a li- ense should be modified or revoked. applications and statements shall signed by the applicant or licensee a corporate officer thereof under oath affirmation.

(c) Each application and statement all contain complete and accurate dis- sure as to all matters and things re- ired to be disclosed.

§ 70.23 *Requirements for the approval applications.* A license application l be approved if the Commission de- mines that:

(a) The special nuclear material is be used for the conduct of research development activities of a type spe- ed in section 31 of the act[4] or in activities licensed by the Commission pursuant to section 103 or 104 of the act; and

(b) The applicant is qualified by reason of training and experience to use the material for the purpose requested in accordance with the regulations in this chapter; and

(c) The applicant's proposed equipment and facilities are adequate to protect health and minimize danger to life or property; and

(d) The applicant's proposed procedures to protect health and to minimize danger to life or property are adequate; and

(e) Where the quantity of material requested, or the nature of the proposed activities are such as to require consideration of these factors by the Commission, that the applicant appears to be financially qualified to assume responsibility for the payment of Commission charges for use, consumption or loss of special nuclear material and to engage in the proposed activities in accordance with the regulations in this part. If the allocation (pursuant to § 70.31 (b)) of a substantial quantity of special nuclear material is requested, the application should demonstrate that the applicant appears to be financially able to undertake and carry out the proposed use of special nuclear material for a reasonable period of time; and

(f) The special nuclear material can be made available to the applicant substantially in accordance with the estimated schedule, if any, in the application. In the event that applications for special nuclear material exceed the amount available for distribution, the Commission will give preference to those activities which are most likely, in the opinion of the Commission, to contribute to basic research, to the development of peacetime uses of atomic energy, or to the economic and military strength of the Nation. In the event that applications for special nuclear material for use in activities licensed by the Commission pursuant to section 104b of the act exceed the amount of

[4] The types of research and development ctivities specified in section 31 are those ating to:

(1) Nuclear processes;

(2) The theory and production of tomic energy, including processes, ma- erials, and devices related to such roduction;

(3) Utilization of special nuclear ma- erial and radioactive material for medi- al biological, agricultural, health or ilitary purposes;

(4) Utilization of special nuclear ma- erial, atomic energy, and radioactive ma- erial and processes entailed in the utili- ation or production of atomic energy or uch material for all other purposes, in- luding industrial use, the generation of able energy, and the demonstration of e practical value of utilization or pro- ection facilities for industrial or com- ercial purposes; and

(5) The protection of health and the romotion of safety during research and roduction activities.

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special nuclear material available for such use, the Commission will give preference to such of said applications as will, in the opinion of the Commission, lead to major advances in the application of atomic energy for industrial or commercial purposes.

LICENSES

§ 70.31 *Issuance of licenses.* (a) Upon a determination that an application meets the requirements of the act, and of the regulations of the Commission, the Commission will issue a license in such form and containing such conditions and limitations as it deems appropriate or necessary to effectuate the purposes of the act.

(b) (1) The Commission will normally include in licenses issued pursuant to section 53a (1) of the act provisions establishing the availability to the licensee, as needed, of the quantities of special nuclear material required for conduct of the activities authorized by the license. Such provisions usually will be in the form of a statement that the Commission has allocated to the licensee, for use in the conduct of such activities, a designated quantity (or quantities) of special nuclear material; and may include an estimated schedule for a reasonable period of time of special nuclear material transfers to the applicant and of special nuclear material returns to the Commission.

(2) Provisions allocating special nuclear material will not be included in a license where the special nuclear material involved is to be charged to a quantity allocated to another licensee. Unless other arrangements are made with the Commission, special nuclear material transferred to a licensee to be fabricated or processed for another licensee will be charged to the quantity allocated in the latter's license.

(c) Any license issued to a person for use of special nuclear material in activities in which special nuclear material will be produced shall (subject to the provisions of § 70.41 (b)) be deemed to authorize such person to possess, use, and transfer the special nuclear material produced in the course of such authorized activities.

(d) No license will be issued (1) to any person for a use which is not under the jurisdiction of the United States; or (2) to any person if the Commission finds that the distribution of special nuclear material to such person would be inimical to the common defense and security.

§ 70.32 *Conditions of licenses.* (a) Each license shall expire (except as provided in § 70.33 (b)), at the time specified in the license and shall contain and be subject to the following conditions:

(1) Title to all special nuclear material shall at all times be in the United States;

(2) No right to the special nuclear material shall be conferred by the license except as defined by the license;

(3) Neither the license nor any right under the license shall be assigned or otherwise transferred in violation of the provisions of the act;

(4) All special nuclear material shall be subject to the right of recapture or control reserved by section 108 and to all other provisions of the act;

(5) No special nuclear material may be used in any utilization or production facility except in accordance with the provisions of the act;

(6) The licensee shall not use the special nuclear material to construct an atomic weapon or any component of an atomic weapon;

(7) The licensee will hold the United States and the Commission harmless from any damages resulting from the use or possession of special nuclear material by the licensee;

(8) The license shall be subject to, and the licensee shall observe, all applicable rules, regulations and orders of the Commission.

(b) The Commission may incorporate in any license such additional conditions and requirements with respect to the licensee's receipt, possession, use and transfer of special nu-

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(1) Promote the common defense security;

(2) Protect health or to minimize ger to life or property;

(3) Protect Restricted Data;

(4) Guard against the loss of diver- of special nuclear material.

(5) Require such reports and the ping of such records, and to provide such inspections, of activities under license as may be necessary or ap- priate to effectuate the purposes of act and regulations thereunder.

§ 70.33 *Renewal of licenses.* (a) plications for renewal of a license ould be filed in accordance with 70.21 and 70.22. Information con- ned in previous applications, state- nts or reports filed with the Commis- n under the license may be incorpo- ted by reference: *Provided*, That such ferences are clear and specific.

(b) In any case in which a licensee, less than thirty (30) days prior to piration of his existing license, has d an application in proper form for ewal of a license, such existing li- se shall not expire until the appli- tion for a renewal has been finally termined by the Commission.

§ 70.34 *Amendment of licenses.* Ap- ations for amendment of a license all be filed in accordance with § 70.21) and shall specify the respects in ich the licensee desires his license to amended and the grounds for such endment.

§ 70.35 *Commission action on appli- tions to renew or amend.* In consid- ng an application by a licensee to ew or amend his license, the Com- ssion will apply the criteria set forth § 70.23.

§ 70.36 *Inalienability of licenses.* license granted under the regula- ns in this part and no right to possess utilize special nuclear material nted by any license issued pursuant the regulations in this part shall be nsferred, assigned or in any manner disposed of, either voluntarily or involuntarily, directly or indirectly, through transfer of control of any license to any person unless the Commission shall after securing full information, find that the transfer is in accordance with the provisions of the act, and shall give its consent in writing.

§ 70.37 *Disclaimer of warranties.* Neither the Government nor the Commission makes any warranty or other representation that special nuclear material (a) will not result in injury or damage when used for purposes approved by the Commission, (b) will accomplish the results for which it is requested and approved by the Commission, or (c) is safe for any other use.

§ 70.38 *Reduction and termination of allocations.* (a) The Commission may, in accordance with the procedures provided in Part 2 of this chapter, reduce the quantities of special nuclear material allocated to any licensee pursuant to § 70.31, upon the ground that the quantities allocated exceed those reasonably required, or estimated to be required, for conduct of the activities authorized by the license.

(b) The expiration, revocation or other termination of a license shall terminate all special nuclear material allocations incorporated therein.

ACQUISITION, USE AND TRANSFER OF SPECIAL NUCLEAR MATERIAL

§ 70.41 *Authorized use of special nuclear material.* (a) Each licensee shall confine his possession and use of special nuclear material to the locations and purposes authorized in his license.

(b) The possession, use and transfer of any special nuclear material produced by a licensee, in connection with or as a result of use of special nuclear material received under his license, shall be subject to the provisions of the license and the regulations in this part.

(c) Nothing contained in the regulations in this part or in any license issued pursuant to the regulations in this part shall authorize or be deemed to authorize (1) the distribution of any special

nuclear material to any person for a use which is not under the jurisdiction of the United States or (2) the export from or import into the United States of any special nuclear material.

§ 70.42 *Transfer of special nuclear material.* (a) No licensee shall transfer special nuclear material except as authorized pursuant to this section.

(b) Any licensee may transfer special nuclear material:

(1) To the Commission;

(2) To a licensee whose license authorizes him to receive such special nuclear material;

(3) As otherwise authorized by the Commission in writing.

§ 70.43 *Licensee's responsibility for special nuclear material.* (a) Any licensee who receives special nuclear material from the Commission shall be responsible and shall reimburse the Commission for any loss, consumption or contamination of, or damage to, such special nuclear material occurring from the time of delivery of such material to the licensee or to a carrier for delivery to the licensee and until such material has been returned to the Commission by delivery at the laboratory, plant or office designated for the return of the material in his license or other written instruction from the Commission.

(b) The transfer of special nuclear material by a licensee to another licensee shall not relieve the transferor of responsibility to the Commission for loss, consumption or contamination of, or damage to, such special nuclear material unless, upon receiving an agreement signed by the transferee assuming such responsibility, the Commission shall give its consent in writing. The Commission will not unreasonably withhold its consent. Such arrangements may be made with the Commission in advance for a series of anticipated transfers.

RECORDS, REPORTS AND INSPECTIONS

§ 70.51 *Records.* Each licensee shall keep records showing the receipt, inventory and transfer of special nuclear material.

§ 70.52 *Reports of accidental criticality or loss of special nuclear material.* Each licensee shall promptly report to the Commission any case of accidental criticality and any loss, other than normal operating loss, of special nuclear material.

§ 70.53 *Inspections.* (a) Each licensee shall afford to the Commission at all reasonable times opportunity to inspect special nuclear material and the premises and facilities wherein special nuclear material is used, produced, or stored.

(b) Each licensee shall make available to the Commission for inspection, upon reasonable notice, records kept by the licensee pertaining to his receipt, possession, use, or transfer of special nuclear material.

§ 70.54 *Tests.* Each licensee shall perform, or permit the Commission to perform, such tests as the Commission deems appropriate or necessary for the administration of the regulations in this part, including tests of (a) special nuclear material, (b) facilities wherein special nuclear material is utilized, produced or stored, (c) radiation detection and monitoring instruments, and (d) other equipment and devices used in connection with the production, utilization or storage of special nuclear material.

MODIFICATION AND REVOCATION OF LICENSES

§ 70.61 *Modification and revocation of licenses.* (a) The terms and conditions of all licenses shall be subject to amendment, revision, or modification by reason of amendments to the Atomic Energy Act of 1954, or by reason of rules, regulations or orders issued in accordance with the act or any amendments thereto;

(b) Any license may be revoked, suspended or modified for any material false statement in the application or any statement of fact required under section 182 of the act or because of con-

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ons revealed by such application or tement of fact or any report, record, inspection or other means which ld warrant the Commission to re- to grant a license on an original lication, or for failure to construct operate a facility in accordance with terms of the construction permit or nse, the technical specifications in application, or for violation of, or ure to observe any of the terms and ditions of the act, or of any regu- on of the Commission.

(c) Upon revocation, suspension or dification of a license, the Commis- may immediately retake possession all special nuclear material held by licensee. In cases found by the mmission to be of extreme importance the national defense or security, or to health and safety of the public, the mmission may recapture any special lear material held by the licensee or to any of the procedures provided der the Administrative Procedure

(d) Except in cases of willfulness or se in which the public health, inter- or safety requires otherwise, no li- se shall be modified, suspended or oked unless, prior to the institution proceedings therefor, facts or conduct ich may warrant such action shall e been called to the attention of the nsee in writing and the licensee shall e been accorded opportunity to dem- strate or achieve compliance with all ful requirements.

70.62 *Suspension and operation in or national emergency.* Whenever gress declares that a state of war or ional emergency exists, the Com- sion, if it finds it necessary to the mon defense and security, may,

(a) Suspend any license it has is- d,

(b) Order the recapture of special lear material distributed.

(c) Order the operation of any li- sed facility.

(d) Order entry into any plant or fa- y in order to recapture special nu- r material or to operate the facility.

Just compensation shall be paid for any damages caused by recapture of special nuclear material or by operation of any facility, pursuant to this section.

ENFORCEMENT

§ 70.71 *Violations.* An injunction or other court order may be obtained prohibiting any violation of any provision of the act or any regulation or order issued thereunder. Any person who wilfully violates any provision of the act or any regulation or order issued thereunder may be guilty of a crime and, upon conviction, may be punished by fine or imprisonment or both, as provided by law.

NOTE: The record keeping and reporting requirements contained herein have been approved by the Bureau of the Budget in accordance with the Federal Reports Act of 1942.

Dated at Washington, D. C., this 30th day of January 1956.

K. E. FIELDS,
General Manager.

PART 81—STANDARD SPECIFICATIONS FOR THE GRANTING OF PATENT LICENSES

After notice and hearing, the proposed rules published in the FEDERAL REGISTER, 20 F. R. 2283, dated April 8, 1955, entitled "Standard Specifications for the Granting of Patent Licenses", are hereby adopted as follows: The rules are to become effective thirty days after the date of publication.

GENERAL PROVISIONS

Sec.
81.1 Purpose.
81.2 Definitions.
81.3 Communications.

COMMISSION-OWNED PATENTS

81.10 Contents of application.
81.11 Basis for issuance.
81.12 Conditions and limitations of the license.

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PATENTS DECLARED TO BE AFFECTED WITH THE PUBLIC INTEREST

81.20 Contents of application.
81.21 Basis for issuance.
81.22 Conditions of the license.

OTHER PATENTS USEFUL IN THE PRODUCTION OR UTILIZATION OF SPECIAL NUCLEAR MATERIAL OR ATOMIC ENERGY

81.30 Scope.
81.31 Contents of application.
81.32 Basis for issuance.
81.33 Conditions of the license.

AUTHORITY: §§ 81.1 to 81.33 issued under sec. 161, 68 Stat. 948; 42 U. S. C. 2201. Interpret or apply secs. 153, 156, 68 Stat. 945, 947; 42 U. S. C. 2183, 2186.

GENERAL PROVISIONS

§ 81.1 *Purpose.* The regulations in this part establish the standard specifications for the issuance of licenses on patents owned by the Commission, patents declared to be affected with the public interest pursuant to section 153a of the act, and other patents useful in the production or utilization of special nuclear material or atomic energy licensed pusuant to section 153e of the act.

§ 81.2 *Definitions.* As used in this part:

(a) "Act" means the Atomic Energy Act of 1954 (68 Stat. 919), including any amendments thereto;

(b) "Commission" means the Atomic Energy Commission or its duly authorized representatives.

§ 81.3 *Communications.* All communications concerning the regulations in this part, including applications for licenses, should be addressed to the United States Atomic Energy Commission, 1901 Constitution Avenue NW., Washington 25, D. C., Attention: Chief, Patent Branch.

§ 81.4 *Interpretations.* Except as specifically authorized by the Commission in writing, no interpretation of the meaning of the regulations in this part by any officer or employee of the Commission other than a written interpretation by the General Counsel will be recognized to be binding upon the Commission.

COMMISSION-OWNED PATENTS

§ 81.10 *Contents of application.* Each application shall contain the name and address of the applicant and the State of incorporation if applicant is a corporation.

§ 81.11 *Basis for issuances.* The Commission will issue the license upon receipt of an application containing the required contents.

§ 81.12 *Conditions and limitations of the license.* Each license shall contain and be subject to the following conditions and limitations;

(a) The license shall be non-exclusive, revocable, and royalty-free;

(b) Neither the license nor any right under the license shall be assigned or otherwise transferred;

(c) The license shall not constitute a license or authorization under any provision of the act other than section 156 of the act.

(d) The Commission makes no representation or warranty that the exercise of the license will not result in infringement of any other patent, nor does the Commission assume any liability resulting from the exercise of the license.

(e) The licensee shall be subject to, and the licensee shall observe all applicable rules, regulations and orders of the Commission.

PATENTS DECLARED TO BE AFFECTED WITH THE PUBLIC INTEREST

§ 81.20 *Contents of application.* Each application shall contain the following information:

(a) The name and address of the applicant;

(b) The State of incorporation, if the applicant is a corporation;

(c) The activities in the production or utilization of special nuclear material or atomic energy to which applicant proposes to apply the license.

(d) The relationship of the invention or discovery to the activities to which it is to be applied, including an estimate of

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§81.30 *Scope.* Any
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effect on such activities stemming the grant or denial of the license.

(e) The nature and purpose of the which the applicant intends to make the patent license.

(f) Efforts made by applicant to obtain a patent license from the owner of patent;

(g) Terms, if any, on which the owner of the patent proposed to grant applicant a patent license.

§81.21 *Basis for issuance.* The Commission will issue a patent license patents declared by the Commission be affected with the public interest pursuant to section 153 of the act upon finding that:

(a) The activities to which the patent license is proposed to be applied by applicant are of primary importance the conduct of an activity by such applicant authorized under the act.

(b) The applicant cannot otherwise obtain a patent license from the owner the patent on terms which are reasonable for the intended use to be made the patent by the applicant.

§81.22 *Conditions of the license.* Each license shall contain and be subject to the following conditions:

(a) The license shall be non-exclusive and revocable;

(b) Neither the license nor any right under the license shall be assigned or otherwise transferred;

(c) The licensee shall pay a reasonable royalty fee. Such royalty fee may be agreed upon between the owner and patent licensee, or in the absence of agreement shall be determined for patent license by the Commission pursuant to section 157 of the act;

(d) The licensee shall be subject to the licensee shall observe all applicable rules, regulations, and orders of Commission.

PATENTS USEFUL IN THE PRODUCTION OR UTILIZATION OF SPECIAL NUCLEAR MATERIAL OR ATOMIC ENERGY

§81.30 *Scope.* Any person:

(a) Who has made application to the Commission for a license under sections 53, 62, 63, 81, 103, or 104, or a permit or lease under section 67;

(b) To whom such license, permit, or lease has been issued by the Commission;

(c) Who is authorized to conduct such activities as such applicant is conducting or proposes to conduct under a general license issued by the Commission under section 62 or 81; or

(d) Whose activities or proposed activities are authorized under section 31, may at any time make application to the Commission for a patent license for the use of an invention or discovery useful in the production or utilization of special nuclear material or atomic energy covered by a patent.

§ 81.31 *Contents of application.* Each application shall contain the following information:

(a) The name and address of the applicant;

(b) The State of incorporation, if the applicant is a corporation;

(c) The activities in the production or utilization of special nuclear material or atomic energy to which applicant proposes to apply the license.

(d) The relationship of the invention or discovery to the activities to which it is to be applied, including an estimate of the effect on such activities stemming from the grant or denial of the license.

(e) The nature and purpose of the use which the applicant intends to make of the patent license;

(f) Efforts made by applicant to obtain a patent license from the owner of the patent;

(g) Terms, if any, on which the owner of the patent proposed to grant applicant a patent license.

§ 81.32 *Basis for issuance.* The Commission will issue the patent license upon a finding that:

(a) The invention or discovery covered by the patent is of primary importance in the production or utilization of special nuclear material or atomic energy;

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(b) The licensing of such invention or discovery is of primary importance to the conduct of the activities of the applicant;

(c) The activities to which the patent license is proposed to be applied by such applicant are of primary importance to the furtherance of policies and purposes of the act; and

(d) Such applicant cannot otherwise obtain a patent license from the owner of the patent on terms which the Commission deems to be reasonable for the intended use of the patent to be made by such applicant.

§ 81.33 *Conditions of the license.* Each license shall obtain and be subject to the following conditions:

(a) The license shall be non-exclusive and revocable;

(b) Neither the license nor any right under the license shall be assigned or otherwise transferred;

(c) The license shall be limited to the purposes for which it is issued;

(d) The licensee shall pay a reasonable royalty fee. Such royalty fee may be agreed upon between the owner and such patent licensee, or in the absence of such agreement shall be determined for each patent license by the Commission pusuant to section 157 of the act;

(e) The licensee shall be subject to and the licensee shall observe all applicable rules, regulations, and orders of the Commission.

Dated at Washington, D. C., this 12th day of January 1956.

K. E. FIELDS,
General Manager.

PART 95—SAFEGUARDING OF RESTRICTED DATA

The following regulations establish requirements for the safeguarding of Secret and Confidential Restricted Data and apply to all persons who receive such data under an access permit issued pursuant to the regulations in Part 25 of this chapter. Because the Atomic Energy Commission has issued a substantial number of access permits, and because interested persons will not be adversely affected, the Commission has found that good cause exists why the regulations in this part should be made effective without the customary 30 day period of notice.

Pursuant to the Administrative Procedure Act, Public Law 404, 79th Cong., 2d Sess., the following rules are published as a document subject to codification, to be effective upon publication in the Federal Register.

GENERAL PROVISIONS

Sec.
95.1 Purpose.
95.2 Scope.
95.3 Definitions.
95.4 Communications.
95.5 Submission of procedures by access permit holder.
95.6 Specific waivers.
95.7 Interpretations.

PHYSICAL SECURITY

95.21 Protection of Restricted Data in storage.
95.22 Protection while in use.
95.23 Establishment of security areas.
95.24 Special kinds of classified material.
95.25 Protective personnel.

CONTROL OF INFORMATION

95.31 Access to Restricted Data.
95.32 Classification and preparation of documents.
95.33 External transmission of documents and material.
95.34 Accountability for Secret Documents.
95.35 Authority to reproduce.
95.36 Changes in classification.
95.37 Destruction of documents or material containing Restricted Data.
95.38 Suspension or revocation of security clearance.
95.39 Expiration, suspension or revocation of access permits.
95.40 Termination of employment.
95.41 Continued applicability of the regulations in this part.

Sec.
95.42 Reports.
95.43 Inspection.
95.44 Violations.

AUTHORITY: §§ under sec. 161i, U. S. C. 2201.

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§ 95.3 *Definitio* part,

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Sec.
95.42 Reports.
95.43 Inspection.
95.44 Violations.

AUTHORITY: §§ 95.1 to 95.44 issued under sec. 161i, p, 68 Stat. 948, 42 U. S. C. 2201.

GENERAL PROVISIONS

§ 95.1 *Purpose.* The regulations in this part establish requirements for the safeguarding of Secret and Confidential Restricted Data. This part does not apply to Top Secret Restricted Data.

§ 95.2 *Scope.* The regulations in this part apply to all persons who receive access to Restricted Data under an Access Permit issued pursuant to the regulations in Part 25 of this chapter.

§ 95.3 *Definitions.* As used in this part,

(a) "Act" means the Atomic Energy Act of 1954 (68 Stat. 919), including any amendments thereto;

(b) "Commission" means the Atomic Energy Commission or its duly authorized representatives;

(c) "Document" means any piece of recorded information regardless of its physical form or characteristics;

(d) "L clearance" means a security clearance granted by the Commission for access to Confidential Restricted Data;

(e) "Permittee" means the holder of an access permit issued pursuant to the regulations in Part 25 of this chapter.

(f) "Person" means (1) any individual, corporation, partnership, firm, association, trust, estate, public or private institution, group, Government agency other than the Commission, any State or any political subdivision of, or any political entity within a State, or other entity; and (2) any legal successor, representative, agent or agency of the foregoing;

(g) "Q clearance" means a security clearance granted by the Commission for access to Secret as well as Confidential Restricted Data;

(h) "Restricted Data" means all data concerning (1) design, manufacture or utilization of atomic weapons; (2) the production of special nuclear material; or (3) the use of special nuclear material in the production of energy, but shall not include data declassified or removed from the Restricted Data category pursuant to section 142 of the act;

(i) "Security area" means a physically defined space, access to which is subject to security restrictions and control;

(j) "United States", when used in a geographical sense, includes all Territories and possessions of the United States, the Canal Zone and Puerto Rico.

§ 95.4 *Communications.* All communications concerning the regulations in this part should be addressed to the U. S. Atomic Energy Commission, 1901 Constitution Avenue. NW., Washington 25, D. C., Attention: Division of Civilian Application.

§ 95.5 *Submission of procedures by access permit holder.* No permittee shall receive documents or material containing Restricted Data until he shall have submitted to the Commission a written statement of his procedures for the safeguarding of Restricted Data and for the security education of his employees and the Commission shall have determined and informed the permittee that his procedures for the safeguarding of Restricted Data are in compliance with the regulations in this part and that his procedures for the security education of his employees are designed to assure that all his employees who will have access to Restricted Data are informed about and understand the regulations in this part.

§ 95.6 *Specific waivers.* The Commission may, upon application of any interested party, grant such waivers from the requirements of this part as it determines are authorized by law and will not constitute an undue risk to the common defense and security.

§ 95.7 *Interpretations.* Except as specifically authorized by the Commission in writing, no interpretation of the

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meaning of the regulations in this part by any officer or employee of the Commission other than a written interpretation by the General Counsel will be recognized to be binding upon the Commission.

PHYSICAL SECURITY

§ 95.21 *Protection of Restricted Data in storage.* (a) Persons who possess Restricted Data pursuant to an Access Permit shall store Secret and Confidential documents and material when not in use in accordance with one of the following methods:

(1) In a locked vault, safe, or safe-type steel file cabinet having a 3-position dial-type combination lock: or

(2) In a dual key, Bank Safety Deposit Box; or

(3) In a steel file cabinet secured by a steel lock bar and a 3-position dial-type changeable combination padlock from which the manufacturer's identification number (if any) has been obliterated; or

(4) In a locked steel file cabinet when located in a security area established under § 95.23 or when the cabinet or the place in which the cabinet is located is under Commission approved automatic alarm protection.

(b) Changes of combination: Each permittee shall change the combinations on lock of his safekeeping equipment whenever such equipment is placed in use, whenever an individual knowing the combination leaves his employ, or whenever the combination has been subjected to compromise, and in any event at least once a year. Permittees shall classify records of combinations no lower than the highest classification of the documents and material authorized for storage in the safekeeping equipment concerned.

§ 95.22 *Protection while in use.* While in use, documents and material containing Restricted Data shall be under the direct control of an appropriately cleared individual and the Restricted Data shall be capable of being removed from sight immediately.

§ 95.23 *Establishment of security areas.* (a) When, because of their nature or size, it is impracticable to safeguard documents and material containing Restricted Data in accordance with the provisions of §§ 95.21 and 95.22, a security area to protect such documents and material shall be established.

(b) The following controls shall apply to security areas:

(1) Security areas shall be separated from adjacent areas by a physical barrier designed to prevent entrance into such areas by unauthorized individuals and access to the Restricted Data within the area.

(2) During working hours admittance shall be controlled by an appropriately cleared individual posted at each unlocked entrance.

(3) During non-working hours admittance shall be controlled by protective personnel on patrol, with protective personnel posted at unlocked entrances or by such automatic alarm systems as the Commission may approve.

(4) Each individual authorized to enter a security area shall be issued a distinctive badge or pass when the number of employees assigned to the area exceeds thirty.

§ 95.24 *Special kinds of classified material.* When the Restricted Data contained in material is not ascertainable by observation or examination at the place where the material is located and when the material is not readily removable because of size, weight, radioactivity, or similar factors, the Commission may authorize the permittee to provide such lesser protection than is otherwise required by §§ 95.21 to 95.23, inclusive, as the Commission determines to be commensurate with the difficulty of removing the material.

§ 95.25 *Protective personnel.* Whenever protective personnel are required by § 95.23, such protective personnel shall:

(a) Possess an "L" clearance if the Restricted Data being protected is classified confidential or a "Q" clearance

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(b) Be armed with side-arms of not than .38 caliber.

§ 95.31 *Access to restricted data.* (a) cept as the Commission may author- no person subject to the regulations this part who possesses Restricted ta shall permit any individual to ve access to Confidential Restricted ta unless such individual has an "L" "Q" clearance, or permit any individ- l to have access to Secret Restricted ta unless such individual has a "Q" arance.

(b) In addition, no person subject to e regulations in this part who pos- sses Secret Restricted Data, shall per- it any individual in his employ to have cess to such Restricted Data unless he s determined that the employee needs cess to such Restricted Data in the rformance of his duties; or permit r other permittee or Commission con- ctor to have access to such data un- s such permittee or contractor is thorized by his access permit or pur- ant to his Commission contract to eive access to Restricted Data in the rticular categories and classifications volved.

(c) Inquiries concerning the clear- ce status of individuals and the scope access permits may be addressed to Commission office administering the ess permit.

§ 95.32 *Classification and prepara- n of documents*—(a) *Classification.* stricted Data which may be origi- ed by any person subject to the regu- ions in this part shall be classified in ordance with guides furnished by the mmission.

(b) *Classification consistent with ent.* Each document containing stricted Data shall be classified ret or Confidential according to its n content.

(c) *Classified marking.* Unless oth- rise authorized below, the assigned ssification of a document shall be spicuously marked or stamped at the and bottom of each page and on the front cover, if any; and the document shall bear the following additional markings on the first page and on the front cover:

RESTRICTED DATA

This document contains Restricted Data as defined in the Atomic Energy Act of 1954. The information relates to the civilian applications of atomic energy. Its transmittal or the disclosure of its contents in any manner to an unauthorized person is prohibited.

(d) *Documentation.* (1) All Secret documents shall bear on the first page a properly completed documentation stamp such as the following:

This document consists of ____ pages. Copy No. _____ of _____ Series _____.

(2) The series designation shall be a capital letter beginning with the letter "A" designating the original set of copies prepared. Each subsequent set of copies of the same documents shall be identified by the succeeding letter of the alphabet.

(e) *Letter of transmittal.* A letter transmitting Restricted Data shall be marked with a classification at least as high as its highest classified enclosure. When the contents of the letter of transmittal warrant lower classification or require no classification, a stamp or marking such as the following shall be used on the letter:

When separated from enclosures handle this document as _____.

(f) *Permanently fastened documents.* Classified books or pamphlets the pages of which are permanently and securely fastened together shall be conspicuously marked or stamped with the assigned classification at the top and bottom on the outside front cover, on the title page, on the front page and on the inside and outside of the back cover. The additional markings referred to in paragraph c of this section shall be placed on the first page and on the front cover.

(g) *Physically connected documents.* The classification of a file or group of physically connected documents shall

be at least as high as that of the most highly classified document therein. It shall bear only one over-all classification, although pages, paragraphs, sections, or components thereof may bear different classifications. Each document separated from the file or group shall be handled in accordance with its individual classification.

(h) *Attachment of security markings.* Documents which do not lend themselves to marking or stamping shall have securely affixed or attached a tag, sticker, or similar device bearing the appropriate security markings.

§ 95.33 *External transmission of documents and material*—(a) *Restrictions.* (1) Documents and material containing Restricted Data shall be transmitted only to persons who are appropriately cleared and otherwise eligible for access under the requirements of § 95.31.

(2) In addition such documents and material shall be transmitted only to persons who possess facilities for their physical security consistent with this part. Any person subject to the regulation in this part who transmits such documents or material shall be deemed to have fulfilled his obligations under this subparagraph by securing a written certification from the prospective recipient that such recipient possesses facilities for its physical security consistent with this part.

(3) Documents and material containing Restricted Data shall not be exported from the United States without prior authorization of the Commission.

(b) *Preparation of documents.* Documents containing Restricted Data shall be prepared for transmission outside an individual installation in accordance with the following:

(1) They shall be enclosed in two sealed opaque envelopes or wrappers.

(2) The inner envelope or wrapper shall be addressed in the ordinary manner and sealed with tape, the appropriate classification shall be placed on both sides of the envelope and the additional marking referred to in § 95.32 (c) shall be placed on the side bearing the address.

(3) The outer envelope or wrapper shall be addressed in the ordinary manner. No classification or additional marking shall be affixed which indicates that the document enclosed therein contains Restricted Data.

(4) A receipt, which identifies the document, the date of transfer, the recipient and the person transferring the document shall accompany the document and shall be signed by the recipient and returned to the sender whenever the custody of a Secret document is transferred.

(c) *Preparation of material.* Material, other than documents, containing Restricted Data shall be prepared for shipment outside an individual installation in accordance with the following:

(1) The material shall be so packaged that the classified characteristics will not be revealed.

(2) A receipt which identifies the material, the date of shipment, the recipient, and the person transferring the material shall accompany the material and the recipient shall sign such receipt whenever the custody of Secret material is transferred.

(d) *Methods of transportation.* (1) Secret documents and material shall be transported only by one of the following methods:

(i) By registered mail,

(ii) By railway or air express protective signature service, or

(iii) By individuals possessing appropriate AEC security clearance who have been given written authority by their employers.

(2) Confidential documents and material shall be transported by one of the methods set forth in subparagraph (1) of this paragraph except that:

(i) Confidential material may be shipped in sealed carload or truckload lots where the bill of lading requires the

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carrier to check the seals en route to and at destination, or in planeload lots where the bill of lading requires the carrier to maintain continuous surveillance of the cargo until delivery to the consignee.

(ii) Confidential material of less than carload, truckload, or planeload lots may be shipped by regular commercial carrier when the container and its contents weigh more than 500 pounds and such container is locked and sealed.

(e) *Transmission by cryptographic means.* Cryptographic systems shall not be used for the transmission of Restricted Data unless approved by the Commission.

§ 95.34 *Accountability for secret documents.* Each permittee possessing documents containing Secret Restricted Data shall establish a document accountability procedure and shall maintain records to show the disposition of all such documents which have been in his custody at any time.

§ 95.35 *Authority to reproduce.* Nothing in this part shall be deemed to prohibit any person possessing documents containing Restricted Data from reproducing any Confidential documents, or any Secret documents originated by him. He shall not reproduce any other documents containing Secret Restricted Data without prior authorization from the Commission or from the originator of the document.

§ 95.36 *Changes in classification.* Documents containing Restricted Data shall not be downgraded to a lower classification or declassified except as authorized by the Commission. Requests for downgrading or declassification shall be submitted to: U. S. Atomic Energy Commission, Washington 25, D. C. Attention: Division of Classification. If the Commission approves a change of classification or declassification, the previous classification marking shall be cancelled and the following statement, properly completed, shall be placed on the first page of the document:

Classification cancelled (or changed to) _____ by authority
(Insert appropriate classification)
of _____
(Person authorizing change in classification)
by _____
(Signature of person making change and date thereof)

Any person making a change in classifications or receiving notice of such a change shall forward notice of the change in classification to holders of all copies as shown on his records.

§ 95.37 *Destruction of documents or material containing Restricted Data.* (a) Documents containing Restricted Data may be destroyed only by shredding and burning, pulping or by any other method that assures complete destruction of the information. If the document contains Secret Restricted Data, a permanent record of the subject, title, or report number of the document, its date of preparation, its series designation and copy number, and the date of destruction shall be signed by the person authorizing the destruction of the document and shall be maintained in the office of the last custodian.

(b) Restricted Data contained in material, other than documents, may be destroyed only by a method that assures complete obliteration, removal, or destruction of the Restricted Data.

§ 95.38 *Suspension or revocation of security clearance.* In any case where the security clearance of an individual subject to the regulations in this part is suspended or revoked in accordance with the procedures set forth in Part 4 of this chapter, such individual shall, upon due notice from the Commission of such suspension or revocation and demand by the Commission, deliver to the Commission any and all documents or materials in his possession containing Restricted Data for safekeeping and

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such further disposition as the Commission determines to be just and proper.

§ 95.39 *Expiration, suspension or revocation of access permits.* (a) Upon expiration of an access permit, the person to whom such permit had been issued may, except as provided in paragraph (b) of this section, (1) deliver all documents or materials in his possession containing Restricted Data to the Commission or to a person authorized to receive them; (2) destroy them; or (3) retain them in his possession.

(b) In any case where an access permit has expired or has been suspended or revoked and the Commission has determined that further possession by the former access permit holder of documents or materials containing Restricted Data would endanger the common defense and security, such former access permit holder shall, upon due notice from the Commission of such expiration, suspension, or revocation and of such determination, deliver to the Commission any and all documents or materials in his possession containing Restricted Data for safekeeping and such further disposition as the Commission determines to be just and proper.

§ 95.40 *Termination of employment.* Each permittee shall furnish promptly to the Commission written notification of the termination of employment of each individual who possesses a security clearance under his permit. Upon such notification the Commission may (a) terminate the individual's security clearance, or (b) transfer the individual's security clearance to the new employer of the individual to allow continued access to Restricted Data where authorized pursuant to Commission regulations.

§ 95.41 *Continued applicability of the regulations in this part.* The expiration, suspension, revocation or other termination of a security clearance or access permit shall not relieve any person from compliance with the regulations in this part.

§ 95.42 *Reports.* Permittees shall report promptly to the Commission all losses of documents or material containing Restricted Data.

§ 95.43 *Inspection.* The Commission may make such inspections of the premises, activities, records, and procedures of any person subject to the regulations in this part as the Commission deems necessary to effectuate the purposes of the act.

§ 95.44 *Violations.* An injunction or other court order may be obtained prohibiting any violation of any provision of the act or any regulation or order issued thereunder. Any person who wilfully violates any provision of the act of any regulation or order issued thereunder may be guilty of a crime and, upon conviction, may be punished by fine or imprisonment or both, as provided by law.

NOTE: The record keeping and reporting requirements contained herein have been approved by the Bureau of the Budget in accordance with the Federal Reports Act of 1942.

R. W. COOK,
Acting General Manager.

PART 110—UNCLASSIFIED ACTIVITIES IN FOREIGN ATOMIC ENERGY PROGRAMS

The regulations in this part incorporate a general authorization made by the Commission under section 57 a. (3) (B) of the Atomic Energy Act of 1954 (68 Stat. 919); establish reporting requirements applicable to persons who engage in certain unclassified activities in foreign atomic energy programs; and establish procedures governing applications for specific authorizations to engage directly or indirectly in the production of special nuclear material outside of the United States. Notice of the general authorization was published in the Federal Register on October 5, 1955 (20 F. R. 7399). The notice included a statement that the Commission would soon promulgate regulations incorporating the authorization and that such regulations would include pro-

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110.1 Purpose.
110.2 Scope.
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110.6 Authoriz
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110.9 Contents
110.10 Reports.
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visions requiring persons who have engaged in certain activities pursuant to the authorization to submit a report to the Commission concerning such activity. The regulations published below provide a period of 30 days for all persons who have previously engaged in such activities to submit the required reports. In light of these considerations, the Atomic Energy Commission has found that the customary general notice of proposed rule making and public procedure thereon are unnecessary and would be contrary to the public interest; and that good cause exists why the regulations in this part should be made effective without the customary 30-day period of notice.

Pursuant to the Administrative Procedure Act, Public Law 404, 79th Congress, 2d Session, the following rules are published as a document subject to modification.

Sec.
110.1 Purpose.
110.2 Scope.
110.3 Definitions.
110.4 Communications.
110.5 Interpretations.
110.6 Authorization requirement.
110.7 Generally authorized activities.
110.8 Application for specific authorization.
110.9 Contents of application.
110.10 Reports.
110.11 Additional information.
110.12 Enforcement.
110.13 Effective date.

AUTHORITY: §§ 110.1 to 110.13 issued under sec. 57, 68 Stat. 932, 42 U. S. C. 2077 and sec. 161, 68 Stat. 948, 42 U. S. C. 2201, for the purposes of sec. 223, 68 Stat. 958, 42 U. S. C. 2273, §§ 110.10 and 110.11 issued under sec. 161 p., 68 Stat. 950, 42 U. S. C. 2201.

§ 110.1 *Purpose.* The regulations in this part incorporate a general authorization made by the Commission under section 57a (3) (B) of the Atomic Energy Act of 1954 (68 Stat. 919); establish reporting requirements applicable to persons who engage in certain unclassified activities in foreign atomic energy programs; and establish procedures governing applications for specific authorizations to engage directly or indirectly in the production of special nuclear material outside the United States.

§ 110.2 *Scope.* The regulations in this part apply to all persons within or under the jurisdiction of the United States.

§ 110.3 *Definitions.* As used in this part:

(a) "Act" means the Atomic Energy Act of 1954 (68 Stat. 919) including any amendments thereto.

(b) "Agreement for cooperation" means an agreement for cooperation with any nation or regional defense organization pursuant to section 123 of the act.

(c) "Atomic weapon" means any device utilizing atomic energy, exclusive of the means for transporting or propelling the device (where such means is a separate and divisible part of the device), the principal purpose of which is for use as, or for development of, a weapon, or weapon prototype, or a weapon test device.

(d) "Commission" means the Atomic Energy Commission or its duly authorized representatives.

(e) "Defense information" means any information in any category determined by any Government agency authorized to classify information, as being information respecting, relating to, or affecting the national defense.

(f) "Nuclear reactor" means an apparatus, other than an atomic weapon, designed or used to sustain nuclear fission in a self-supporting chain reaction.

(g) "Person" means (1) any individual, corporation, partnership, firm, association, trust, estate, public or private institution, group, Government agency other than the Commission, any State or any political subdivision of, or any political entity within a State; and (2) any legal successor, representative, agent or agency of the foregoing.

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(h) "Research and development" means (1) theoretical analysis, exploration, or experimentation; or (2) the extension of investigative facilities and theories of a scientific or technical nature into practical application for experimental and demonstration purposes, including the experimental production and testing of motors, devices, equipment, materials, and processes.

(i) "Restricted data" means all data concerning (1) design, manufacturing or utilization of atomic weapons; (2) the production of special nuclear material; or (3) the use of special nuclear material in the production of energy, but shall not include any data declassified or removed from the restricted data category pursuant to section 142 of the act.

(j) "Source of material" means source material as defined in the regulations contained in part 40 of this chapter.

(k) "Special nuclear material" means special nuclear material as defined in the regulations contained in Part 70 of this chapter.

(l) "United States", when used in a geographical sense, includes all territories and possessions of the United States, the Canal Zone and Puerto Rico.

§ 110.4 *Communications.* All communications concerning the regulations in this part should be addressed to the United States Atomic Energy Commission, Washington 25, D. C., Attention: Division of Civilian Application.

§ 110.5 *Interpretations.* Except as specifically authorized by the Commission in writing no interpretation of the meaning of the regulations in this part by any officer or employee of the Commission other than a written interpretation by the General Counsel will be recognized to be binding upon the Commission.

§ 110.6 *Authorization requirement.* Section 57 a. (3) of the act provides that it shall be unlawful for any person to engage directly or indirectly in the production of any special nuclear material outside of the United States except (a) under an agreement for cooperation made with a foreign nation pursuant to section 123 of the act or (b) upon authorization by the Commission after a determination that such activity will not be inimical to the interest of the United States.

§ 110.7 *Generally authorized activities.* (a) Pursuant to section 57 a. (3) (B) of the act, the Atomic Energy Commission has determined that any activity which:

(1) Constitutes directly or indirectly engaging in the production of any special nuclear material in any foreign country other than countries or areas now or hereafter listed as Subgroup A countries or destinations in § 371.3 of the Comprehensive Export Schedule of the United States Department of Commerce (15 CFR 371.3); and

(2) Does not involve the communication of Restricted Data or other classified defense information; and

(3) Is not in violation of other provisions of law;

will not be inimical to the interest of the United States and is authorized by the Atomic Energy Commission.

(b) Nothing contained in paragraph (a) of this section shall relieve any person from compliance with other provisions of law or regulation, including rules, regulations or orders relating to the export of production or utilization facilities, or source, special nuclear, or byproduct materials, pursuant to the Atomic Energy Act of 1954; the Export Control Act of 1949, as amended; the Mutual Security Act of 1954; or other law.

§ 110.8 *Application for specific authorization.* Any person who proposes to engage directly or indirectly in the production of special nuclear material outside of the United States may apply, unless such proposed activity is author-

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§ 110.9 *Contents of application.* (a)
ach application shall contain the fol-
wing information:

(1) The full name, address and citi-
nship of the applicant. If the appli-
nt is a corporation or other entity, it
all indicate the State where it was
corporated or organized, the location
the principal office, and shall fur-
sh information known to the appli-
nt concerning the control or owner-
ip, if any, exercised over the appli-
nt by any alien, foreign corporation
foreign Government. Each appli-
tion shall contain complete and accu-
te disclosure with respect to the real
rty or parties in interest.

(2) A complete statement of the ac-
ity for which Commission authoriza-
n is requested, including designation
the country or countries involved and
detailed description of the specific
oject to which such activity relates.

(b) If the application contains re-
icted data or other defense informa-
n, it shall be prepared in such man-
that all restricted data and other
fense information are separated from
unclassified information.

(c) Information contained in appli-
tions, statements or reports otherwise
d by the applicant with the Com-
ssion may be incorporated by refer-
e, provided that each such reference
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§ 110.10 *Reports.* (a) Except as
vided in paragraph (c) of this sec-
n, each person who engages in an
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section shall within 30 days from
commencement of such activity sub-
a report to the Atomic Energy Com-
ion, Washington 25, D. C., Atten-
: Division of Civilian Application.

Each such report shall contain the following information:

(1) The name, address and citizenship of the person submitting the report;

(2) The name, address and citizenship of the person or persons for whom such activities are performed;

(3) A description of the activity, including its locations.

(b) Activities to be reported:

(1) The design, construction, or operation, outside the United States, of:

(i) A nuclear reactor; or

(ii) A facility for the separation of isotopes of uranium or plutonium; or

(iii) A facility for the chemical, physical or metallurgical processing or fabrication or alloying of special nuclear material; or

(iv) A facility for the production of heavy water, zirconium (hafnium-free or low-hafnium), reactor-grade graphite, or beryllium; or

(2) The design or fabrication outside the United States, of any component part especially designed or fabricated for a nuclear reactor or other facility specified in subparagraph (1) of this paragraph; or

(3) The furnishing of designs, drawings, or other technical data for use outside the United States in the construction or operation of a facility specified in subparagraph (1) of this paragraph or in the fabrication of a component part specified in subparagraph (2) of this paragraph; or

(4) The separation, outside of the United States, of isotopes of uranium or plutonium; or

(5) The production, outside of the United States, of heavy water, zirconium (hafnium-free or low-hafnium), reactor-grade graphite, or beryllium; or

(6) The chemical, physical or metallurgical processing or fabrication or alloying, outside of the United States, of special nuclear material.

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(c) The reporting requirements of this section shall not apply to:

(1) Any activity consisting only of (i) the communication of information generally available to the public in published form; or (ii) financial assistance; or (iii) the transmittal of information relating only to conceptual design or performance characteristics of nuclear reactors or facilities; or (iv) the comparative evaluation of types of reactors of facilities; or (v) any combination of the foregoing.

(2) Any person to the extent that such person engages in activity authorized by § 110.7 as the employee of a person required to submit a report pursuant to paragraph (a) of this section.

(3) Any activity specifically authorized by the Commission.

§ 110.11 *Additional information.* The Commission may at any time require any person who engages in activity specified in § 110.10 to submit additional information with respect to such activity.

§ 110.12 *Violations.* An injunction or other court order may be obtained prohibiting any violation of any provision of the act or any regulation or order issued thereunder. Any person who wilfully violates any provision of the act or any regulation or order issued thereunder may be guilty of a crime and, upon conviction, may be punished by fine or imprisonment or both, as provided by law.

§ 110.13 *Effective date.* The regulations in this part are effective upon publication in the FEDERAL REGISTER, except that persons who engaged prior to such publication in activities for which reports are required by § 110.10 shall not be required to submit such reports to the Commission until 30 days after such publication.

NOTE: The reporting requirements contained herein have been approved by The Bureau of the Budget in accordance with the Federal Reports Act of 1942.

Dated at Washington, D. C., this 12th day of January 1956.

K. E. FIELDS,
General Manager.

PART 130—PRIORITIES REGULATION

ABANDONMENT OF PRIORITY

The following rule is published as an amendment to the Priorities Regulation and is to be added as a new paragraph (d) to § 130.33. In accordance with section 4 of the Administrative Procedures Act, Public Law 404, 79th Cong., 2d Sess., the rules shall be effective 30 days after the date of publication.

§ 130.33 *Abandonment of priority*

* * *

(d) Any property on which a priority has been abandoned shall be offered by the sales agency to the priority classes, if any, to which propery of the same type will, subsequent to such abandonment, be offered; provided that when a senior occupant of a government-owned duplex house abandons his senior occupant's priority, the property in question shall be first offered to the junior occupant of such house if he has not exercised a priority to purchase another house hereunder. If all such priority rights have expired or lapsed, such property shall be disposed of as provided in section 53 (b), (c) and (d) of the act.

(Secs. 42, 111, 115, 69 Stat. 475, 483)

Dated at Washington, D. C., this 20th day of April 1956.

K. E. FIELDS,
General Manager.

ACCESS PERMITS

EXTENSION OF TERM OF PERMIT

1. Pursuant to the provisions of the Atomic Energy Act of 1954 (68 Stat. 919), each access permit issued by the Atomic Energy Commission and dated

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between May 16, 1955 and February 3, 1956, inclusive, is hereby amended by extending the term of the permit to the date two years after the date of the permit.

2. Any holder of an access permit affected by this amendment who desires his permit to terminate at an earlier date than that provided for in this amendment should submit a request therefor to the Atomic Energy Commission, 1901 Constitution Avenue NW., Washington 25, D. C., Attention, Division of Civilian Application.

Dated at Washington, D. C. this 5th day of April 1956.

K. E. FIELDS,
General Manager.

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APPENDIX 8

Statements Issued by White House on Allocation of Uranium 235, February 22, 1956

Statement by the President

Mankind's hopes and aspirations for peace and greater well-being are closely linked to the world's progress in developing the peaceful uses of atomic energy. The program to further this development has advanced steadily in the past two years.

I am announcing today further steps by the United States toward the production of peaceful power from the atom.

At the recommendation of Chairman Lewis L. Strauss of the U. S. Atomic Energy Commission, in which the Departments of State and Defense concur, I have determined, under Section 41b of the Atomic Energy Act of 1954, that substantial quantities of the special nuclear material uranium 235 may now be designated for research and development purposes and for fueling nuclear power reactors at home and abroad. This material will be available for either sale or lease under conditions prescribed by the United States Government. The Commission's recommendations are based on extensive studies that have been in progress since enactment of the Atomic Energy Act of 1954.

The quantities of uranium 235 which will be made available for distribution over a period of years under this determination are:

a. In the United States, through lease for all licensed civilian purposes, principally for power reactors—20,000 kilograms.
b. Outside the United States, through sale or lease for peaceful purposes, principally power and research reactors—20,000 kilograms. This is in addition to the 200 kilograms already made available for research reactors abroad.

It is not intended that nations which are presently producing uranium 235, or the Soviet Union and its satellites, shall share in this distribution.

Distribution of special nuclear material will be subject to prudent safeguards against diversion of the materials to non-peaceful purposes.

The quantities of uranium 235 to be made available as a result of this determination will permit us to carry out our responsibilities in the development of atomic energy for the common defense and security of the United States and for contributing to the peace and general welfare of the world.

Significant actions are under way to create an international agency and an integrated community for Western Europe to develop peaceful uses of atomic energy. The United States welcomes this progress and will cooperate with such agencies when they come into existence.

The special nuclear material to be made available will support the start of nuclear power programs with a generating capacity of several millions of electrical kilowatts. With this assurance, such programs may be undertaken in the next several years, in this country and abroad.

As additional projects are undertaken by our industry and by other nations, more nuclear fuel will be required. The Atomic Energy Commission has informed me that it will recommend that additional supplies be made available as become necessary in the future.

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This action demonstrates the confidence of the United States in the possibilities of developing nuclear power for civilian uses. It is an earnest of our faith that the atom can be made a powerful instrument for the promotion of world peace.

Statement by Lewis L. Strauss, Chairman, U. S. Atomic Energy Commission

The President's action in authorizing the Atomic Energy Commission to make available 40,000 kilograms of uranium 235 for use here and abroad in the development of nuclear power is the most important step toward peaceful uses of atomic energy since the passage of the Atomic Energy Act of 1954.

The President's action has two major aspects:

It authorizes the Atomic Energy Commission to provide sufficient uranium 235 to meet the estimated requirements of the private and public power groups in the United States which, in the role of pioneers, have announced plans for the construction and operation of nuclear power plants.

It enables the Commission to respond to the top-priority question concerning the availability of nuclear fuel being asked by our friends abroad who wish to negotiate agreements with the United States for assistance in developing their respective nuclear power programs.

We are now embarking on programs of aid in nuclear power development, extending beyond our previous programs of support of atomic energy research in the United States and abroad. Under these new programs we will provide uranium 235 to support nuclear power development during the life of the licenses issued under our civilian applications program at home and the expected life of agreed power reactor projects abroad using our fuel. The 40,000 kilograms of uranium 235 available to domestic and foreign users will not all be distributed in the coming year or in any other single year. It will be distributed over a period of years as needed, with smaller amounts in the early years.

Prior to the President's action today, the United States offered to make available, within prudent security considerations, to friendly nations prepared to invest their own funds in nuclear programs both access to and training in the new technology of theory, design, construction and operation of power reactors.

We have carried out that promise in several ways. At the International Conference on the Peaceful Uses of Atomic Energy held in Geneva in August 1955, the United States presented along with the valued contributions of other nations, much data useful in nuclear power research and development. We also have encouraged friendly nations to seek, under mutually acceptable standards of necessary security, more precise data and assistance in the power reactor field.

The research type of bilateral agreements for cooperation now in effect with nations contain these words:

> "It is the hope and expectation that this initial agreement. . . . will lead to the consideration of further cooperation extending to the design, construction and operation of power-producing reactors."

Several nations are presently negotiating with us for the type of agreement enunciated in the bilateral research agreements.

As for training representatives of friendly nations in the new technology of power reactors, we have organized a special school at the Commission's Argonne National Laboratory from which 40 scientists and engineers already have been graduated and 30 more are now attending classes. These 70 men come from 29 nations. It is planned to extend this training. Among other means will be a proposed educational and research institution in the Far East.

In the present state of the nuclear art, countries with available water power or supplies of coal and oil will, for some time to come, find it more economic to build and operate conventional power plants.

The authorization of 20,000 kilograms of uranium 235 to be made available for lease to civilian users in the United States was based on estimates of current and future needs. These include the needs of existing licenses and pending applications for licenses as well as proposals received by the Commission—including proposals under the Power Demonstration Reactor Program—which seem likely to lead to the filing of license applications during the current fiscal year ending June 30, 1956.

Only part of the special nuclear material will be distributed in any one year. Licenses may be issued for a varying period extending up to 40 years, and delivery of uranium 235 to licensees will be spread over the life of the licenses, to permit start-up of reactors and replacement of fuel as required in later years.

The uranium 235 will be distributed under provisions of Section 53 of the Atomic Energy Act of 1954 and will be allocated to specific licensees only on the basis of a Commission determination of the licensee's need for the material.

The procedures which will govern the distribution of the 20,000 kilograms of uranium 235 to be made available to other countries, as well as charges for sale or lease, will be announced in the near future. However, based on the value of $25 per gram of contained uranium 235 for enriched uranium leased for research reactors, as announced by the U. S. Atomic Energy Commission at the International Conference on the Peaceful Uses of Atomic Energy, the 40,000 kilograms of uranium 235 now made available for such sale or lease would have a value of one billion dollars.

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APPENDIX 9

Public Health and Safety Precautions for Eniwetok Tests

Protection of the public health and safety is a primary consideration in the conduct of the nuclear tests which will begin in the spring of 1956 at the Eniwetok Proving Ground.

Various precautions have been taken to keep significant radioactive fallout within the confines of the danger area in the Pacific which was announced on March 1, 1956. With the exception of Joint Task Force facilities, there are no inhabited places within the danger area.

There is no reason to expect that hazardous fallout will occur outside the danger area, and it is highly unlikely that any inhabitants of atolls will have to be moved. However, complete plans have been made for transportation of the inhabitants should such action have to be taken.

Elaborate systems have been established to detect and measure radioactivity in the vicinity of the Proving Ground, in the United States, and in other parts of the world. In addition, extensive marine surveys will be conducted to measure radioactivity in sea water and marine organisms.

More detailed information on health and safety measures relating to the test series follows:

FALLOUT PREDICTIONS

Tests will be conducted only when the forecast pattern of significant fallout is entirely within the danger area, in which there are no inhabitants. In forecasting fallout patterns, scientists will make use of improved methods of collecting and evaluating data which have been developed as a result of intensive study of the problem of predicting fallout in the vicinity of the Proving Ground.

Fallout predictions are dependent upon the accuracy of weather information. The weather reporting network which will be utilized for the 1956 tests will be larger than those in effect during any previous operation. Additional surface and upper air observing stations have been established, and improved equipment and techniques have been developed to increase the altitude and improve the accuracy of weather observations. As a result, more complete and earlier weather information will be provided.

Research has been conducted in the special field of tropical meteorology, and weather observers and forecasters have been instructed in the new methods of forecasting which have been developed as a result of these studies.

Trained personnel have been organized into a fallout prediction unit. They will utilize newly-developed fallout computers, will assist in predicting fallout patterns by mechanizing most of the mathematical procedures involved. Use of the computers is expected to allow forecasts to be made much more rapidly than heretofore, so that the final decision to conduct or postpone a test can take last-minute weather observations into account.[1] Models of the clouds produced by large-

[1] The fallout computer, designed by the National Bureau of Standards, works in the following way:

Weather information and estimates of the diameter and height of the cloud and the distribution of radioactivity within the cloud are fed into the computer by setting various dials. One-twentieth second after the data is set up, the machine visually displays a predicted fallout pattern on the face of a television-like tube. The predicted radioactive intensity at any point up to 250 miles or more from ground zero is indicated by the brightness of the pattern at the particular point in question.

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scale nuclear detonations have been developed as a result of experience gained from the 1954 testing operations, and these also are expected to improve fallout predictions.

With better weather information, more accurate cloud models, and faster procedures made possible by computing machines, the fallout prediction unit will be able to make much more rapid and accurate forecasts of fallout patterns than was possible two years ago. Tests will be conducted only when significant fallout is predicted entirely within the danger area.

ENERGY RELEASE OF DETONATIONS

As announced on March 1, 1956, the 1956 tests will involve weapons generally smaller in yield than those tested during the 1954 series. The energy release of the largest 1956 test is expected to be substantially below that of the maximum 1954 test.

DANGER AREA

The danger area is generally rectangular in shape and comprises roughly 375,000 nautical square miles. Its boundaries were announced on March 1, 1956. While slightly smaller than the danger zone used in the latter part of the 1954 series, the area is many times larger than the initial danger area used in 1954, and has been reoriented slightly for increased safety. Outside of the test facilities, no inhabited atoll is within the area.

All ships, aircraft and persons have been cautioned to remain clear of the danger area by notices which have been given the widest possible distribution through United States and international marine and aviation organizations. The Department of State has notified all Diplomatic Missions in Washington of the extent of the area.

Regular air and sea searches of the area will be conducted in advance of the start of operations. Before each shot, the patrol of the danger area will be intensified, particularly in the area where fallout is forecast.

RADIATION MONITORING IN PROVING GROUND REGION

After each detonation, aircraft will track the radioactive cloud. In addition, aircraft using aerial monitoring equipment will survey populated areas south and east of the Proving Ground to detect any radioactivity on land masses and on the surface of the sea.

Radiological safety personnel, equipped with radiation detection and measuring instruments and two-way radios to enable them to communicate with the central Task Force Radsafe Office, will be stationed on the nearby inhabited atolls to the east and south of the Proving Ground, and at weather stations of the weather reporting network. In the unlikely event of significant fallout in an inhabited area, the monitors would warn the inhabitants and advise and assist them in taking safety measures. The monitors also will train Marshallese medical practitioners and health aids in basic emergency measures.

EMERGENCY PLANNING

As a result of the monitoring procedures described above, the Task Force will have warning should an unexpected wind shift carry the cloud toward an inhabited area, and also will receive information by radio on the levels of radioactivity on the inhabited atolls.

It is not expected that there will be need to move any of the inhabitants at any time during the test series. However, as a precaution, complete plans have been prepared for transporting persons from populated atolls in the event that such action were considered advisable.

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RADIATION SURVEYS OF SEA AND MARINE LIFE

Outside of the testing area, the detonations are not expected to produce levels of radioactivity in the ocean which would be hazardous to marine life or to persons eating food fish. However, an extensive program of measurements of radioactivity in the sea water and in marine organisms will be conducted.

Beginning about June 10, a fast U. S. Navy vessel will work westward from the test site, making sweeps between 10 and 14 degrees North latitude west as far as fallout radioactivity can be detected.

Continuous readings of radioactivity in the surface water will be taken by means of a device which pumps water around a detection instrument in a tank on the deck of the ship. The ship will stop each 25 miles to take samples of the water at the surface and at depths of 25, 50, 75 and below 100 meters.

Personnel aboard the ship also will make tows for plankton—tiny marine organisms which tend to concentrate radioactive materials in their tissues. Fish will be caught, and analyzed for radioactivity.

After the series, when test radioactivity will have moved further away from the test site, a similar survey will be carried out as far west as radioactivity can be detected.

The Commission also has entered into a contract with the George Vanderbilt Foundation at Stanford University, under which scientists will collect samples of water, plankton, marine invertebrates and fish in the vicinity of the Palau Islands. These samples will be sent to the biological laboratory at the Hanford Works for analyses.

In addition to these investigations, land and marine biological surveys will be conducted on Eniwetok and Bikini atolls and in their lagoons. Samples of water, lagoon life, and animal life on the atolls will be collected and analyzed for radioactivity.

FALLOUT MONITORING IN UNITED STATES

The heavier particles fall out of the radioactive cloud at early times after a detonation, while their radioactivity is still high. Therefore, the highest levels of radioactivity occur over a local area downwind from the point of detonation. The area of significant fallout is expected to occur entirely within the uninhabited danger area surrounding the Eniwetok Proving Ground.

As the radioactive cloud is transported away from the point of detonation, it is widely dispersed by air currents and diluted by normal air. Its radioactivity also decreases rapidly because of the normal process of radioactive decay.[2] By the time the cloud from an Eniwetok test has traveled eastward across the ocean, it will have become a dispersed, invisible air mass, which has lost much of its original radioactivity.

As a result, the levels of radioactivity in the United States from the Eniwetok tests are expected to be low. Levels of 10 or more times the normal background may be reached in some localities at some times. However, these increases in background will be temporary, and will result in exposure far below amounts which would affect the health of exposed persons.

As it has in the past, the Commission will conduct extensive radiological monitoring operations within the United States during the test series. These operations are not conducted in the expectation of possible hazard, but for scientific purposes and to keep the public informed on levels of radioactivity.

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[2] Radioactive fallout consists of a mixture of radioisotopes, with varying half-lives. The mixture as a whole decreases in radioactivity in such a way that for every seven fold increase in age, the total radioactivity is decreased 10-fold. Thus, the radioactivity at seven hours after the explosion is only one-tenth that at one hour, and in 49 hours is one-hundredth, etc.

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Two types of monitoring operations will be conducted within the United States. One will consist of a network of U. S. Weather Bureau stations, which collect fallout samples at selected locations throughout the nation. The collection method is simple. A sheet of film covered with an adhesive is exposed outdoors on a tray for 24 hours, and then is mailed to the Commission's New York Health and Safety Laboratory. There, the sample is reduced to ashes, and the ashes are monitored with sensitive laboratory instruments. Very minute amounts of radioactivity can be measured by this technique.

During the 1956 series, the following Weather Bureau stations will make fallout collections:

Albuquerque, N. Mex.
Atlanta, Ga.
Billings, Mont.
Binghamton, N. Y.
Boise, Idaho
Boston, Mass.
Chicago, Ill.
Cincinnati, Ohio
Cleveland, Ohio
Concord, N. H.
Corpus Christi, Tex.
Dallas, Tex.
Des Moines, Iowa
Detroit, Mich.
Grand Junction, Colo.
Hatteras, N. C.
Jacksonville, Fla.
Knoxville, Tenn.
Las Vegas, Nev.
Los Angeles, Calif.
Louisville, Ky.
Medford, Oreg.
Memphis, Tenn.
Miami, Fla.
Minneapolis, Minn.
New Haven, Conn.
New Orleans, La.
New York (La Guardia), N. Y.
Philadelphia, Pa.
Pittsburgh, Pa.
Rapid City, S. Dak.
Rochester, N. Y.
St. Louis, Mo.
Salt Lake City, Utah
San Francisco, Calif.
San Juan, P. R.
Scottsbluff, Nebr.
Seattle, Wash.
Tucson, Ariz.
Washington, D. C. (Silver Hill, Md.)
Wichita, Kans.

This collection system does not provide immediate information on dose rates, since the samples must be mailed to the Health and Safety Laboratory and counted there. However, the information collected has varied scientific uses. It is needed by the Commission to compute and record the overall accumulation of radioactivity as a result of tests. It is needed by the photographic industry and by scientists conducting experiments with low-level radiation, since these activities can be affected by even a very slight increase over the normal background. The data also are used by meteorologists to trace air masses and check predicted trajectories.

More rapid information on radiation levels will be provided by 39 monitoring stations located in cities across the country.

Twenty-seven of these stations have been set up by the U. S. Public Health Service, which has been furnishing fallout monitoring services to the Commission for the past two years in States near the Nevada Test Site. At the Commission's request, the Public Health Service has established an expanded monitoring program which will be in operation with the forthcoming test series.

The monitoring stations established by the Public Health Service will collect daily readings of radioactivity and forward the data to a central collection office in Washington. The monitoring stations also will report data to the State Health Officers of the States in which the stations are located.

The primary purposes of the network are to give State and local health departments more experience in studying fallout and normal background radiation levels, and to obtain daily records

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Health Service network
in the following cities:
Lawrence, Mass.
Hartford, Conn.
Albany, N. Y.
Bethesda, Md.
Gastonia, N. C.
Atlanta, Ga.
Jacksonville, Fla.
New Orleans, La.
Austin, Tex.
Berkeley, Calif.
Salt Lake City, Utah
Richmond, Va.
Los Angeles, Calif.
Portland, Oreg.
Oklahoma City, Okla
Jefferson City, Mo.
Cincinnati, Ohio
Indianapolis, Ind.
Springfield, Ill.
Des Moines, Iowa
Lansing, Mich.
Minneapolis, Minn.
Las Vegas, Nev.
Seattle, Wash.
Trenton, N. J.
Denver, Colo.
Honolulu, T. H.

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Argonne National
mont, Ill.
Atomic Energy Pro
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Los Alamos Scient
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General Electric Co
clear Propulsion
Ohio
Oak Ridge National
Ridge, Tenn.

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radioactivity. The stations will be manned by trained technicians from state health departments, local universities, and scientific institutions.

Monitoring stations in the Public Health Service network will be located in the following cities:

Lawrence, Mass.
Hartford, Conn.
Albany, N. Y.
Bethesda, Md.
Gastonia, N. C.
Atlanta, Ga.
Jacksonville, Fla.
New Orleans, La.
Austin, Tex.
Berkeley, Calif.
Salt Lake City, Utah
Richmond, Va.
Los Angeles, Calif.
Portland, Oreg.
Oklahoma City, Okla.
Jefferson City, Mo.
Cincinnati, Ohio
Indianapolis, Ind.
Springfield, Ill.
Des Moines, Iowa
Lansing, Mich.
Minneapolis, Minn.
Las Vegas, Nev.
Seattle, Wash.
Trenton, N. J.
Denver, Colo.
Honolulu, T. H.

In addition to the Public Health Service network, monitoring stations set up by the Commission will collect data at locations, listed below:

Atomic Energy Project, Salt Lake City, Utah
University of California Radiation Laboratory, Berkeley, Calif.
Argonne National Laboratory, Lemont, Ill.
Atomic Energy Project, Rochester, N. Y.
Los Alamos Scientific Laboratory, Los Alamos, N. Mex.
General Electric Co., Aircraft Nuclear Propulsion Dept., Evendale, Ohio
Oak Ridge National Laboratory, Oak Ridge, Tenn.
Atomic Energy Project, University of California at Los Angeles
Sandia Corporation, Sandia, N. Mex.
Hanford Operations Office, U. S. Atomic Energy Commission, Richland, Wash.
Idaho Operations Office, U. S. Atomic Energy Commission, Idaho Falls, Idaho
New York Operations Office, U. S. Atomic Energy Commission, New York, N. Y.

MEASUREMENTS OF RADIOACTIVITY OUTSIDE THE U. S.

Samples of airborne dust will be taken at approximately 70 various localities throughout the world, in addition to the 41 U. S. stations. Previous studies of this kind have shown that the average gamma ray dosage delivered to world inhabitants by all tests to date is less than the dose they have received from natural background radiation during the same period of time. All of these dosages are believed by radiologists and radiobiologists to be harmless.

Radiostrontium-90 has been demonstrated to be potentially the most hazardous of bomb products which compose airborne dust or fallout. As in the past, soils will be sampled on a world-wide basis, and samples of other materials such as milk and cheese, field crops, and human and animal bones, will be taken for analysis of their radiostrontium content. These samplings are carried out, together with radiochemical analysis, for a 2-fold purpose: 1) ascertain the world-wide distribution of radioactive fission products—particularly strontium-90—in the air, water and soils of the earth as a result of atomic tests to date; 2) to ascertain the relationship of man to his environment, particularly as regards strontium-90. These observations, when combined with studies on the biological hazards of strontium-90, have disclosed that nowhere in the world are there concentrations of this isotope remotely approaching hazard-

ous amounts. The average concentration observed in human bone is less than 1/10,000 of the concentration which might be expected to show ill effect on human beings. The highest concentrations found in any individuals are less than ten times the average.

SUMMARY

Elaborate precautions are being taken to limit significant fallout to the uninhabited danger area surrounding the Eniwetok Proving Ground.

Information on radioactivity on inhabited atolls in the Marshall Islands will be obtained rapidly and transmitted to the Task Force Headquarters.

Should there be significant fallout on an inhabited atoll, monitors will advise the inhabitants regarding basic emergency measures, and the inhabitants could be moved away from the atoll quickly if such action were considered necessary.

Ocean water and marine life will be analyzed for radioactivity, and measurements of radioactivity will be taken within the United States and in other parts of the world. Levels of radioactivity outside the danger area are expected to be far below those which would be hazardous to exposed persons.

May 1, 1954

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