73761

DELETED VERSION ONLY

CONTENTS

* Transmitted as a separate document.

[redacted]

Part I

Raw Materials

U_3O_8 PROCUREMENT

Current Receipts (UNCLASSIFIED)

Uranium concentrates received by the United States during the July-September quarter totaled 7,588 tons of U_3O_8, approximately 9 percent less than the receipts for the previous quarter and about 45 percent more than for July–September 1957. Domestic deliveries were 43 percent of the total receipts. (End of UNCLASSIFIED section.)

Table 1 —United States Receipts of U_3O_8 (short tons) [redacted]

Source	April–June 1958	July–September 1958
United States	3,227	3,224
Canada	3,187	3,100
North America	6,414	6,324
[redacted]	[redacted]	[redacted]
Belgian Congo	344	128
Australia	49	[redacted]
[redacted]	[redacted]	[redacted]
Overseas	1,897	1,234
Total	8,311	7,558

Deliveries to the United Kingdom by overseas sources under contract to the Combined Development Agency (CDA) totaled 523 tons during the quarter. (End of [redacted] section.)

DOMESTIC OPERATIONS (UNCLASSIFIED)

Production

United States production of U_3O_8 during the quarter was 3,224 tons, only 3 tons less than in the preceding quarter, but 48 percent more than in the corresponding quarter a year ago. September production was at an annual rate of 14,500 tons.

[redacted]

During the July-September quarter the three new mills listed below were brought into operation.

Company	Location	Rated capacity (tons of ore per day)
Phillips Petroleum Co.	Grants, New Mexico	1,725
Homestake-Sapin Partners	Grants, New Mexico	1,500
Cotter Corporation (Pilot Plant)	Canon City, Colorado	50

At the end of September, 21 mills having an aggregate processing rate of 16,250 tons per day were operating and 3 new mills with a total capacity of 4,000 tons of ore per day were under construction. Ore fed to process during the July-September quarter totaled 1,428,000 tons, an increase of 5 percent over the quantity fed to process in the preceding quarter.

Ore receipts during the quarter amounted to 1,358,900 tons, equivalent to an annual delivery rate of 5,436,000 tons. More than 98 percent of this ore was purchased by private buying stations. The AEC continued to operate ore-buying stations at Monticello, Utah, and Grants, New Mexico. It was announced in August that the purchase of ore at Grants would be discontinued on October 1, 1958. Operation of this ore-buying station is no longer required since the processing plants in the area are furnishing a market to independent producers of amenable ore.

Limited Expansion of Uranium Procurement

In August the AEC announced the execution of an amendment to its contract with the Texas-Zinc Minerals Corporation. The modified contract provides for (1) extension of the agreement from March 1962 to December 31, 1966, (2) the treatment of increased amounts of ore from independent producers at the company's mill at Mexican Hat, Utah, (3) the postponement of delivery of about 1,500,000 pounds of U_3O_8 beyond March 31, 1962, and (4) the purchase of AEC-owned stockpiles at White Canyon, Utah.

This is the first such action by the AEC to implement the policy announced April 2, 1958, of providing a market for independent miners in areas having adequate milling capacity but where the portion available for independent producers is insufficient. The possible need for similar revisions of existing contracts with mill operators in some of the other areas was under study.

Contracts covering the major portion of the anticipated 3,300 tons of additional daily ore milling capacity were being negotiated. The additional milling capacity is to serve those areas having either no market or an inadequate market for ore reserves developed prior to November 1, 1957.

Ore Reserves

Uranium ore reserves were estimated to be 82,000,000 tons averaging 0.28 percent U_3O_8 on September 30. This is an increase of about 4,000,000 tons over the June estimate. Much of this increase is in the Grants, New Mexico, district and is the result of private development work extending over a considerable period. In addition there were approximately 1,900,000 tons of ore in Government and private stockpiles. (End of UNCLASSIFIED section.)

FOREIGN PROCUREMENT

Canada [redacted]

Canadian production during the July-September quarter was at the rate of 1,190 tons of U_3O_8 per month. Of this amount approximately 135 tons per month were delivered to the United Kingdom Atomic Energy Authority (UKAEA). This delivery is pursuant to an agreement by which a total of 5,500 tons of U_3O_8 was released for delivery to the UKAEA between July 1, 1958, and March 31, 1962, from Canadian production under contract to the AEC. (End of [redacted] section.)

(UNCLASSIFIED) Canadian Government figures released at the Geneva Conference place Canadian reserves at 377,000,000 tons containing approximately 392,000 tons of U_3O_8.

Mr. W. M. Gilchrist was appointed president of Eldorado Mining and Refining, Ltd., a corporation of the Canadian Government, to succeed Mr. R. J. Henry who died on July 6. Mr. Gilchrist was formerly a vice president of the corporation.

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(End of UNCLASSIFIED section.)

Belgian Congo [redacted]

The supplemental agreement was executed with the African Metals Corporation, the United States sales agent for Union Miniere du Haut-Katanga, providing for the delivery of refined uranium trioxide instead of uranium concentrates. The delivery of the first 10-ton shipment of refined uranium trioxide is expected to begin before the end of 1958, with uranium concentrates continuing to be received until that time. After the initial delivery of uranium trioxide, the Belgians expect to deliver approximately 30 tons per month, or about 330-350 tons per year.

The Belgian Government and the Union Miniere du Haut-Katanga were notified that it appeared unlikely that the Combined Development Agency or its partners would wish to continue purchases of Congo uranium beyond December 31, 1960, the expiration date of the present contract.

Australia

At Radium Hill in South Australia production continued normally. Production at the Rum Jungle plant located in the Northern Territory dropped about 15 percent because of the lower grade mill feed. Combined production of the two plants is about 400 tons of U_3O_8 annually. (End of section for [redacted].)

Portugal (UNCLASSIFIED)

Portugal continued its regular production of uranium concentrates.

Assistance to Foreign Countries

A three-man geologic team arrived in Argentina at that government's invitation to advise the Argentine atomic energy commission on various exploration and development problems.

Limited technical assistance in uranium exploration continued in Australia, Brazil, Chile, and Peru.

Two Indians joined the Japanese and Thai technicians participating in a training program in uranium exploration, mining, and ore processing in the western United States. (End of UNCLASSIFIED section.)

Part II

Special Nuclear Materials

SUMMARY [redacted]

In the July-September quarter production schedules were met or exceeded for special nuclear materials for weapons, military reactors, research, and civilian uses. No unusual operating difficulties were encountered. Programs were established for the production of limited quantities of high purity lithium 7 and test quantities of plutonium 238.

Table 1—Production at Annual Rates [redacted]

Product	July–September 1958 Actual	Forecast
Plutonium separated	DELETED	
Tritium separated		
Uranium 235 withdrawn		
Lithium 6 withdrawn		

REACTOR PRODUCTS

Reactor Operations

Total reactor production during the quarter was about 5 percent greater than in the preceding quarter. The increase was principally attributable to the fact that the last of the Savannah River reactors to undergo installation of larger heavy water pumps resumed operation in July. At Hanford, however, plutonium formation was slightly lower than in the preceding quarter. While less operating time was lost because of slug failures, the seasonal increase in temperature of river water coolant resulted in a general reduction of power levels.

Table 2 shows the quantities of plutonium and tritium produced in the reactors during the past two quarters, expressed as a percentage of Hanford's plutonium production in the April-June quarter. Tritium production is expressed in terms of equivalent plutonium production displaced.

Table 2—Production Reactor Operations

Product and site	April–June 1958	July–September 1958
Plutonium		
Hanford		
Savannah River		
Total plutonium	DELETED	
Tritium		
Savannah River		
Total reactor products		

Plutonium

Plutonium 239 separations were 2 percent more than forecast.

An interim program was initiated to produce test amounts of plutonium 238 for certain weapon purposes, and plans were being formulated for a larger scale production program. (See also Part III of this report.) Plutonium 238 is formed by irradiating neptunium 237, an isotope which is found in small but extractable quantities in irradiated uranium. Plans call for recovering neptunium from the process streams of chemical separation plants by ion-exchange techniques. After the neptunium is incorporated into reactor target elements and irradiated, the plutonium 238 can then be separated from the remaining neptunium. The initial program is being operated on an interim basis using existing facilities and laboratory equipment. Since only small quantities of plutonium 238 are contemplated, there will be no appreciable effect on the plutonium 239 production schedules.

Tritium

Tritium separations for the quarter were about as forecast. July production was relatively low because a quantity of aged target slugs was processed. These slugs originally had received less irradiation than is currently given tritium target elements, and, moreover, the original tritium content had been reduced by decay into helium 3. Production in August and September was devoted to processing more current material.

A second separations line was started up in August in Savannah River's H area. The new capacity will permit reduction of the accumulated inventory of irradiated material.

Three of Savannah River's five reactors will continue to operate with enriched loading for tritium production throughout the next quarter. Early in 1959 one of these reactors is scheduled to return to plutonium production.

URANIUM 235

The quantity of uranium 235 produced in the July-September quarter was slightly higher than forecast and 11 percent more than in the preceding quarter.

LITHIUM

The production of lithium 6 was essentially as forecast.

In order to satisfy the immediate research requirements for lithium 7 for the Aircraft Nuclear Propulsion (ANP) and Systems for Nuclear Auxiliary Power (SNAP) programs, plans were made to modify a small portion of the lithium 6 plant for production of high purity lithium 7. It is intended to operate the modified portion for about 2 months and thereafter to restore it to lithium 6 production. The quantity of lithium 7 produced will be adequate to provide for the military requirement and to meet possible civilian reactor demands. The temporary diversion of part of the plant capacity to lithium 7 production will not affect meeting scheduled military requirements for lithium 6.

FEED MATERIALS

The St. Louis Destrehan Street refinery has been placed in standby except for the forging of dingot metal in the metal pilot plant. The Weldon Spring extrusion facility, which will replace the forging step, was expected to be in operation by the middle of October. After the extrusion facility is in full operation the Destrehan Street forging operations will be terminated. (End of [redacted] section.)

Part III

Weapons

This part of the QUARTERLY PROGRESS REPORT has been transmitted as a separate document.

Part IV

Reactor Development

AIRCRAFT REACTORS

Nuclear Propulsion for Manned Aircraft

Direct cycle approach. Work on the direct cycle approach was continued by the General Electric Company under contracts with the AEC and the Air Force. The AEC is supporting the reactor portion of the effort and the Air Force is supporting the associated turbomachinery work. The objective of the effort is to ground test by the fall of 1960 a nuclear propulsion system. The system, designated the XMA, consists of a preprototype reactor and associated X-211 turbomachinery.

Preparations were being made for the operation during October of the Heat Transfer Reactor Experiment No. 3 (HTRE-3) at the National Reactor Testing Station. This experiment is the first of the HTRE series to have a horizontal configuration, a solid moderator, and a flight-type shield. The critical experiment for the HTRE-3 was completed and the fuel elements were modified for power operation. The dolly assembly, including engines and superstructure, was completed except for fuel loading and final assembly.

Modifications to the Initial Engine Test (IET) facility to accommodate the HTRE-3 were completed. These modifications included instrumentation and supporting equipment and facilities such as a shielded approach roadway, for higher power operation. Construction work on the Flight Engine Test (FET) facility and the Shield Test Pool Facility (STPF) continued. The purpose of the FET is to test full-scale, direct-cycle turbojet propulsion systems. The STPF is a facility containing a two-compartment pool for tests required in designing aircraft reactor shielding.

Indirect cycle approach. Work continued on research and development applicable to a high performance, indirect cycle aircraft reactor. Preliminary designs of two experimental reactors were being prepared as a further guide to the research effort on the lithium-cooled, indirect-cycle system. Both designs called for reactors with a capacity of 10,000 thermal kilowatts and an ability to operate at temperatures between 1,800 and 2,000 degrees Fahrenheit. One reactor design was based on moderated neutrons at intermediate velocities while the reactor of the other design was based on unmoderated neutrons at fast velocities. Preparations were begun for the critical experiments to mockup the experimental reactor designs. In-pile experiments were being conducted to verify the performance and integrity of the fuel elements selected for the designs.

Continued testing verified previous results which indicated that an alloy of niobium and zirconium is compatible with lithium at high temperatures. During operation of test loops the alloy showed little or no effects from corrosion or mass transfer.

A new statement defining work to be performed in the development of a lithium-cooled reactor system during the year ending September 30, 1959, was agreed to by Pratt & Whitney and the AEC.

Nuclear Propulsion for Unmanned Vehicles

Nuclear rocket propulsion (Project ROVER). Development work to demonstrate the feasibility of nuclear rocket propulsion continued at the Los Alamos Scientific Laboratory (LASL).

Assembly of Kiwi A, the first of a series of nonflyable experimental reactors for the project, was begun in late July at the Nevada Test Site. Kiwi A is to have a power output of 100,000 kilowatts. The fuel elements are to be of graphite plate type, and the propellant is to be pressurized helium and hydrogen gas. However, since the test cell was not completed on schedule, the installation of the complete reactor and control system was delayed. Checkout of the system prior to testing is expected to begin in early December.

LASL continued research on reactor materials and basic design for Dumbo A, a 500,000-kilowatt nonflyable experimental reactor. Refractory metal fuel elements are to be used in the reactor.

As a result of legislation creating the National Aeronautics and Space Administration (NASA), Air Force responsibility for certain nonnuclear components in support of the AEC ROVER effort has been transferred to NASA. No delay to the project is expected to result from the rearrangement of the working relationships and the division of responsibilities now being worked out between the AEC and NASA. The AEC is to exercise technical direction of the project within the framework of guidance provided by NASA. Both agencies are in accord with the objectives and technical approach for the project, which is continuing to be pursued as vigorously as possible consistent with a sound technological approach.

Nuclear ramjet propulsion (Project PLUTO). Air Force studies have shown that propulsion of minimum altitude, supersonic missiles may be an extremely promising application of nuclear ramjet engines. In this connection the Department of Defense, on July 3, reaffirmed its interest and requested the AEC to pursue the investigation of the feasibility of nuclear ramjet propulsion as vigorously as technical progress permits. It was also requested that every effort be made to meet the scheduled date of January 1960 for the test of Tory II. Tory II is to be a nonflyable, experimental reactor of intermediate size which will operate at the high temperatures and power densities required for ramjet operation.

Analytical studies, neutron measurements, and materials development and testing continued at the University of California Radiation Laboratory at Livermore. Beryllium oxide was selected as the fuel element material for the Tory II reactor, and several methods of fabricating the fuel element for the first core were under investigation. The design concept for Tory II was frozen and detailed design work was started.

North American Aviation, Inc. (Missile Development Division), Convair Corporation (San Diego Division), and Chance Vought Aircraft, Inc., were awarded Air Force contracts to conduct preliminary systems studies on a low altitude supersonic missile powered by nuclear ramjet.

Systems for Nuclear Auxiliary Power (SNAP). Development work continued on two systems to provide nuclear auxiliary power, primarily for the Air Force Advanced Reconnaissance System, Weapon System 117L, and for other space applications. SNAP-I, being developed by The Martin Company, is the 500-electric-watt isotope unit. SNAP-II, under development by Atomics International, is the 3-electrical-kilowatt reactor unit.

Tests of SNAP-I isotope cores, less fuel, were conducted under simulated launch-failure conditions. While final evaluation of the data is not complete, preliminary results were satisfactory. Low velocity impact tests of these cores were begun at the Aberdeen Proving Ground in Maryland to gain information on atmospheric re-entry problems. Efforts to improve containment materials against mercury corrosion were intensified.

Inpile experiments on the SNAP-II reactor fuel element indicate that the heat conductivity value may be higher than was predicted. If these results can be verified, the power capability of the core could be greatly increased. (End of [redacted] section.)

ARMY REACTORS

Army Package Power Reactors (APPR)

APPR-1 (UNCLASSIFIED). Operation of the 2,000-electrical-kilowatt APPR-1 at Fort Belvoir, Virginia, was continued by Alco Products, Inc., under a jointly funded Army-AEC operating contract. On September 30 the APPR-1 had operated for 7,300 full-power hours, or 8.6 thermal megawatt years of its expected core life of 13 megawatt years, and had generated 14,600,000 kilowatt hours of electrical power.

The primary research and development effort was directed toward the study of the buildup of long-lived radioactive nuclides contained in the corrosion particles which plate out on the walls of the primary system, particularly in the tubes of the steam generator.

APPR-1A. Construction at Fort Greeley, Alaska, of the APPR-1A, the Army's first field model reactor, patterned after the Fort Belvoir prototype, was approximately 25 percent complete. This plant will provide 2,000 electrical kilowatts and 12,300 kilowatts of space heat. Structural steel for the turbine building was in place, and the stainless steel liner was installed in the spent fuel pit. Peter Kiewit Sons' Company is the construction contractor for the Army. (End of UNCLASSIFIED section.)

APPR-1B ([redacted]). Design work was initiated for the APPR-1B, an improved type of core system to be capable of producing 2.5 times the reactor heat of the present APPR-1 core and to have a minimum core life of one year at full power. Alco Products, Inc., is under contract to the AEC for the development of the core system, and under contract to the Army for an improved APPR-1 type plant. The development of the improved core and plant was undertaken in response to an urgent requirement from the Department of Defense for a reliable, self-sufficient power plant with an electrical output of 5,000 to 7,000 kilowatts to meet power requirements at missile defense installations. Completion of the core design is required by June 30, 1959. (End of [redacted] section.)

APPR-2 (UNCLASSIFIED). The APPR-2 is to be located at an Air Force Control and Warning Station in the United States as selected by the Air Force on the basis of recommendations of a joint AEC-Air Force Site Screening Board. The jointly funded AEC–Air Force project is to provide a factory-preassembled air-transportable prototype nuclear power plant. The plant will utilize a pressurized water reactor with a capacity of 10,000 thermal kilowatts, and is to be capable of providing approximately 1,000 electrical kilowatts and 2,000 kilowatts of space heat. The reactor will incorporate all possible advances in pressurized water technology in order to provide a plant optimized for military utilization. Invitations were prepared* calling for proposals from industry for the design, development, fabrication, installation, and test operation of the plant. The estimated time for completion of the project was revised from two years to two and one-half years.

*Invitations were issued October 10 calling for proposals to be submitted by December 1, 1958.

Argonne Low Power Reactor (ALPR)

The ALPR, a boiling water reactor designed to produce 200 kilowatts of electricity and 400 kilowatts of space heat, achieved criticality on August 12 at the National Reactor Testing Station (NRTS). At the end of September the plant was undergoing zero-power tests. Considerable progress was made in developing a low-cost powder-metallurgy approach using an aluminum alloy to fabricate ALPR-type fuel plates. Plants of the ALPR type are intended for use at small, remote military installations.

Selection of a contractor was under way to replace the Argonne National Laboratory as operator of the ALPR on January 1, 1959. The contractor is to carry out research and development work on small boiling-water reactor power plants to include over-all system analyses, preparation for higher power operation, and study of packaging techniques to reduce onsite erection time of subsequent plants.

Gas Cooled Reactor Experiment (GCRE)

Criticality of the GCRE is scheduled for the summer of 1959 at NRTS. Fabrication of the nonnuclear portion by Farnsworth & Chambers Co., Inc., of Houston, Texas, was 12 percent complete and is scheduled to be finished at the end of April 1959. Aerojet-General Corporation submitted the final working drawings for installation of the reactor and control equipment, and completed preparations to assemble the fuel elements from plates to be furnished by M&C Nuclear, Inc. Testing of the reference fuel element continued at the Battelle Research Reactor loop. (End of UNCLASSIFIED section.)

Portable Gas Cooled Reactor (PGCR) ([redacted])

In August the Department of Defense requested that the AEC expand its efforts in the development of gas-cooled reactors to include design, construction, and test operation by June 30, 1962, of a prototype mobile nuclear power plant. The plant, which is to have a capacity of 400 electrical kilowatts and 300 thermal kilowatts for space heating, must be capable of operating under extreme environmental conditions and must be adaptable to transportation intact by trailer or cargo aircraft. (End of [redacted] section.)

Advanced Reactor Studies ([redacted])

Formal approval was given to the three contractors performing studies on compact reactors for the Army to proceed with the preliminary design of an initial reactor experiment (Task II) in the development of a compact, lightweight, mobile power plant with a capacity of up to 3,000 electrical kilowatts. To meet these requirements the three contractors, Curtiss-Wright Corporation, General Electric Company, and the Nuclear Development Corporation of America, had each previously proposed (Task I) a version of a liquid-metal-cooled, fast reactor system. Final submission of the studies is due in December. (End of [redacted] section.)

NAVAL REACTORS ([redacted])

Nuclear Submarines in Operation

The miles traveled and core life consumed by nuclear-powered submarines in operation with the Navy are tabulated on the following page.

Submarine	Reactor type	Miles traveled		Core life consumed to date
		Total	Submerged	(full power hours)
Nautilus	S2W	131,600	95,600	2,490 (second core)*
Seawolf	S2G	65,600	52,400	1,950
Skate	S3W	34,500	29,200	1,325

Nuclear Submarines Launched or in Trial Tests

Two submarines satisfactorily completed their initial builders' trials during the quarter. The *Sargo*, powered by an S3W reactor, was built at the Mare Island Naval Shipyard. The *Swordfish*, with an S4W reactor, built at the Portsmouth Naval Shipyard, completed her initial builder's trials satisfactorily and received preliminary acceptance by the Navy in September. Two submarines were launched; the *Seadragon*, which is to be propelled by an S4W reactor, was launched August 16 at the Portsmouth Naval Shipyard, while the *Triton* (S4G), which is to use two S3G-type reactors, was launched on August 19, at Groton, Connecticut.

Nuclear Ships Authorized

Congress authorized 11 nuclear submarines and a nuclear guided missile destroyer in the Navy's fiscal year 1959 shipbuilding program. This action brought the number of nuclear-powered ships authorized for the Navy to a total of 36 — 33 submarines and 3 surface ships. The other 2 surface ships which were authorized previously are an aircraft carrier and a guided missile cruiser.

Naval Reactor Projects Under Development by AEC

Submarine Reactors

Submarine Advanced Reactor (S3G/S4G). The Submarine Advanced Reactor (S3G) prototype achieved initial criticality at West Milton, New York. It was operated in high power ranges for the first time on September 10, with Chairman McCone present. Two S3G-type reactors are to be used in the *Triton*.

Nuclear Hunter-Killer Submarine Reactor (S1C). Construction of site facilities continued at Windsor, Connecticut. Installation of both steam generators in the S1C prototype hull was completed, and installation of the propulsion plant auxiliary machinery continued.

High Speed Submarine Reactor (S5W). The core was installed in the reactor of the *Skipjack* under construction by the Electric Boat Division of General Dynamics Corporation at Groton, Connecticut. Precritical testing was begun.

Surface Ship Reactors

Large Ship Reactor (A1W). The core was installed in the first reactor pressure vessel of the A1W plant at the Naval Reactor Facility, Idaho, during August.†

Destroyer Reactor (D1G). Construction of the prototype hull of the D1G plant was in progress at West Milton, under contract with the Bethlehem Steel Company.

* The first core was removed on February 26, 1957, after 2,178 full power hours of core life had been consumed.

† The first of the two nuclear reactors achieved criticality on October 21.

Guided Missile Destroyer Reactor (DLG(N)). A contract for the construction of a nuclear-powered destroyer (DLG(N)), which will utilize two D1G-type reactors, was awarded to Bethlehem Steel Company. (End of [redacted] section.)

MARITIME REACTORS (UNCLASSIFIED)

NS Savannah. Over-all construction of the ship including its propulsion system was 24 percent complete on September 30. Although fabrication of components was somewhat behind schedule, the delays encountered were not serious, and the project is expected to be substantially on schedule by the end of December. Fuel loading is to take place in January 1960. Operational availability is to follow within the same year after tests and sea trials have been performed.

Construction of the propulsion system, which is the responsibility of the AEC, was 28 percent complete. Nuclear testing of the first fuel element, fabricated by Babcock & Wilcox, was begun in the Vallecitos Boiling Water Reactor in August. A panel of specialists in the fields of physics, reactor technology, controls and safety, metallurgy, and instrumentation reviewed the power plant design. The conclusions were favorable, but further work was initiated to simplify the control rod drive system, the water purification system, and the control console. Fabrication of long lead time items for the nuclear propulsion system progressed satisfactorily.

Construction of the ship, except for the propulsion system, is the responsibility of the Maritime Administration, and was 19 percent complete.

Announcement was made on July 25 of the selection of States Marine Lines to serve as general operating agent for the *Savannah* during the initial operating period. Babcock & Wilcox began the training of the licensed engineers. Two test boilers are to be installed in the ship to provide emergency power during startup and sea trials. The equipment is to be removed after the nuclear power plant has been fully tested, and will be used for similar purposes in later nuclear-powered merchant ships.

Maritime gas-cooled propulsion system. Research work on the maritime gas-cooled propulsion system indicated that the primary coolant will be either helium or carbon dioxide, and that the moderator will probably be graphite. Under a subcontract being negotiated with General Dynamics Corporation, Westinghouse Electric Corporation proceeded with the preliminary design of the rotating machinery. Westinghouse also began an evaluation of the properties in both helium and carbon dioxide environments of the most promising materials for this machinery.

Boiling water reactor system. The General Electric Company completed a preliminary design study of a 22,000-shaft horsepower boiling water reactor system for installation in a T-5-type tanker of approximately 22,000 dead-weight tons. The study was being evaluated for possible application to a larger propulsion system for a larger tanker which would be more nearly competitive with conventional tankers.

Symposium. The 1958 Nuclear Merchant Ship Symposium, held on August 21 in Washington, D. C., was attended by approximately 700 people representing both the maritime and reactor fields. The proceedings are to be published by the AEC Technical Information Service Extension.

Economic and engineering analysis of nuclear-powered merchant ships. The contract with the American Radiator and Standard Sanitary Corporation for an economic and engineering analysis of nuclear merchant ships was extended to cover an additional nine tanker sizes. The initial study had already covered the economic characteristics of 72 ships, including such types as tankers and dry cargo vessels.

CIVILIAN POWER REACTORS

Ad Hoc Advisory Committee on Reactor Policies and Programs

An *Ad Hoc* Advisory Committee on Reactor Policies and Programs was established in September to review the AEC civilian power program and to advise on future power reactor policies. It was planned that the committee would complete its task by December 31, 1958. Mr. A. Tammaro, Assistant General Manager for Research and Industrial Development, was appointed chairman. Other members of the committee are listed below.

Dr. Henry D. Smyth Vice-Chairman	Chairman, Board of Scientific and Engineering Research, Princeton University
Mr. James Black	Chairman, Pacific Gas and Electric Company
Mr. Marion W. Boyer	Standard Oil Company of New Jersey
Dr. Harvey Brooks	Dean of Engineering and Applied Physics, Harvard University
Mr. Eger V. Murphree	President, Esso Research and Engineering Company
Mr. Eugene Starr	Bonneville Power Administration
Dr. Robert E. Wilson	Formerly Chairman of the Board of Standard Oil Company of Indiana

AEC Experimental Power Reactor Projects

Pressurized-water type. The Shippingport Atomic Power Plant completed on August 14 a 1,000-hour test at full power during which more than 60,000,000 kilowatt-hours of electrical power were generated for the system of the Duquesne Light Company. The test provided valuable information in such areas as core life, primary coolant radiochemistry, and primary plant radioactivity levels. Extended periods of steady power operation such as this 1,000-hour test are necessary to obtain reliable data on these characteristics because they change slowly with time and are affected by the plant power level. During the remainder of August and the first 3 weeks of September periodic physics tests were conducted involving both critical and subcritical operation. A period of concentrated operator training and routine plant maintenance also was completed. A second 1,000-hour full-power test was begun on September 22.

Boiling-water type. Test operation of the Experimental Boiling Water Reactor (EBWR) at Argonne National Laboratory (ANL) with an intentionally ruptured fuel element was interrupted on September 9 when a condenser leak was detected. The power level of the plant was decreased from 20,000 thermal kilowatts to 5,000 thermal kilowatts while repairs were made to the condenser. Personnel were able to enter the condenser to make repairs without receiving radiation exposure above the maximum permissible limit. The reactor resumed operation at 20,000 thermal kilowatts on September 10.

BORAX IV was shut down at the National Reactor Testing Station (NRTS) and is to be dismantled. BORAX V, which is to use some of the supporting facilities of BORAX IV, is to have a flexible assembly which can be used to evaluate new core configurations, void fractions, water-to-fuel ratios, and nuclear superheat, as well as forced circulation. The facility is to be completed about the end of the calendar year 1959.

Homogeneous type. During the first part of the quarter the Homogeneous Reactor Experiment No. 2 (HRE-2) at Oak Ridge continued to operate as a quasi-two-region reactor. For 2

days in August the reactor reached its design power level of 5,000 thermal kilowatts and then was operated at 3,500 thermal kilowatts. However, short irregular pulses of power were observed which were not understood.

During September the reactor was shut down. An improved viewing system was used to observe the outside of the zirconium core vessel in an effort to locate the hole through which fluid from the core region transfers to the heavy water blanket region. On September 26 an oval-shaped hole was found, measuring an inch and a half by one inch. Three days later a cavity was discovered on the outer surface of the core vessel, indicating that corrosion is occurring on the blanket side of the vessel wall.

Measurements showed that the thickness of the vessel wall had decreased since the reactor was put in operation. There was evidence that the lower section of the core vessel was corroding more rapidly than the upper section.

Work on the molten salt reactor type continued at Oak Ridge. A test loop was under construction to study the forced circulation of molten salt fuels in a radiation field in the Materials Testing Reactor at NRTS. Calculations were performed comparing use of uranium 235 and uranium 233 as reactor fuel for a 20-year period. For the reactor fueled with uranium 235 it would be necessary to buy 3,000 kilograms of uranium 235 during the period and about 1,000 kilograms would remain unconsumed. For the reactor fueled with uranium 233 it would be necessary to buy about 1,350 kilograms of uranium 233 during the period and there would be a breeding gain of about 100 kilograms.

Fast-breeder type. At NRTS the Experimental Breeder Reactor No. 1 (EBR-1) continued operation with the third core to provide information on the stability of fast reactors and to study the causes which led to the melt-down of the second core in 1955. The melt-down is believed to have resulted from the distortion or "bowing" of the fuel elements. The third core was designed with supporting devices to control the bowing. Operation of the core with these devices rigidly supporting the elements indicated that the instabilities associated with the second core can be removed successfully by proper engineering design and are not inherent in the reactor type. During the quarter experiments were begun to investigate what effects less rigid support of the fuel elements would have on reactor stability.

Construction of the Experimental Breeder Reactor No. 2 (EBR-2) continued at NRTS. The reactor containment vessel was 77 percent complete at the end of September, and construction was in progress on the laboratory and service building. Fuel development work continued at the Argonne National Laboratory. The EBR-2, which is to have a thermal capacity of 62,500 kilowatts and an electrical capacity of 16,500 kilowatts, is to be in full power operation in September 1962.

Construction of the Transient Reactor Test (TREAT) facility, designed to investigate the effects of extreme operating conditions in fast reactors, was about 94 percent complete at the end of September at NRTS. Criticality is scheduled for January 1959.

Sodium graphite type. Operation of the Sodium Reactor Experiment (SRE) at Santa Susana, California, was continued to test fuel elements and components of the reactor system. A thorium-uranium fuel loading was being prepared for testing in the SRE. Preliminary results of the first irradiation of uranium carbide fuel indicates considerable promise for use in sodium graphite reactors.

Organic-moderated type. The Organic-Moderated Reactor Experiment (OMRE) at NRTS was shut down during most of July to complete modifications. At the end of July the reactor was started up again with two experimental elements inserted in the core. The OMRE was operated with increasing concentrations of polymerized (decomposed) organic material in the

coolant system. A decrease in heat transfer capability of the organic coolant was noted when the concentration of polymerized organic material approached 40 percent.

Liquid metal type. Brookhaven National Laboratory (BNL) was selected as the site for the Liquid Metal Fuel Reactor Experiment No. 1 (LMFRE-1) subject to a hazards evaluation approval. Work on the test loop was in progress at BNL. Babcock & Wilcox prepared to perform critical experiments for the LMFRE-1 at their Lynchburg facility.

Over-all design of the Plutonium Recycle Test Reactor (PRTR) at Hanford was 99 percent complete. Erection of the containment vessel was started. The Advisory Committee on Reactor Safeguards is to consider the preliminary hazards report in October. Invitations to bid on the remaining major items were solicited during September. The scope of the project was revised to include a facility for examining fuel elements, with no increase in the total estimated cost of the project. The over-all design of the Plutonium Fabrication Laboratory associated with the PRTR at Hanford was 62 percent complete.

Excavation and foundation work were in progress for the Fuels Technology Center at Argonne National Laboratory. A fixed-price contract was awarded to the Malan Construction Company in September for the construction of the building superstructure, complete with mechanical and electrical services. The center will be the first facility to be devoted primarily to research on solid plutonium fuels.

Heavy water type. Tentative selection of a site was made for the Heavy Water Components Test Reactor (HWCTR) at Savannah River. Safety aspects of the site were to be reviewed by the Advisory Committee on Reactor Safeguards. The design and development program for the reactor was approved in August. The HWCTR is to be used to test fuel elements and other components for the prototype heavy-water-moderated power reactor.

Gas-cooled type. Preliminary design work was continued by Kaiser Engineers and ACF Industries on a prototype Gas Cooled Power Reactor (GCPR) of 30,000 electrical kilowatts capacity fueled with partially enriched uranium. Since helium has shown significant advantages over carbon dioxide as a coolant, Oak Ridge carried on tests to study the behavior in a helium atmosphere of graphite and various metals useful in fuel cladding. Stainless steel, niobium, and molybdenum were virtually unaffected by exposures to static helium for a period of 1,000 hours at 1,400 degrees Fahrenheit in the presence of graphite.

Reactor Studies

Individual letters and a public announcement were issued August 29, 1958, inviting proposals to undertake design studies, in accordance with engineering requirements established by the AEC, of a heavy-water-moderated power reactor capable of operating on natural uranium fuel. A selection board was reviewing the 15 proposals submitted before the deadline of September 29.

Individual letters of invitation and a press release were issued on September 15 inviting proposals to undertake separate studies on two large-scale power reactors and one intermediate-sized prototype power reactor. The studies are to be on boiling-water, pressurized-water, and organic-cooled nuclear power plants and are to be performed in accordance with engineering requirements established by the AEC. The proposals are to be submitted by October 15, 1958.*

*Twenty-nine proposals were received by October 15 on the boiling-water, 26 on the pressurized-water, and 30 on the organic-cooled reactor types.

Preparations were in progress to invite industry to submit proposals for performance of research and development work and a conceptual design for a fast breeder reactor using plutonium oxide-uranium oxide fuel cycle.* This concept offers the promise of reducing fuel costs.

Advanced Design Studies

The preliminary evaluation of the pebble bed reactor design concept was completed by Sanderson and Porter who were continuing with the analysis of the reactor fuel cycle and heat transfer problems. In this concept fuel is in the form of small spheres of graphite impregnated with uranium or thorium. The core also contains graphite structure to divide the core into regions and to serve as a moderator. Helium is used as the coolant. Fuel element irradiation work was under way at Battelle Memorial Institute and physics calculations were being performed by Alco Products, Inc.

The fluidized bed reactor concept was being evaluated by The Martin Company. In this concept water flows up through a bed of unclad uranium dioxide fuel particles to remove heat and to serve as a moderator. The Martin Company study is to include corrosion and erosion tests, an analysis of various methods of control, study of nuclear and heat transfer parameters, and selection of optimum reactor design conditions.

A procedure was formalized for reviewing proposals from industry requesting support for development of new reactor concepts. Such proposals will be evaluated semiannually on a competitive basis.

Power Demonstration Program

AEC Research and Development Assistance

AEC assistance for the existing 10 projects in the Power Demonstration Reactor Program varies according to the requirements of each project. No financial support is given to plant construction except to 4 projects of cooperative or publicly owned agencies. The AEC provides all the funds for reactor construction for the 3 projects of the Rural Cooperative Power Association, the City of Piqua, and the Chugach Electric Association. The AEC is to own these reactors and sell steam to the utilities. In the case of the Consumers Public Power District, the AEC is to provide the major portion of the funds for the reactor construction and will retain title to those portions of the plant constructed with AEC funds. In no case are AEC funds used to meet the construction costs of the turbogenerator and other nonnuclear portions of the proposed nuclear plants.

Preconstruction assistance from the AEC may include support for specific research and development work by the proposer, and for the performance of certain research and development work in AEC facilities. Postconstruction assistance by the AEC may consist of research and development work in such areas of reactor operation as the extension of fuel element operating life, and the development of techniques to deal with unusual maintenance problems posed by nuclear operation. In addition the AEC offers the waiver of normal charges for the use of fissionable materials and heavy water for specified periods of time.

Under Public Law 85-590 enacted August 4, 1958, future cooperative arrangements must be based upon proposals submitted in response to public announcements by the Commission of particular reactor projects considered technically desirable for construction.

*Public announcement of the invitation was made October 3.

Gas-cooled, Graphite-moderated Nuclear Power Plant

On September 22 a public announcement was issued inviting proposals to design, develop, construct, and operate a gas-cooled, graphite-moderated nuclear power plant on the basis of a cooperative arrangement under which the AEC would provide research and development assistance to be agreed upon. The proposals were to be submitted by November 21, 1958. A site selection board was established on September 22 to evaluate possible AEC sites for location of the gas-cooled power reactor in the event that acceptable proposals are not received.

Summary of Power Demonstration Projects

Table 1 contains general data on specifications and construction schedules and costs for those projects which are under contract, or for which a basis of contract negotiation has been approved. The following paragraphs summarize the status of these projects at the end of September.

First Invitation

Construction of the pressurized water reactor plant for the Yankee Atomic Electric Company at Rowe, Massachusetts, was approximately 9 percent complete and slightly ahead of schedule. The foundation for the reactor and vapor container was placed, and the steel structure for the building was completed. Fabrication was completed of the in-pile test loop to be inserted in the Materials Testing Reactor.

The contract between the Yankee Atomic Electric Company and the AEC was signed June 6, 1956. The Westinghouse Electric Corporation is the designer, and the Stone and Webster Engineering Company is the architect-engineer and construction contractor.

Construction of the power plant building and the control building was in progress for the Power Reactor Development Company (PRDC) fast breeder power plant at Monroe, Michigan.

The contract between PRDC and AEC was signed on March 26, 1957. Atomic Power Development Associates, Inc., of Detroit has been selected by PRDC to design the reactor. Commonwealth Associates, Inc., of Jackson, Michigan, is the architect-engineer. United Engineers and Constructors, Inc., of Philadelphia is the erection engineer. The Detroit Edison Company, one of the 21 companies comprising PRDC, will build, own, and operate the electric power generating facilities of the plant, and will distribute the power over its system.

Preliminary design was completed for the Hallam Nuclear Power Facility, the sodium graphite reactor project which is to provide steam to the power plant of the Consumers Public Power District at Hallam, Nebraska. At the end of September the preliminary design was being reviewed, work on engineering design was initiated, and the preliminary safeguards report was being evaluated. The possibility was being studied of using the radioactive sodium coolant from the reactor to irradiate various industrial products and food. This application appears promising.

Atomics International was selected to perform the research, development, and nuclear design of the reactor by Consumers Public Power District under the terms of its proposal of April 1955, which contemplated that the reactor would be constructed by Consumers. However, under the terms of the contract executed September 20, 1957, between AEC and Consumers, AEC will construct the reactor, while Consumers will provide the site and a turbogenerator, will contribute $5,220,000 toward the cost of the construction of the nuclear portion of the plant, and will operate the plant for 5 years. Following execution of this contract, continued responsibility of Atomics International for research, development, and design work for the project was provided under Atomics International's existing contract with the AEC. The

Table 1—Power Demonstration Projects

Specification	Yankee Atomic Electric Company	Power Reactor Development Company	Consumers Public Power District	Rural Cooperative Power Association	City of Piqua	Chugach Electric Association	Northern States Power Company	Carolinas-Virginia Nuclear Power Associates, Inc.	Pennsylvania Power and Light Company	East Central and Florida West Coast Nuclear Power Groups
Location	Rowe, Mass.	Monroe, Mich.	Hallam, Nebr.	Elk River, Minn.	Piqua, Ohio	Anchorage, Alaska	Sioux Falls, S. Dak.	Parr Shoals, S. C.	Eastern Pennsylvania	Not announced
Type of reactor	Pressurized water	Fast breeder	Sodium graphite	Boiling water	Organic moderated	Sodium-cooled, heavy-water	Boiling water	Pressurized heavy water	Aqueous homogeneous	Gas-cooled, heavy-water-moderated
Heat output	392,000 kw.	300,000 kw.	245,000 kw.	73,000 kw.[c]	45,500 kw.	40,000 kw.	203,000 kw.[c]	60,500 kw.	500,000 kw.	173,000 kw.
Electrical output, net	110,000 kw.	90,000 kw.	75,000 kw.	22,000 kw.	11,400 kw.	10,000 kw.	62,000 kw.	16,950 kw.	150,000 kw.	46,000 kw.
Amount of fuel	22,800 kg. UO_2	1,800 kg. U-metal	23,800 kg. UO_2	4,219 kg. thorium, 148 kg. enriched U	6,250 kg. U-metal	10,000 kg. UO_2	4,100 kg. UO_2	3,410 kg. UO_2	14,980 kg. thorium, 280 kg. U 233, 25 kg. enriched U	30,000 kg. UO_2
Fuel form	Rods	Pins in rods held in square cans	Rod clusters	Pellets in tubes	Plates	Rod clusters	Plates	UO_2 pellets in tubes	Liquid	UO_2 in form unspecified
Enrichment, percent U 235	3.02	27	2.5	Fully	1.8	About 2	1.6	2.0	Fully	1.15
Moderator	H_2O	None	Graphite	H_2O	Terphenyl	Heavy water	H_2O	D_2O	D_2O	D_2O
Coolant	H_2O	Sodium	Sodium	H_2O	Terphenyl	Liquid sodium	H_2O	D_2O	Fuel slurry	CO_2
Reactor outlet temperature (°F)	Approx. 600°	800°	925°	531°	600°	950°	489°	574°	580°	1,070°
Reactor pressure	2,000 psi	Negligible	60 psi	875 psi	120 psi	Negligible	Approx. 600 psi	1,500 psi	2,000 psi	535 psi

Steam conditions (psi at °F)	540 at 475°	600 at 740°	800 at 825°	600 at 825°	450 at 550°	850 at 850°	500 at 825°	415 at 725°	400 psi, saturated	1,000 to 1,800 at 1,000°
Control method	Control rods and boric acid	Control rods	Control rods	Control rods	Control rods	Control rods	Control rods	Control rods	U concentration and temperature coeff.	Not available
Decision to proceed	1956 (Feb.)	1955 (July)	1955 (Oct.)	1956 (April)	1956 (Sept.)	1956 (Aug.)	1957 (May)	1958 (April)	Not available[g]	Not available
Design start	1956 (July)	1956 (Jan.)	1958 (April)	1958 (June)	1958 (Oct.)	1959 (July)	1958 (Aug.)	1958 (July)	Not available	Not available
Construction start	1957 (Nov.)	1956 (Aug.)	1959 (April)	1958 (Aug.)	1959 (Nov.)	1960 (April)	1959 (July)	1959 (June)	Not available	Not available
Construction completion	1960 (June)	1960 (Aug.)	1961 (Oct.)	1960 (Dec.)	1961 (May)	1962 (July)	1962 (March)	1962 (April)	1963 (Dec.)	Not available
Criticality	1960 (July)	1960 (Aug.)	1961 (Nov.)	1961 (Jan.)	1961 (July)	1962 (July)	1962 (May)	1962 (June)	Not available	1963 (June)
Full power operation	1960 (late)	1961 (Sept.)	1962 (June)	1961 (June)	1961 (Oct.)	1963 (July)	1962 (Fall)	1962	Not available	1963
Total estimated plant cost	$53,917,000	$51,081,000[a]	$50,175,000	$11,719,000[a]	$9,442,000	$11,079,000	$21,600,000	$21,141,000[f]	$57,050,000	$25,885,000[a]
AEC	-0-	-0-	$24,013,000	$9,383,000[d]	$5,487,000	$9,229,000	-0-	-0-	-0-	-0-
Proposer	$53,917,000	$51,081,000	$26,162,000	$2,450,000	$3,955,000	$1,850,000	$21,600,000	$21,141,000	$57,050,000	$25,885,000
Research and development cost										
AEC	$5,000,000	$4,450,000	$26,165,000	$2,176,000	$6,818,000	$12,380,000	$6,000,000	$13,905,000	$25,330,000[h]	$11,646,000[j]
Proposer	-0-	$16,065,000	-0-	-0-	-0-	$25,000	$1,200,000	$6,667,000	$21,325,000[i]	$17,946,000[j]
Waiver of use charges	$2,980,000	$3,703,000	$1,326,000[b]	Not available[b]	$250,000[b]	$620,000[b]	$1,000,000	$1,170,000	$4,961,000	$800,000

[a] Includes first core.
[b] Government-owned reactor—costs absorbed without formal waiver.
[c] Includes 14,800 kilowatts of conventional superheating capacity.
[d] Includes $114,000 in contract amendment for modification and spare parts.
[e] Includes 39,000 kilowatts from either nuclear or conventional superheater.
[f] Existing turbine generator not included.
[g] Decision to proceed depends on outcome of research and development work in Phase I which expires December 1959.
[h] Includes $7,000,000 for Phase I.
[i] Includes $5,500,000 for pre-Phase I.
[j] Includes AEC costs of $2,649,000 and proposers' costs of $3,507,000 for work to be undertaken at option of AEC.

Bechtel Corporation was selected in April 1958 from 12 companies which had responded to invitations to submit proposals for the architect-engineer services incident to design, construction, procurement, and installation of equipment of the nuclear portion of the plant.

Second Invitation

Construction was begun of the Rural Cooperative Power Association (RCPA) boiling water reactor project at Elk River, Minnesota, on August 5. Excavation was completed for the containment vessel.

The contract between RCPA and the AEC was signed June 27, 1958. The utility provides the plant site and turbogenerator facilities, and is to operate the entire plant for 5 years. Steam produced by the reactor is to be purchased from the AEC. The AEC signed a contract with ACF Industries, Inc., on June 16, 1958, for the development, construction, and test operation of the reactor.

The contract with the City of Piqua, Ohio, for the operation of the organic-moderated reactor was signed by Piqua on September 5. AEC, with the concurrence of Piqua, was withholding final execution of the contract until the Advisory Committee on Reactor Safeguards could consider further the safety aspects of the project. Negotiations with Atomics International on contract provisions for the design and construction of the reactor were in progress.

Work on the Chugach Electric Association sodium-cooled, heavy-water-moderated reactor was begun by the Nuclear Development Corporation of America (NDA) under a contract signed April 10, 1957. The initial contract, providing for research, development, and preliminary design work was amended on June 26, 1958. Under the amended contract NDA is to perform work on the preliminary layout of the 10,000-electrical-kilowatt project for Chugach and to undertake evaluation and conceptual design of a larger reactor of this type. Additional development, engineering design, and construction would be authorized only after the results of these studies are available.

Third Invitation

Ground breaking for the Northern States Power Company boiling water reactor is scheduled for July 1959, and research and development in support of the reactor design are in progress. The plant is to be located on the Big Sioux River, about 6 miles northeast of Sioux Falls, South Dakota. The preliminary hazards summary report and the applications for a construction permit and a special nuclear materials license were submitted to the AEC. Design was essentially complete of the critical experiment facility to be constructed at Greendale, Wisconsin, by Allis-Chalmers Manufacturing Company.

As a consequence of the nuclear superheat feasibility study performed under the AEC-Northern States Power Company contract, the power company has concluded that nuclear superheat is both feasible and desirable for the "Pathfinder Plant." On July 11 the power company submitted to the AEC a proposal to amend the existing contract so that an estimated $2,500,000 would be provided by the AEC for the additional research and development support required to incorporate nuclear superheat in the plant by the completion date of June 30, 1962.

The contract between the Northern States Power Company and the AEC for the development, construction, and operation of the plant was signed November 19, 1957. The Allis-Chalmers Manufacturing Company is the principal subcontractor.

Negotiations were in progress on the definitive contract for the Carolinas-Virginia Nuclear Power Associates, Inc., pressurized-heavy-water power reactor at Parr Shoals, South Carolina. Based on a previous letter of agreement, research and development work on the project was begun in May.

The contract will cover the design, development, fabrication, and test operation of the reactor. The power group has engaged Stone and Webster Engineering Corporation as architect-engineer for the proposed project and has made arrangements with Westinghouse Electric Corporation to develop and furnish plant equipment.

Contract negotiations were in progress on Phase I of the Pennsylvania Power and Light Company–Westinghouse Electric Corporation project for an aqueous homogeneous reactor to be located in eastern Pennsylvania. Both companies continued research and development work on the project.

Negotiations were begun on the contract with the East Central Nuclear Group–Florida West Coast Nuclear Group for their proposed gas-cooled, heavy-water-moderated reactor project. It is expected that the General Nuclear Engineering Corporation of Dunedin, Florida, will be the nuclear design agent and that the American Electric Power Service Corporation will be the principal design and construction engineer for the project. Research and development work on the project began in March 1958.

GENERAL ENGINEERING AND DEVELOPMENT

Fuel Technology

The Materials Testing Reactor (MTR) at the National Reactor Testing Station was operated with plutonium fuel elements during August. After an initial period of operation at low power levels to determine reactor physics constants, the reactor was brought in successive steps to the level of 30,000 kilowatts. The run was completed without incident by the exhaustion of the fuel supply on August 31 after 262 megawatt days of operation. This experiment advanced the technology of plutonium fuel element handling and fabrication, and provided reactor physics data and valuable experience in the operation of a plutonium-fueled reactor.

Preparations were made to load the MTR with fuel elements containing uranium 233, the fissionable material formed by irradiating thorium.

Samples of arc-melted and cast enriched uranium carbide were irradiated in the MTR at 600 degrees centigrade to a burnup of 1,000 megawatt days per ton. The test indicated that uranium carbide prepared in this method may be suitable for use at elevated temperatures as fuel in reactors other than water-cooled types.

Fuel elements fabricated with uranium dioxide (UO_2) as loose powder in stainless steel tubes were being irradiated to high burnup in the General Electric Company's Vallecitos Boiling Water Reactor. The resulting performance data will be of particular interest because of the low fabrication cost of this type of fuel element.

Advanced Engineering Test Reactor (AETR)

A contract is to be negotiated with the Internuclear Company for additional design and development of the AETR, a "flux-trap," multicore reactor designed primarily to test a variety of fuel assemblies for power reactors. Oak Ridge National Laboratory is to perform the fuel element development work for the AETR. (End of UNCLASSIFIED section.)

Beryllium Procurement (CONFIDENTIAL)

The delivery of beryllium billet metal under the contracts with the Brush Beryllium Corporation and the Beryllium Corporation was cut back, effective July 1, 1958. To accord with revised requirements, scheduled annual deliveries by each contractor were reduced from

100,000 pounds to 37,500 pounds. One-third of the 75,000 pounds delivered annually will be provided for Department of Defense usage. At the end of September negotiations were under way on the settlement of claims under these contracts resulting from the partial terminations. (End of [redacted] section.)

Reactor Safety (UNCLASSIFIED)

An experimental technique for obtaining stress-strain curves of porous material like wood and celotex under very rapid loading was developed by Armour Research Foundation under contract with the AEC. The high strength exhibited by these porous materials makes them potentially suitable for blast (energy absorption) shields in reactor containment design.

Waste Disposal and Treatment

Excavation was begun in September for the waste calcination facility at the National Reactor Testing Station by Fluor Corporation, Ltd. The facility is designed to reduce high-level liquid wastes to solids which are safer and more easily stored. This process does not prevent the later recovery of isotopes to meet the growing needs arising from new industrial applications. Laboratory and pilot plant models have indicated that the calcining process will reduce the volume of liquid wastes to about one-seventh of its present bulk. The new facility, capable of handling 1 gallon of waste per minute, will provide experience for full-scale plants.

A theoretical study of the effects of more than 10 years of disposing radioactive wastes in a single area in the Pacific Ocean off the coast of San Francisco was undertaken by the Committee on Oceanography of the National Academy of Sciences at the request of the AEC.

A survey was begun on the wastes from uranium mills, and on the effects of these wastes on the environment. The survey is to be a cooperative effort involving the AEC, the U. S. Public Health Service, the individual states, and the uranium mills.

Direct Generation of Electricity

Electricity was generated directly from fission in an experiment conducted in the CP-5 reactor at Argonne National Laboratory. The process does not depend upon the use of heat energy to drive a turbogenerator as in the usual steam cycle. The process was believed theoretically possible but had never been demonstrated. Potentials up to 65,000 volts were obtained when a cell 3 feet long, containing fissionable material, was placed in a flux of reactor neutrons. Fission products formed in the cell produced the electricity.

TECHNICAL ASSISTANCE AND TRAINING

Training of Power Reactor Supervisors and Operators

At the request of the AEC, the Duquesne Light Company was preparing a proposal for an AEC-sponsored training course in reactor operation and supervision at the Shippingport Atomic Power Station, for American and foreign personnel. American companies engaged in power reactor development have shown an active interest in obtaining such training. In addition, foreign nations have requested permission to assign personnel to the Shippingport Atomic Power Station for operational training. If such a course is offered, tuition charges will be established. This course would be in addition to the reactor supervisors course to be given at the Oak Ridge National Laboratory.

Summer Institute Program

Training in reactor technology was received by 198 faculty members from 108 educational institutions in the Summer Institute Program held from June 23 to August 15. Included in the program for the first time was a basic institute for faculty members from technical institutes which do not offer advanced degrees. The American Society for Engineering Education, co-sponsor of the program with the AEC, has requested that the basic institute for technical institute faculty be repeated next year, and that four unspecified institutes be given for engineering faculties of universities and colleges.

On-the-Job Training

A recent survey conducted by the American Society for Engineering Education for the AEC showed that 141 engineering schools wished to send 379 people to AEC sites for on-the-job training.

Loan of Materials to Educational Institutions

The loan without charge of AEC-furnished materials to 34 educational institutions was approved during July and August. This brings to 94 the number of educational institutions receiving the loan of source, special nuclear, and byproduct materials without charge. (End of UNCLASSIFIED section.)

Part V

Licensing and Regulation

LICENSING (UNCLASSIFIED)

Licensing actions and applications received during the July-September quarter are described below. A statistical summary of licensing actions during the quarter is shown in Table 1, which also gives cumulative figures as of September 30, 1958.

Power Reactors

The General Electric Company was authorized to perform, in its Vallecitos Boiling Water Reactor, tests of two types of fuel elements designated as "Geneva Conference Fuel" and "APPR Fuel," and tests designated as "Irradiation of Lockheed Sources," "Automatic Pressure Regulator Tests," and "Operation with *Savannah* Fuel."

Commonwealth Edison Company furnished supplemental hazards data for the Dresden nuclear power reactor being constructed in Grundy County, Illinois.

Consolidated Edison Company of New York furnished additional information in connection with the nuclear power plant which it is constructing at Indian Point, New York. The supplemental data include (1) revised special nuclear material requirements, (2) a revised core design report, (3) a report entitled "Evaluation of Potential Radiation Hazards Resulting from Assumed Release of Radioactive Wastes to Atmosphere from the Proposed Buchanan Power Plant," and (4) a design report and hazards analysis for the containment vessel.

Yankee Atomic Electric Company furnished additional hazards, waste disposal, and financial data concerning the power reactor which it is constructing at Rowe, Massachusetts.

Test Reactors

A notice was published in August of the proposed issuance to the General Electric Company of a license to conduct critical experiments in the General Electric Test Reactor (GETR) at power levels not to exceed 50 thermal kilowatts. A hearing was held September 17 before the hearing examiner regarding the proposed issuance to the General Electric Company of a license to operate the GETR at power levels up to 33,000 kilowatts.

Pursuant to the order of the hearing examiner, a permit was issued on July 21 to the National Advisory Committee for Aeronautics (now superseded by the National Aeronautics and Space Administration) for the construction of a 60,000-kilowatt pressurized-water-test reactor near Sandusky, Ohio. This reactor will be used for investigations to further the development of materials and components suitable for aircraft propulsion reactors or for propulsion reactors and auxiliary nuclear power systems for space vehicles.

Table 1 — Summary of Licensing Actions

	July–September 1958			
	Applications received	Permits or licenses issued	Total issued through September	Permits or licenses in effect September 30
Facilities*				
Power Reactors				
Construction permits	0	0	5	4
Licenses to operate	-	0	1	1
Test Reactors				
Construction permits	0	1	3	3
Licenses to operate	-	0	0	0
Research Reactors				
Construction permits	4	2	27†	9‡
Licenses to operate	-	2	31	17
Licenses to acquire, possess, and operate	3	1	10	10
Reactor Exports				
Research reactors	0	2	21	§
Test reactors	0	0	2	§
Power reactors	1	0	0	§
Critical Experiment Facilities				
Construction permits	0	1	13	1
Licenses to operate	-	1	11	10¶
Operators' Licenses	57	54	313	306
Special Nuclear Material Licenses	32	26	240	214
Source Material Licenses issued or renewed		525	13,833	1,286
To raw material producers		116	4,355	463
To source material processors		7	171	49
To domestic distributors		25	699	122
To consumers		173	4,508	652
For export		204	4,100	§

*Applications to construct and operate are filed simultaneously; conversions from construction permits to licenses to operate are made upon satisfactory completion of construction.

†Permits authorize the construction of 70 reactors and modification of 2 reactors.

‡Permits authorize the construction of 40 reactors.

§Export licenses terminate on completion of shipment.

¶Two of the licenses authorize possession only.

Westinghouse Electric Corporation filed a final hazards summary report for the 20,000-kilowatt testing reactor being constructed at Waltz Mill, Pennsylvania.

Research Reactors

Aerojet-General Nucleonics (AGN) was authorized to construct ten 15-watt pool-type research reactors (Model AGN-211) at San Ramon, California, and to operate one of them. AGN later applied for authority to increase the power level of three of these reactors to 100 watts. The 100-watt reactors are to be redesignated as Model AGN-211P.

AGN was authorized to modify the control rods and use 780 grams of uranium 235 as reactor fuel, in lieu of 1,000 grams originally estimated, for the 1-watt AGN-211 reactor operating at San Ramon. AGN was also authorized to increase to 20 watts the operating level of a 5-watt reactor (Model AGN-201M) at San Ramon.

The University of Delaware was licensed to acquire and operate an AGN-201 100-milliwatt reactor on its campus at Newark, Delaware.

The Babcock & Wilcox Company was authorized to build and operate a 10-kilowatt pool-type research reactor at Lynchburg, Virginia.

Battelle Memorial Institute was authorized to make certain modifications in its research reactor and changes in its operating procedures, and was issued a revised special nuclear material transfer schedule.

Curtiss-Wright Corporation was authorized to use an additional 200 grams of uranium 235 contained in fuel elements for its research reactor at Quehanna, Pennsylvania.

General Dynamics Corporation, San Diego, California, was authorized to conduct experiments in the TRIGA reactor relating to (1) neutron studies of nuclear cross sections and solid state properties, (2) shielding studies of neutrons streaming through holes in a water shield, and (3) a series of reactivity compensation experiments.

The General Electric Company advised that its 30-kilowatt reactor in Alameda County, California, designated as the NTR, was shut down in mid-March pending repair and modification of the reactor and issuance of a revised license to operate. With the consent of General Electric Company, an order was issued on August 13 suspending operation of the reactor under the existing license.

A notice was published of the proposed issuance to Industrial Reactor Laboratories, Inc. (IRL), of a license to operate its 5,000-kilowatt reactor at Plainsboro, New Jersey. IRL subsequently advised there would be a delay in completion of gas leakage tests and requested a license, pending completion of these tests, to proceed with criticality and low power tests.

A notice was published of the proposed issuance to Nuclear Development Corporation of America of a construction permit and a license to operate at Pawling, New York, a heavy-water-moderated research and training reactor designed to operate at a steady thermal power level of 5 watts and for short periods at power levels up to 100 watts.

The University of Michigan was authorized to operate the Ford Nuclear Reactor at power levels up to 1,000 kilowatts, in lieu of the 100-kilowatt operation previously authorized.

Iowa State College applied for a construction permit and license to operate a 10-kilowatt Argonaut-type reactor (Model UTR-10) on its campus at Ames, Iowa, by the American Radiator & Standard Sanitary Corporation.

North Carolina State College applied for a construction permit and license to operate a 10-kilowatt pool-type reactor on its campus at Raleigh, North Carolina. This will be the second research reactor operating on this campus.

Applications for licenses to acquire and operate reactors manufactured by Aerojet-General Nucleonics were filed by Rice Institute, Houston, Texas, and the University of Oklahoma, Norman, Oklahoma, each for a Model AGN-211 15-watt pool-type reactor, and by the University of Maine, Orono, Maine, for an AGN-201 100-milliwatt reactor. The University of Oklahoma withdrew its previous application for a license to construct and operate a 5-watt Atomics International Model L-47 laboratory reactor.

The University of Arizona applied for a construction permit and license to operate on its campus at Tucson, Arizona, a 10-kilowatt tank-type isotope-production reactor designated by the builder, General Dynamics Corporation, as the TRIGA reactor.

The University of Tennessee requested a construction permit and license to operate a research reactor on its campus at Knoxville, Tennessee. The university's plans call for a 10-kilowatt heavy-water-moderated reactor to be built by Nuclear Development Corporation of America.

Reactor Export Licenses

S. A. Innocente Mangili Adriatica, Inc., New York City, was authorized to ship a 50-kilowatt solution-type research reactor (Atomics International Model L-54) to Politecnico di Milano, Milan, Italy.

American Machine & Foundry Company, New York City, was authorized to export a 5,000-kilowatt tank-type research reactor to Osterreichische Studiengesellschaft fur Atomenergie Gesellschaft m.b.h., near Vienna, Austria.

American Intercontinental Trade & Service Co., Inc., New York City, applied for a license to export to Centre d'Etudes l'Energie Nucleaire, Brussels, Belgium, a 43,000-thermal-kilowatt pressurized-light-water power reactor built by Westinghouse Electric Corporation.*

Critical Experiment Facilities

The Babcock & Wilcox Company was authorized to construct and operate a third critical experiment facility at Lynchburg, Virginia, to obtain data for the proposed Liquid Metal Fuel Reactor Experiment.

The General Dynamics Corporation was authorized to (1) erect a graphite thermal column on one side of the existing CIRGA facility and measure the effects of various reflecting shielding materials placed around the thermal column, and (2) modify the CIRGA facility and perform tests to simulate and provide data for the REGA research reactor which General Dynamics proposes to build.

The Westinghouse Electric Corporation was authorized to perform a third series of critical experiments for the Yankee power reactor.

Materials Licenses

Allocations made under special nuclear material licenses during the quarter totaled 5,132 grams of plutonium, 540,617 grams of uranium 235, and 5 grams of uranium 233. Of the total

*License issued November 6.

uranium 235 allocated, 225,000 grams were for reactor fuel, 270,100 grams for critical experiments, 45,500 grams for commercial fuel element fabrication, and 17 grams for research and development.

During the quarter 1,777 radioisotope licenses were issued. These included, in addition to renewals and amendments, 446 licenses issued to new licensees. New licensees during the quarter and the number of licensees on September 30 are classified as follows:

	New Licensees July–September 1958	Licensees on September 30
Medical institutions and physicians	113	1,797
Industrial companies	78	1,358
Federal and state laboratories	239	587
Colleges and universities	9	238
Foundations and institutions	3	45
Other	4	50
Total	446	4,075

There were reported 636 shipments to non-Soviet bloc countries during the July-September quarter. The Oak Ridge National Laboratory (the AEC's principal distributor of radioisotopes) made 1,147 shipments of radioisotopes; by September 30 ORNL had made a total of 115,460 shipments.

Licenses authorizing disposal of radioactive wastes at sea were issued to Isotopes Specialties Company, Inc., Burbank, California, American Mail Line, Ltd., Seattle, Washington, and New England Tank Cleaning Company, Cambridge, Massachusetts.

Notices were published of the proposed issuance of licenses to provide radioactive waste disposal service to the Walker Trucking Company, New Britain, Connecticut, and Nuclear Engineering Company, Inc., Walnut Creek, California. In both cases a petition to intervene and a request for a hearing were filed with the AEC. The petition in the case of the Nuclear Engineering Company was subsequently withdrawn.* The petition in the case of the Walker Trucking Company was filed by the town of Portland, Connecticut,† where the company proposes to prepare packaged waste for sea disposal and store such packages temporarily. The petition was based on the objections of oil companies in the immediate vicinity of the Walker Trucking Company location.

A hearing was held July 30–31 in the matter of the apparent violation by Advance Industrial X-Ray Laboratories (a division of Air Frame Inspection, Inc.), Los Angeles, of certain license conditions and regulations, which may have contributed to a radiation incident involving the loss of a 29-curie iridium 192 source and exposure of personnel to radiation in excess of permissible limits. The testimony was under consideration by the hearing examiner.

On August 29 an order was issued to Empire Steel Castings, Inc., Reading, Pennsylvania, to cease and desist from further use of a 1-curie cobalt 60 source possessed without a by-product material license. The firm was directed to place the source in storage pending either transfer of the source to a licensed recipient or the issuance of a license by the AEC.

*A license was issued to Nuclear Engineering Company on October 22.

†Two additional petitions to intervene were filed by Elliott Earl, Managing Director of the Institute for Nuclear Serology, Manchester, Connecticut, and Walter A. Lynch of Port Washington, New York. The matter of the Walker Trucking Company was set down for a prehearing conference and for a hearing, to be held in Hartford on November 18 and 19, respectively.

REACTOR SAFETY

The AEC staff conducted safety reviews of more than 55 privately owned and Government-owned facilities. Reactors at the Geneva Conference were evaluated for safety of operation.

The Advisory Committee on Reactor Safeguards met in July and August to review eight projects referred to it by AEC.

COOPERATION WITH STATES AND OTHER AGENCIES

Upon request, the AEC staff reviewed proposed legislation on radiation safety regulations of a number of states including Idaho, Tennessee, and New Mexico. It is expected that the 45 state legislatures meeting early in 1959 will consider a number of bills in the atomic energy field.

Several meetings were held with other Federal agencies to discuss problems and develop pertinent regulations with respect to the transportation of radioactive materials.

Representatives of the South Carolina Industrial Commission met with the AEC staff to discuss usage and movements of radioactive materials within South Carolina. The staff also met with officials of the Utah Department of Health, the Idaho Health and Labor Departments, and the Maryland-National Capital Park and Planning Commission.

FINANCIAL PROTECTION AND INDEMNITY

Two proposed amendments to the temporary indemnity regulation (10 CFR Part 140) were published in the Federal Register on August 28. The first set forth the proposed form of indemnity agreement to be entered into with reactor licensees; the second requested public comment concerning whether or not the AEC should accept the insurance associations' standard nuclear energy liability insurance policy as proof of financial protection. Interested persons had until November 1 to submit written comments on the two proposed amendments.

Work was nearing completion on a third proposed amendment, concerning the method of computing the amount of financial protection which reactor licensees must procure. (End of UNCLASSIFIED section.)

Part VI

Industrial Development

INDUSTRIAL PARTICIPATION (UNCLASSIFIED)

Foreign Third-Party Liability

European efforts to solve the third-party liability problem were centered principally around the preparation of the draft convention sponsored by the Organization for European Economic Cooperation (OEEC).* The convention would establish uniform law for those countries which signed the convention. This approach would impose liability in the event of a nuclear incident only upon the operator of the nuclear installation involved, and suits for damages could not be maintained against any other persons (including suppliers). The draft convention would appear to be approaching its final form, and may be submitted for consideration to OEEC member governments toward the end of 1958.

The Commission in September 1958, also suggested that the International Atomic Energy Agency (IAEA) institute necessary studies and proposals for action to effect a worldwide solution to the problem, and the IAEA's response has been most favorable.

Commercial Services Available

Materials and services available commercially. An announcement was issued September 5 by the AEC to guide industry by listing those materials and services related to the atomic energy industry which are available from commercial sources and for which the AEC no longer acts as supplier. The materials and services listed were:

1. Materials:

   a. Thorium metal and oxides,
   b. Natural uranium metal,
   c. Natural uranium compounds, and
   d. Heavy water in quantities less than 125 pounds (available through commercial retailers).

2. Services:

   a. Conversion of enriched or depleted uranium hexafluoride into uranium metal, oxides, and other enriched or depleted uranium compounds,

* The members of the OEEC are: Austria, Belgium, Denmark, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Sweden, Switzerland, Turkey, and the United Kingdom. The United States is an associate member.

b. Recovery of uranium from unirradiated scrap resulting from uranium conversion, fuel element fabrication, etc. (The AEC continues to offer the service of recovery of uranium and plutonium in irradiated fuel.),

c. Fabrication of fuel elements, and

d. Gamma-irradiation services and experiments.

Reactor fuel cores. The assembly of reactor cores was begun at the Montville, Connecticut, plant of the Olin Mathieson Chemical Corporation. In its announcement of August 26 the corporation stated that initially its work would be primarily for the military services, but that a growing demand was anticipated for its services from American and foreign industry.

Efforts to Advance Industry

AEC procurement of commercial processing and fabrication services. The Hartford Area Office of the AEC issued invitations to industry to bid for the preparation of uranium metal slabs depleted in uranium 235. The slabs are to be used in work being performed by Pratt & Whitney under AEC contract. The invitation to perform this work is part of the effort of the AEC to have its nonroutine requirements for processing nuclear materials met by private industry whenever sources are available at reasonable prices.

Sales of uranium enriched to 99.97 percent in the uranium 238 isotope. The AEC announced that it will sell to licensees uranium enriched to more than 99.97 percent in the uranium 238 isotope. Gram and milligram quantities of this material are used in fission chambers for routine measurement and control purposes and in research for precise measurements of neutron cross sections. The material enriched in uranium 238 is sold in the following forms from the Oak Ridge National Laboratory.

	Per gram of uranium
U_3O_8 (uranium oxide)	$15.25
⅛-inch diameter cast rod	16.50
Metal foil	16.75

The prices listed do not include transportation or standard handling charge of $14 per shipment.

Sales of depleted uranium. Slightly more than 71,000 kilograms of depleted uranium were sold during the quarter. The availability of various assays of depleted uranium for sale on an unclassified basis was announced on June 27, 1958.

Test irradiation services. Industrial concerns and research and educational institutions were invited to submit proposals by January 12, 1959, to perform test irradiation services for the AEC. The irradiation services would be performed in reactors specially designed to test reactor materials and components. Requirements of industry and other Government agencies for space in test reactors are expected to increase significantly in the next several years. Civilian and military reactor projects under development by the AEC will require irradiation services for at least a 5-year period. The invitation to perform irradiation services furthers the AEC policy announced in November 1956 of fostering the construction of non-Government-owned test reactors by industry.

Meetings. Industrial representatives were invited to attend certain meetings held primarily for the purpose of enabling AEC and contractor personnel to exchange information on technical subjects. One such meeting was held on the role of analytical chemistry in nuclear

reactor technology at Gatlinburg, Tennessee, from September 29 through October 1. Another, on weak interactions, is to be held at Gatlinburg on October 27–29.

A technical information meeting on gas-cooled power reactors was scheduled for October 21–22 at Oak Ridge National Laboratory.

Tentative plans called for AEC-sponsored meetings to be held on test reactors, waste fission product recovery, and industrial uses of radioisotopes.

Leasing of Heavy Water

The policy to lease heavy water for use in domestic and foreign research, medical, and testing reactors was announced by the AEC on August 15. Previous transactions in heavy water were primarily on a sales basis. The policy provides operators of these types of reactors with the choice of leasing heavy water at a charge of 4 percent per year of the sales price, or of purchasing the heavy water at $28 per pound. The heavy water is to be leased in quantities of one short ton or more for the initial inventory requirement of the reactor. Leasing of heavy water would permit the reduction of the initial capital outlay for these types of reactors.

Access Permit Program

During the July-September quarter 48 new applications for access permits were received, compared with 55 in the preceding quarter. On September 30 there were 1,419 access permits in effect. About 59 percent of the permits were issued for access to Secret–Restricted Data. Of the 1,003 permits due to expire by September 30, 81 percent had been renewed.

ISOTOPE DEVELOPMENT

Food Irradiation Facility

In July a contract was signed with the Curtiss-Wright Corporation to design, develop, and test operate a cobalt 60 High Intensity Food Irradiator (HI-FI). The HI-FI is to be completed in the summer of 1960 at the U. S. Army Ionizing Radiation Center at Lathrop, California. About 2,000,000 curies of cobalt 60 are to be produced at Savannah River for the facility. Cobalt 60 test slugs were being irradiated at Savannah River to develop source parameters.

A temporary irradiation facility was established at Savannah River to enable the United States Army Quartermaster Corps to perform that phase of its food irradiation project concerned with long-term feeding of animals. The facility uses spent fuel elements as radiation sources to sterilize food with doses of 3 to 6 megarads, and is capable of producing 10 tons of irradiated food per month. Irradiation of food was begun on July 9.

Advisory Committee on Isotope and Radiation Development

An Advisory Committee on Isotope and Radiation Development was established to advise the AEC on such activities as (1) the development of practical industrial uses of radioisotopes and high-level radiation, (2) the encouragement of private production of radioisotopes, and (3) the assistance required by industrial personnel to obtain technological training for practical applications of radioisotopes.

Meeting on High-Level Radiation

A meeting was held in August with AEC contractors to coordinate efforts in determining present and future prospects for the application of high-level radiation, the technical and managerial problems peculiar to the applications of high-level radiation, and the power and types

of radiation sources required. The AEC contractors attending the meeting were representatives of the CEM group (chemicals, electronics, and metallurgy) consisting of Emerson Radio and Phonograph Corporation, General Aniline and Film Corporation, Revere Copper and Brass, Incorporated, and representatives from Radiation Applications, Incorporated, and W. H. Johnston Associates.

Joint Industry-Government Program to Develop Industrial Uses of Radioisotopes

Industrial organizations and research laboratories were invited by public announcement on September 29 to participate in joint industry-Government projects to expand and develop industrial uses of radioisotopes. Applicants are to submit proposals by June 30, 1959, including a statement of the industrial problem and outlining the research and development work to investigate the use of radioisotopes for its solution. The projects are to be carried out by AEC-financed contracts.

Radioisotope Distribution and Sales

As of September 30, 565,000 curies of radioisotopes were sold by the Oak Ridge National Laboratory and distributed by 115,460 shipments. (End of UNCLASSIFIED section.)

Project PLOWSHARE [redacted]

During the quarter the possible use of nuclear explosions for nonmilitary applications continued under investigation. In addition, the AEC worked with the State Department and other Government agencies in establishing the United States position on nuclear explosions for peaceful purposes to be reflected in the Geneva discussions on the Discontinuance of Nuclear Testing. It was planned at that time that our program to investigate the use of nuclear explosions for peaceful purposes would continue, even though international supervision might be necessary.

The kinds of projects which will be ready for execution in the next few years and problems involved in carrying out experiments are being studied. (Certain related studies are described under CHEMISTRY RESEARCH on page 46.) Specifically, the AEC is considering the following experiments as being the most feasible for execution during the next few years:

1. The Salado salt bed detonation of 10 kilotons at 1,200-foot depth to be fired in the fall of 1959. Core drilling for survey purposes had begun. The site of the shot and conditions of firing are under consideration.

2. The oil-shale experiment to be conducted on Government land, with a detonation of a few kilotons to be fired during the summer of 1960. AEC is considering an arrangement for this shot whereby the site is furnished by the Department of the Interior. The preparations for the firing, including digging a shaft, would be a cooperative venture with the oil industry. The explosive, its emplacement, and firing would be provided by the AEC. A meeting was held in Laramie, Wyoming, in August with representatives of the AEC, the Bureau of Mines, and the University of California Radiation Laboratory to discuss the recovery of oil from oil shales through use of nuclear explosions. It was concluded that the prospect for recovery was promising and warranted approaching the oil industry for further examination of the technical aspects involved and for an expression of interest on the part of the industry. Accordingly, plans were made for a meeting with representatives of the oil industry in January 1959. The Bureau of Mines and the AEC have a working arrangement for the experiment for the recovery of oil from shale and for the development of other mineral resources with nuclear devices.

3. The oil-sands firing in the Athabaska area of Alberta, Canada, of a device with a few tens of kilotons at a depth 1,200 to 1,500 feet. The Richfield Oil Company has developed a rather definitive plan for this experiment. The company has offered to prepare the site of detonation and to furnish logistic support, and has offered also to reimburse the AEC for producing the explosion. We have offered to supply information, advice, and technical assistance to any joint Richfield–Canadian organization set up to formulate plans for the experiment. Further action on plans for this experiment is contingent upon approval by and a request from the Canadian Government.

4. Civil engineering applications. At some time during the 1960-1961 period the AEC hopes to conduct one or more civil engineering experiments. Several possibilities have been suggested including the excavation of a harbor in Alaska, the breaking of an atoll reef, and the clearance of the Madeira River in Brazil.

Numerous inquiries and proposals have been received from, and meetings have been held with, representatives of private industry who are interested in the PLOWSHARE project. These include most of the major oil companies, many chemical companies, some mining firms, some engineering firms, and various other industrial groups.

In order to assist industry in participating in Project PLOWSHARE, the AEC has determined, and the Department of Defense has concurred, that the following general information on size, yield, and cost of nuclear devices can be furnished to science and industry on an unclassified basis. Use of such information will permit them to evaluate more fully the economics of conducting experiments or detonations for peaceful purposes:

1. The cost of fabricating and firing a device 30 inches in diameter and of a few kilotons yield, all from fission, would approximate $500,000 when made available in small numbers.

2. The cost of fabricating and firing a device 30 inches in diameter of a few tens of kilotons yield, all from fission, would approximate $750,000 when made available in small numbers.

3. The cost of fabricating and firing a device 60 inches in diameter with a yield range up to 5 megatons, 5 percent from fission and 95 percent from fusion, would be approximately $1,000,000 in small numbers.

4. In the event of multiple firing in the same location, or of using large numbers of devices, the cost per firing would be substantially reduced.

5. These costs are only those incident to the fabrication of the device, emplacing it in its firing location, making the firing attachments, firing, and studies to assure public safety and to determine the results of the detonation. The costs do not include costs of preparing a hole, shaft, structures for the firing, or studies to determine the extent of industrial utility. (End of [redacted] section.)

Part VII

Physical Research

HIGH ENERGY PHYSICS (UNCLASSIFIED)

Argonne National Laboratory

A high energy physics program is being inaugurated at Argonne. Dr. Roger H. Hildebrand was appointed Associate Director of the Argonne National Laboratory for the high energy physics program. Duties of the new position include administering the construction of the 10-15 billion-electron-volt proton synchrotron. Preliminary design of this accelerator started in June.

Brookhaven National Laboratory

Design of the new Cosmotron coil at Brookhaven was completed. Changes were necessary in insulation specifications because of failure to pass 10,000-volt acceptance tests. Excessive moisture in the cambric tape was believed to be the cause of the failure, and the manufacturer accordingly agreed to predry all the cambric insulating tape as well as to use an extra finishing coat of varnish. At the end of September the manufacturer was working around-the-clock on a 6-day workweek in order to make up as much of the delay as possible. Delivery of all conductors was expected to be completed by mid-November. Operation of the Cosmotron is now expected to resume in January 1959.

University of California Radiation Laboratory at Berkeley

The Bevatron resumed normal operation in August after repairs were made to the generator that broke down in April. During most of the period of breakdown the machine was operated on one generator at lower energy and at a slower pulse rate. Also during this period modifications were made to the injector to permit maximum extraction of the beam into the racetrack. During August and September, performance of the Bevatron was generally satisfactory in spite of intermittent shutdowns caused by minor troubles with the high voltage rectifier tubes (ignitrons) in the power supply.

A group from Duke University operated their helium bubble chamber, using the Bevatron beam, to study hyperfragments. Other outside groups using the machine included those from Princeton University and the Massachusetts Institute of Technology.

The 72-inch bubble chamber is substantially completed and is undergoing preoperational testing. This chamber will be capable of analyzing the entire range of nuclear interactions and events which the Bevatron can produce. It is the largest such device in the world. Prior to using liquid hydrogen in the chamber, the entire system will be thoroughly checked, using

liquid nitrogen. Cooling of the chamber to the temperature of liquid nitrogen (−195° centigrade) was accomplished. A Horton sphere 22 feet in diameter was constructed adjacent to the bubble chamber for storage of liquid hydrogen and for use as a discharge reservoir in case of emergency.

Oak Ridge National Laboratory

The site was selected for construction of the cyclotron, authorized as project 59-e-14. Basic magnet design for the Oak Ridge cyclotron is now firm and features a three-fold azimuthally varying magnetic field which will provide suitable focusing forces for the fixed-frequency acceleration of protons at energies up to 75 million electron volts (Mev). Moreover, because of a wide range of control of average magnetic field strength and configuration and because of the incorporation of a variable radiofrequency system, it will be possible to accelerate heavier particles such as helium, carbon, nitrogen, oxygen, neon, and argon to energies up to 100 Mev.

Yale University

The operating schedule for the Yale heavy ion linear accelerator (HILAC) was increased to incorporate an additional operating shift. To make the machine available for additional experiments, preparations were begun to double the pulse rate of five per second and to limit to one half a week out of each 4 weeks the period for machine development and scheduled maintenance. Universities possessing accelerators have experienced a general increase in the demand for operating time to perform research.

CONTROLLED THERMONUCLEAR RESEARCH

Geneva Conference

A major part of the time of key SHERWOOD laboratory personnel was devoted to the final preparation of exhibits, and the setting up and dismantling of these exhibits in Geneva. All exhibits operated satisfactorily during the Conference and were generally acknowledged to be successful and impressive.

On August 30, the Chairman of the United States Delegation, Lewis L. Strauss, and the Chairman of the United Kingdom Delegation announced complete declassification of the programs of both countries for research on the control of thermonuclear reactions.* The vast bulk of information relating to controlled thermonuclear research had been previously declassified, the most recent previous major action having been announced jointly in January 1958.

During the Conference it became known that the USSR (1) is working on the pinch approach at a level comparable with the United States–United Kingdom effort, (2) does not appear to have a strong effort along the lines of the Stellarator, and (3) has built a series of experimental devices of increasing size to investigate high energy ion injection into mirror geometries. This latter effort parallels the mirror programs at Oak Ridge National Laboratory and the University of California Radiation Laboratory at Livermore.

Russian theoreticians discussed a new form of energy radiation loss which they expect may occur in very hot plasmas. This loss is associated with the spiraling of fast electrons in a magnetic field and, when coupled with ordinary bremsstrahlung losses, may require higher operating temperatures for an ultimate thermonuclear power producer.

*The basis for the Commission's decision to declassify Project SHERWOOD and the plans for announcing this decision were described in a letter to the Joint Committee dated August 28, 1958.

Los Alamos Scientific Laboratory

Operation of the shock-mirror device, Scylla, at the Los Alamos Scientific Laboratory lent further support to the idea that the neutrons produced in this device may be thermonuclear. Preliminary neutron energy measurements failed to disclose the existence of bombardment or mass motion effects in the plasma. However, further work is necessary to establish conclusively the characteristics of the plasma.

Studies with Perhapsatron S-4 furnished additional experimental information on the complex behavior of stabilized toroidal pinch discharges. There is some evidence for the existence of small-scale turbulence or plasma oscillation effects at the plasma surface.

Oak Ridge National Laboratory

Development of a new (von Ardenne-type) ion source and high current capacity accelerating tube progressed to the point where these improved components could be installed on the DCX machine at Oak Ridge. Improved diagnostic techniques have been developed for studying the "partial burnout" which may have been attained in a hydrogen plasma. The "burnout" condition will be reached when the injected ion beam current is high enough to overcome the cooling effects of the neutral gas background.

Princeton

Encouraging results were obtained from ion cyclotron heating studies with the B-65 Stellarator device. Plasma temperatures of approximately half a million degrees were maintained for periods of several milliseconds by the radiofrequency power supply, operating at a power level of about 250 kilowatts. As with the pinch devices, it is not known what loss processes constitute the principal energy drain on the plasma. Under certain conditions, neutrons have been produced in the B-65, but they are probably not of thermonuclear origin.

Design and fabrication of Model C components has begun. This work is being carried out by C. Stellarator Associates, a working group composed of personnel of Allis-Chalmers and Radio Corporation of America. In August, Princeton decided to postpone detailed design and fabrication of a portion of the projected radiofrequency heating equipment for the Model C and to revise the design of the lower frequency (magnetic pumping) equipment.

Construction of the Phase I-A supporting facilities for Model C was one-third complete. Separate contracts were awarded for construction of the Phase I buildings, which will house the experimental complex. Building construction is essentially on schedule.

University of California Radiation Laboratory

In the mirror machine program at Livermore, emphasis continues to be on plasma diagnostics and on improvement of plasma sources and injection techniques.

The pinch group continued to study "anomalous" energy dissipation processes in pinch discharges and the effects of runaway electrons on pinch behavior.

The general nature of the Astron approach was disclosed before an American Physical Society meeting in August. Work continued on the relativistic electron injection system, and an impressive electron beam has been developed.

COMPUTER RESEARCH

Research was begun on the application of cryogenics to computer technology. Use will be made of the fact that it is possible to maintain circulating electrical currents indefinitely at

temperatures a few degrees above absolute zero. These currents may be controlled by a magnetic field that can quench the current by introducing electrical resistance. The electrical engineering problems are new.

From a theoretical standpoint, a computer operating at cryogenic temperatures offers the promise of compactness, reliability, and economy coupled with an effective increase in capacity and speed, resulting from the fact that many basic operations can be performed simultaneously. With respect to these characteristics, such a computer would be more like a human brain than are existing computers.

The research work on certain computer components is being carried out under contracts with Duke University and the General Electric Company, working in collaboration. (End of UNCLASSIFIED section.)

CHEMISTRY RESEARCH

DELETED

Activation Analysis (UNCLASSIFIED)

Semiroutine analytical methods for measurements as low as parts-per-billion have been developed for determining the content of argon, xenon, and krypton in gas and liquid samples. The principle used is based on thermal neutron activation.

NUCLEAR STRUCTURE AND NEUTRON PHYSICS RESEARCH

The total neutron cross section of neptunium 237 was measured over an energy range from 2 to 40 electron volts using a neutron velocity selector installed at the Low Intensity Testing Reactor at Oak Ridge.

METALLURGY AND MATERIALS RESEARCH

Effects of Radiation on the Oxidation of Niobium

A study of the effect of radiation on the oxidation characteristics of niobium is in progress. Limited experimental results indicate that the rate of oxidation of niobium in early stages of oxidation is not appreciably affected by radiation.

Microstresses in Metal Crystals

A diffraction theory for very thin imperfect surface oxides on single crystals of copper has been developed. Comparisons between theoretical and experimental results appear encouraging. If more precise measurements confirm the correctness of the theory, new information on the structure of such films may result.

Ceramics Research

Hot pressing an intermediate grade of sinterable beryllium oxide at temperatures of 1,050, 1,150, and 1,250 degrees centigrade resulted in densities of 94 to 98 percent of the maximum density theoretically possible. Hot pressing of purified beryllium oxide at these same temperatures resulted in densities of 68, 86, and 97 percent. The high density obtained in the intermediate grade material is attributed partly to an impurity that retains moisture at 1,050 degrees centigrade.

OAK RIDGE REACTOR OPERATIONS

The new Oak Ridge Research Reactor was turned over to the operating group on July 1, and routine operation began in mid-July.

Preparations continued for increasing the power level of the air-cooled graphite reactor at Oak Ridge. Specifications were completed for the enriched fuel elements to be used. The contemplated changes will provide a power level of about 10,000 kilowatts instead of the 3,700 kilowatts currently obtainable with normal uranium fuel.

NATIONAL POLICY ON HIGH ENERGY ACCELERATORS

Meetings have been held with representatives of the Department of Defense, the National Science Foundation, and the Science Advisory Committee for the purpose of developing a national policy for the construction and operation of high energy particle accelerators. A panel of scientists, convened by the National Science Foundation, has submitted a technical analysis of the future needs. A joint subcommittee composed of members of both the General Advisory Committee and the Science Advisory Committee is currently studying the problems. (End of UNCLASSIFIED section.)

Part VIII

Biology and Medicine

RADIOBIOLOGICAL SURVEYS IN THE PACIFIC (UNCLASSIFIED)

Preliminary results of some of the radiobiological surveys conducted in the Pacific during the July-September quarter are given below. These surveys, some of which were still in progress at the end of the quarter, were undertaken to monitor the radioactivity in the water and in marine organisms, resulting from Operation HARDTACK. The surveys were described in detail in the Quarterly Progress Report, April–June 1958.

Fallout During Operation HARDTACK

Highly radioactive fallout was limited to the announced danger area. Radiation doses to members of the Joint Task Force were kept to a minimum, and there were no serious radiation situations.

Marine Radiobiological Surveys

A radiobiological survey of the danger area conducted August 9–15 indicated that the restricted area could be disestablished without hazard. A similar survey was conducted September 3–12 in the area between Eniwetok and Guam, covering most of the western half of the restricted area and extending a considerable distance beyond its western boundary. Sea water and plankton samples indicated that the radioactivity levels were of the same order of magnitude as those found in the post-REDWING survey in 1956. Further evaluation of the results was being made.

Tuna Sampling

By the end of September samples of tuna from about 100 locations in the western and central Pacific and 2 locations in the Indian Ocean had been sent to the Laboratory of Radiation Biology of the University of Washington for gross beta and gamma counts and analysis. Most of the tuna was caught in the area north of the equator, south of Japan, west of the Eniwetok test site, and east of the Philippines. Counting of these samples revealed little radioactivity, most of which could be accounted for by the naturally occurring radioisotope potassium 40. However, at a later time and in limited areas, some tuna may acquire some radioactivity produced by the HARDTACK test, probably by way of the food chain.

SOIL SAMPLING AROUND THE NEVADA TEST SITE

Following Operation PLUMBBOB (1957) soil samples were collected for analysis for strontium 90 from areas around the Nevada Test Site (NTS) receiving some of the heaviest

fallout from tests at NTS. Results of analyses completed by the end of the quarter are given below. These values are substantially lower than values for these areas derived from theoretical calculations. The difference between the actual and expected strontium 90 content may result from such factors as weathering and low rainfall in these areas and from the fact that strontium 90 tends to form a smaller percentage of nearby fallout than predicted from tables of theoretical composition of mixed fission products.

Location	Strontium 90 (millicuries per square mile)
Templute, Nevada	42.3
Cedar City, Utah	36.2
Lund, Nevada	30.7
Beaver, Utah	29.6
Eureka, Nevada	25.6
St. George, Utah	24.1
Alamo, Nevada	15.3
Bishop, California	14.9
Caliente, Nevada	14.6
Overton, Nevada	9.7
Mesquite, Nevada	5.2
Barstow, California	1.96

For comparison, values for some other locations in the United States are given below. It will be noted that the values for soils collected around NTS are not significantly different from the values for these other locations.

Location	Strontium 90 (millicuries per square mile)
Memphis, Tennessee	38.0
Rapid City, South Dakota	31.7
New Orleans, Louisiana	30.4
Detroit, Michigan	29.9
Rochester, New York	27.9
Seattle, Washington	27.5
Los Angeles, California	8.3

(Values obtained from other locations were all within the range shown above.)

PREPARATION FOR LARGE-SCALE RADIOEPIDEMIOLOGIC STUDIES

About 30 scientists engaged in human radiobiologic studies attended a meeting at AEC headquarters in September to advise on planning for large-scale studies of the effects of low-level environmental radiation on human populations. Effort was made to design investigative procedures for measuring general fitness and the effects that environmental radiation may have on fitness. Particular attention was given to leukemia induced by radiation and to the effects of radiation at different altitudes. The first part of the meeting was devoted to review of the status of studies dealing with "ready-made" human radiobiologic situations, such as those at Hiroshima and the Marshall Islands and those presented by accident cases, radium

dial painters, miners of radioactive ores, therapy cases, and people who live in radioactive regions or drink water that is radioactive. The second part of the meeting was devoted to discussion of investigative procedures for more comprehensive studies. It was felt that the studies already under way were valuable and should be continued. It was recognized, however, that the undertaking of more comprehensive studies would present many difficulties and that meaningful scientific information might not be derived from them.

AERIAL RADIATION SURVEYS

During the July-September quarter the U. S. Geological Survey conducted aerial radiation surveys in the southwestern corner of Utah and adjoining territory in Nevada and Arizona to obtain data for use in a study concerned with external gamma radiation levels in and around certain communities. In addition firm plans were developed to extend the aerial monitoring program conducted in connection with fall 1958 weapons test activities at the Nevada Test Site to include surveys of Mare Island, Livermore, and Berkeley reactor locations on the West Coast, and Brookhaven and New London on the East Coast.

CIVIL EFFECTS ACTIVITIES

Radiation Surveys—Nevada Test Site Area

Aerial and ground radiation surveys were conducted at NTS in July and August in advance of the experimental phase of the reactor testing activities at Jackass Flats and to provide a followup for fallout studies conducted during Operation PLUMBBOB. Under AEC direction, personnel of the Atomic Energy Project of the University of California at Los Angeles made ground surveys, which included the collection of soil, plant, and animal samples in the Jackass Flats area, and the U. S. Geological Survey conducted airborne surveys. The aerial surveys were completed in early August. The UCLA personnel also conducted a plutonium survey and a strontium and cesium survey in areas contaminated by past tests. (End of UNCLASSIFIED section.)

Participation in Fall 1958 Weapons Tests ([redacted])

In September, and continuing into October, the AEC Civil Effects Test Group and the Office of Civil and Defense Mobilization participated in the weapons tests at NTS. Field work included measurement of fallout by personnel of the UCLA Atomic Energy Project, with aerial radiation monitoring by the U. S. Geological Survey. The air survey capability was made available to the test site radiological safety organization for onsite or offsite emergency assignments. A second project involved the continuation of studies of the angular distribution of prompt bomb radiation in the air and studies of the shielding characteristics of light frame houses against prompt gamma and neutron radiation. This project, as in Operation PLUMBBOB, was being performed by personnel from Oak Ridge National Laboratory. In another project, the effects of nuclear detonations on AEC test structures in regions of high blast pressures and prompt radiation were being studied.

Under an AEC research contract, personnel from Highlands University of Las Vegas, New Mexico, continued botanical field studies initiated during Operation PLUMBBOB. (End of [redacted] section.)

Civil Effects Task Units (UNCLASSIFIED)

A meeting of the AEC Blast Biology Task Unit was held in August at Albuquerque under the chairmanship of Dr. C. S. White of the Lovelace Foundation. The task unit reviewed the

state of knowledge of blast biology, determined the priorities of needs for data, and was to make recommendations as to the field and laboratory experiments required to obtain these data. A similar meeting of the Thermal Biology Task Unit was held in Washington, D. C., in September under the chairmanship of Dr. Herman Pearse of the University of Rochester.

Radiation Monitoring Instruments

Plans were made for the evaluation of two prototype instruments combining a portable transistor radio and a radiation dose rate meter that have been developed for civilian use. Twenty-five instruments of each type will be distributed to AEC laboratories and selected field personnel for test and comment.

EXPANSION OF RESEARCH

A comprehensive analysis and evaluation of the biology and medicine research program was completed during the quarter. This review was conducted in accordance with recommendations made during the 1957 hearings of the Joint Committee on "The Nature of Radioactive Fallout and Its Effects on Man" that the AEC's biomedical program be examined as to possible need for increased research effort in order to accelerate resolution of the problems of the biological hazards of radiation and radioactive fallout. The testimony at the hearings brought out that there was a well balanced AEC-supported research program in biology and medicine and that any proposed increase in research should not be at the expense of long-term basic research by a diversion of effort to a multitude of short-lived programmatic research projects.

As a result of this review the Commission approved, for planning purposes, a 5-year plan for continued expansion of research in biology and medicine, emphasizing particularly the biological hazards of radiation associated with peaceful and military uses of atomic energy.

BERYLLIUM SURVEYS

Because of the health hazards associated with beryllium handling, the Health and Safety Laboratory of the New York Operations Office (HASL) is continually studying beryllium operations and hazards in connection with AEC contractor activities in this field, as a part of its environmental health services and studies.

Surveys of occupational exposure to beryllium dust at the new Beryllium Corporation plant at Hazelton, Pennsylvania, were conducted in January and May 1958. The May survey showed that all production employees were receiving five or more times the maximum acceptable concentration. It was decided to shut down the refinery until major changes in equipment and operations could be made.

A similar survey of the new Brush Beryllium Company refinery at Elmore, Ohio, conducted during the plant shakedown period, showed a large number of the 108 persons studied were being exposed to excessive concentrations of beryllium. HASL made recommendations for improving dust control. It was decided that air concentrations were not sufficiently hazardous to warrant closing the plant, but that extensive plant modifications were needed to ensure satisfactory operations.

In July representatives of HASL and the Chicago Operations Office reviewed decontamination of the AEC beryllium production plant at Luckey, Ohio. Good progress had been made in decontamination since the plant closed down in December 1957, but cleanup probably will not be completed before May 1959. HASL will continue to advise the contractor on decontamination procedures and will help perform periodic tests of certain equipment and buildings which have been decontaminated.

RADIOLOGICAL INCIDENT CENTER

A Radiological Incident Center was established at AEC headquarters in Germantown to coordinate actions required in the event of a radiation incident. The center will be active only in the event of an incident of sufficient magnitude to warrant its utilization to coordinate headquarters responsibilities in such matters as public relations and Congressional notification, and to assist the responsible field office in obtaining help to cope with the incident.

TRAINING AND EDUCATION

Summer Institutes in Radiation Biology

Negotiations were begun for the establishment of training courses in radiation biology for high school science teachers, to be held at 15 to 17 universities in the summer of 1959. Similar summer institutes were held at 12 universities in 1958. These institutes in radiation biology are supported by the AEC in cooperation with the National Science Foundation (NSF) under an arrangement whereby the AEC contracts with the universities offering the courses and the NSF assists the teachers attending the institutes. In its over-all program for summer institutes for 1959 the NSF will support 300 institutes presenting courses in science and mathematics. (End of UNCLASSIFIED section.)

Part IX

International Activities

INTERNATIONAL COOPERATION (UNCLASSIFIED)

International Atomic Energy Agency

The Second Annual General Conference of the International Atomic Energy Agency (IAEA) opened September 22 and was still in session at the end of the month. Chairman McCone, head of the United States delegation, proposed a six-point program for the IAEA:

1. A program of training and research leading to increased use of radioisotopes,

2. Development of international health and safety standards and regulations, procedures for the accountability of material, and measures to solve the third-party liability problem,

3. Establishment of the IAEA as a central coordinating body for the training of nuclear scientists,

4. Research projects to be financed by the United States and carried out in member countries under contracts with the IAEA,

5. A long-range program to assist members in obtaining power facilities, and

6. Continued development of the IAEA as a center for the collection and distribution of scientific information.

Mr. McCone's statement was generally well received as a reaffirmation of strong United States support for the IAEA.

The Board of Governors of the IAEA submitted to the General Conference a proposed program and budget for calendar year 1959. The budget totaled $6,725,000, of which $1,500,000 was for fellowships, equipment grants, and construction of a radioisotope laboratory in Vienna. The $1,500,000 was to be funded through voluntary contributions of member states, while the remaining $5,225,000 was to be funded according to the IAEA assessment formula. The United States pledged $500,000 to the voluntary fund, plus up to $250,000 to match all other contributions after the fund reached a total of $1,000,000.*

Negotiations continued during the quarter on the agreement for cooperation between the IAEA and the United States. A subcommittee of the Board of Governors was also considering agreements with the United Kingdom and the USSR. In September the Board of Governors approved draft agreements for cooperation with five international organizations: International

* The General Conference approved the program and budget for 1959 in October.

Labor Organization, Food and Agriculture Organization, World Meteorological Organization, World Health Organization, and United Nations Educational, Scientific, and Cultural Organization. The board also approved the creation of a Scientific Advisory Committee responsible to the Director General.

The first of the two mobile radioisotope training laboratories to be donated to the IAEA by the United States was presented at the Second General Conference after having been displayed at the Geneva Conference.

A three-man IAEA team visited Pakistan late in July for general consultations on the Pakistani atomic energy program. The team consisted of J. T. Weills of Argonne National Laboratory, H. A. C. McKay of the Atomic Energy Research Establishment at Harwell, and Ole Pedersen, Danish IAEA staff member.

The IAEA mission to Latin America completed its assignment on July 17. The mission visited 17 Central and South American countries, was cordially received everywhere, and appeared to have fulfilled its objective of evaluating prospects for atomic energy training and development in Latin America.

At the end of September, 69 nations were participating members of the IAEA.

European Atomic Energy Community

In September, representatives of the United States and the European Atomic Energy Community (Euratom) met in Brussels to begin organization of the joint nuclear power program and to negotiate certain changes in the agreement for cooperation to reflect the views expressed by Congress. In August, the general international agreement between the United States and Euratom had been approved by Congress, and the necessary legislation to implement the joint program had been enacted, including authorization and appropriation of $3 million to start the research and development program in fiscal year 1959. The revised agreement for cooperation with Euratom will be placed formally before the Joint Committee on Atomic Energy in January 1959.

The United Kingdom appointed A. H. Tandy as its representative to Euratom, the European Common Market, and the European Coal and Steel Community. Mr. Tandy succeeded Sir William Meiklereid, who is retiring.

Negotiations between the United Kingdom and Euratom continued during the quarter. The projected United Kingdom–Euratom agreement is expected to be a broad political convention, providing a basis for commercial contracts for the sale of British power reactors and for cooperation in nuclear research.

Organization for European Economic Cooperation

An AEC team visited Belgium in July to discuss further details of cooperation between the United States and the Organization for European Economic Cooperation (OEEC) in connection with the processing plant to be constructed at Mol, Belgium, by the European Company for the Chemical Processing of Irradiated Fuel (Eurochemic). It was planned that United States assistance would include the long-term assignment of a design consultant, and shorter visits by United States personnel to Mol and by Eurochemic personnel to the United States.

Representatives of the AEC and the Department of State continued to assist the OEEC in its efforts to solve the third-party liability problem. Discussions also continued regarding the scope of United States cooperation in OEEC reactor projects. At the request of the OEEC, preliminary discussions were held in Geneva in August and September regarding the feasibility of a heavy water reactor project in Sweden and the possibility of United States cooperation in this project.

At a meeting held in Paris in June to study the feasibility of constructing a heavy water production plant in Iceland, it was concluded that (1) more technical and site information would be needed and (2) a small standing committee of experts on heavy water processes and industrial construction should be formed to collect and evaluate required data.

On July 22 the statute of the European Nuclear Energy Agency was amended to permit Spain to become an associate member.

AGREEMENTS FOR COOPERATION

With the coming into force of the research agreement with Ireland on July 9, there were 42 bilateral agreements for cooperation in effect with 40 countries; 30 of these were for research and 12 were for power. On September 30 there were, in addition, 3 research and 4 power agreements awaiting ratification.

The research agreement with Brazil was amended to increase the maximum quantity of uranium that can be provided to Brazil under the agreement from 6 to 15 kilograms of contained uranium 235 at 20 percent enrichment. The research agreement with Denmark was amended to permit the transfer of 90-percent-enriched material for use in a research reactor.

Activities Pertaining to Agreements for Cooperation

Australia. As a result of requests made by Australia for more extensive information exchange, consideration was being given to amending the agreement for cooperation with that country to include transfer of classified information on fuel element fabrication, chemical processing, and the fast reactor and sodium reactor programs. It was planned to provide Australia with an edited declassification guide and to explore the possibility of an exchange of personnel.

Austria. The Government of Austria requested amendment of its research agreement to permit the transfer of 90-percent-enriched material. An informal draft of an amendment was submitted to the Austrian Embassy. (End of UNCLASSIFIED section.)

DELETED

Following this meeting a review of the French military and atomic energy security programs was initiated by representatives of the AEC, the Department of Defense, and the Department of State. The French were advised that any further action looking toward cooperation in the submarine propulsion field would have to await the results of this review. (End of [redacted] section.)

Israel (UNCLASSIFIED). During the quarter, Brookhaven began fabrication of a slow neutron chopper for sale to Israel on a government-to-government basis.

Japan. The power agreement with the United States, signed on June 16, was to be considered in a special session of the Diet which convened late in September. This agreement was to receive the particular attention of five key members of the Japanese Diet, the chairman and

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four members of the Science and Technology Committee. This committee is analogous to the United States Joint Committee on Atomic Energy.

An amendment to the United States–Japan power agreement was prepared, which provides that special nuclear material produced in Japanese reactors fueled with materials acquired from the United States and purchased by the United States under its option, will be used for peaceful purposes only. Although it has been the policy of the United States, as stated in a public announcement by the President on November 18, 1956, that materials so acquired will be used solely for peaceful purposes, there was criticism in Japan of the comprehensive agreement with the United States because of the lack of an explicit guarantee in the body of the agreement. This amendment will also increase by 250 grams the research quantities of plutonium which the Japanese may obtain from the United States and will permit transfer of highly enriched uranium to fuel research and testing reactors.

The Japanese have shown interest in the United States–Euratom joint program. They have asked if the United States is prepared to offer a similar program to Japan on a bilateral basis, especially with respect to the deferred payment for initial fuel inventory and the fuel cycle guarantee. The Japanese were referred to the October 1956 announcement that Export-Import Bank loans were available for the export of nuclear power plants on terms similar to those extended for conventional power plants. They were also reminded of the fact that the Euratom program was designed specifically to meet unique circumstances, and of the initiative taken by the Euratom countries in formulating the program. The Japanese were told that any joint programs of this type with other nations or international groups would have to be tailored individually to the political, technological, and economic circumstances.

Philippines. The Philippine Government formally notified the Department of State and the AEC that it plans to "vigorously prosecute" its research reactor project. In 1955 the United States offered to provide the Philippines with a research reactor, and Congress authorized the expenditure of $500,000 for this purpose.

Spain. The Spanish Nuclear Energy Board signed a contract with Atomics International for design studies for the projected 20,000-electrical-kilowatt testing and experimental power reactor. If it is decided to build such a plant in Spain, the dollar costs are likely to become the subject of a loan request.

Switzerland. Arrangements were made to transfer to the University of Geneva the AGN-201 training reactor exhibited by the AEC at the commercial exhibit held in Geneva in conjunction with the Second International Conference on the Peaceful Uses of Atomic Energy. The University of Basel completed arrangements for purchase of the AGN-211 research and training reactor being displayed at the Brussels World's Fair until November 1.

Venezuela. The Venezuelan Government notified the AEC in August that it was ready to proceed with consideration of the power agreement negotiated with the former government of Venezuela in 1957. Signing ceremonies were scheduled for October 8.

Research reactor grants. Payment of a $350,000 research reactor grant was made to the Federal Republic of Germany in July for the 1,000-kilowatt pool-type research reactor at Munich built by AMF Atomics. This was the second actual payment made under the research reactor program; commitments had been made for a total of 16 grants as of September 30.

A request was received from the Government of Iran for a grant to cover part of the cost of a 1,000-kilowatt pool-type research reactor. The University of Tehran signed a contract with AMF Atomics for the construction of this reactor. Processing of the request for a grant awaited the coming into effect of the United States–Iran research agreement, which was signed in 1957 but had not yet been ratified by Iran. (End of UNCLASSIFIED section.)

OTHER FOREIGN ACTIVITIES

DELETED

Brazil (UNCLASSIFIED). The first radioisotope produced in South America (180 millicuries of iodine 131) was presented to officials of the University of Minas Gerais at ceremonies held in August in Sao Paulo. The radioisotope was produced in the 5,000-kilowatt pool-type Sao Paulo research reactor, which went into operation in January 1958.

An agreement for cooperation for the peaceful uses of atomic energy was signed by Brazil and Italy on September 6. This agreement provides for the following, insofar as the domestic legislation and international commitments of both parties permit:

1. Exchange of unclassified technical information,
2. Reciprocal assistance in research,
3. Exchange of scientists and technicians for teaching and observation purposes,
4. Collaboration of Italian personnel in prospecting for uranium and thorium in Brazil, and
5. Eventual arrangements for Italian processing, for Brazil, of Brazilian atomic minerals.

The agreement, which will be effective for 3 years and renewable automatically for like periods, is accompanied by a letter in which the limitations placed on Italy's actions by its treaty obligation to Euratom are explained and acknowledged.

Canada. Following the May 24 accident, decontamination of the National Research Universal (NRU) reactor building was carried out, and NRU was brought back into operation August 15 at an initial power level of 100 kilowatts. The reactor was operated in the 1,000- to 2,000-kilowatt range while the fuel elements of the drawn sheath type were being replaced by elements of the bonded sheath (extrusion clad) type. The refueling took place at a rate of five to six elements a day and was completed by the end of September. Full-power operation was scheduled for October. NRU is the world's largest research and testing reactor, with a design power level of 200,000 kilowatts.

The National Research Experimental (NRX) reactor resumed operation August 8, after having been shut down since July 17 because of an accidental spill of irradiated cobalt pellets.

Atomic Energy of Canada Limited (AECL), expressed interest in leasing heavy water from the United States in accordance with the new AEC policy. AECL needs about 30-35 tons for the projected ZEEP-II reactor at Chalk River and apparently feels it would be advantageous to lease the heavy water, rather than to purchase it. ZEEP-II is to be built for the purpose of studying lattice arrangements for large power reactors and will have served its major purpose within 5 years after its completion.

El Salvador. The United States agreed to assist the School of Medicine of the University of El Salvador in establishing a medical radioisotope program. It was expected that the International Cooperation Administration would make available to El Salvador approximately $13,000 worth of nuclear equipment.

France. The Commissariat a l'Energie Atomique (CEA) announced that its proton synchrotron "Saturne" went into operation at Saclay in August. This accelerator, which produced proton energies of 2.5 billion electron volts in its first test, is one of the largest in operation.

It was reported that Japanese officials intend to hold discussions with the important French chemical firm, Air Liquide, on possible assistance in prospecting for and working Japan's uranium ore resources, as well as assistance in setting up plants to produce heavy water.

The second French plant to produce uranium concentrates was reported to be in full operation near Limoges in central France. The initial capacity of the plant was 200,000 tons of ore per year, with a scheduled increase to 600,000 tons by the end of 1959. A 150,000-ton plant has been in operation since July 1957 near Clisson in western France. The capacity of this plant was to be doubled by October 1958.

Germany. A draft bill on atomic insurance was submitted to the German Cabinet. This bill would provide for compensation up to a maximum of 500 million marks (about $120 million) for damage not covered by existing insurance, arising from a reactor accident.

An agreement for cooperation between Germany and the United Kingdom was reported to be under negotiation in Bonn. This agreement would cover matters not included in the Euratom—United Kingdom agreement.

Ireland. After a 2-year study, the Irish Atomic Energy Committee submitted to its government a report on the Irish atomic energy program. The committee recommended (1) expansion of research on uses of radioisotopes, (2) keeping close watch on power reactor developments, (3) a 1,000-kilowatt pool-type research reactor as the most suitable type for Ireland at the present time, and (4) establishment of an "Atomic Energy Board" which would be responsible for the research reactor and the Irish atomic energy program in general.

Italy. On August 31 the British Nuclear Power Plant Company and the Societa Italiana Meridionale per l'Energia Atomica (SIMEA) signed a contract for the construction of a 200,000-electrical-kilowatt Calder Hall-type atomic power station at Latina, south of Rome. Completion is scheduled for late 1962.

The International General Electric Company was selected by the Societa Elettronucleare Nazionale (SENN) to build its projected power reactor in southern Italy.

New Zealand. New Zealand expressed interest in obtaining a contract from the United States for the sale of uranium from the recently discovered deposits in the Buller area of South Island. New Zealand was advised that the prospects for concluding such a contract at this time were not promising.

Philippines. The Philippine Congress enacted the Science Act of 1958, which placed the Philippine atomic energy program under the direction of a National Science Development Board, the chairman of which was given broad powers. The Science Act of 1958 also established a Philippine Atomic Energy Commission, headed by a single commissioner who reports to the board.

United Kingdom. On July 24, the United Kingdom Atomic Energy Authority (UKAEA) publicly released its "Fourth Annual Report of Activities," covering the year ending March 31, 1958. The report shows that on March 31, 1958, the UKAEA had 23 reactors operable or in advanced stages of construction, with 13 actually in operation. Ten of those in operation are

research and testing reactors of various types at the United Kingdom Atomic Energy Research Establishment at Harwell, while the remaining three are part of the dual-purpose Calder Hall station.

The third and final report of the committee appointed to examine the Windscale incident last year was published early in July. The UKAEA decided to abandon the damaged Windscale No. 1 reactor, but had made no decision regarding disposition of the undamaged No. 2 reactor.

TECHNICAL EXCHANGE AND ASSISTANCE

United States–United Kingdom Cooperation

During the July-September quarter United States teams visited the United Kingdom for classified and unclassified discussions on standard Calder Hall fuel element technology and unclassified discussions on shielding and ruthenium chemistry. United Kingdom representatives visited the Argonne National Laboratory for classified discussions on graphite temperature coefficients and xenon instabilities. One of these representatives visited Hanford for unclassified discussions on the Physical Constants Test Reactor.

The first meetings pursuant to the new United States–United Kingdom agreement for cooperation on the uses of atomic energy for mutual defense purposes were held in Washington, D. C., in August and in Albuquerque in September. (See Part III–Weapons.)

Seventeen United States representatives were authorized to attend conferences on controlled thermonuclear research in the United Kingdom before and after the Geneva Conference. Preliminary proposals were under consideration for the exchange of United States and United Kingdom personnel engaged in controlled thermonuclear research for extended assignments.

United States–Canada Cooperation

A number of visits were exchanged and conferences held with Canada on process development, heavy water power reactors, the NRU incident, shipments of NRX and NRU fuel elements, low-temperature neutron irradiation, the joint sheath program, and the actinium and radium programs.

United States–Australia Cooperation

Professor J. P. Baxter, Chairman of the Australian Atomic Energy Commission, visited AEC headquarters and field installations for discussions on the United States–Australian agreement for cooperation, nuclear power, and the Combined Development Agency contracts for the output of the Rum Jungle and Radium Hill operations.

Pre- and Post-Geneva Conference Discussions

A number of AEC staff members and contractor representatives attended discussions in the United Kingdom, Belgium, France, and other countries, in their fields of interest, before and after the Second International Conference on the Peaceful Uses of Atomic Energy, held in Geneva September 1–13. These discussions included classified meetings in Belgium and the United Kingdom on feed materials and physical metallurgy, and classified discussions in the United Kingdom on fuel fabrication technology, reactor physics, and chemical processing.

International Congress of Industrial Chemistry

Representatives of the AEC participated in the Thirty-first International Congress of Industrial Chemistry, held in Liege, Belgium, September 7–18. Two United States papers were presented.

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NS *Savannah* Training Program

As a result of inquiries by Germany, Norway, and Sweden into the possibility of their representatives observing the construction of the NS *Savannah*, consideration was being given to setting up a training course for 15–20 foreign nationals who are experienced marine engineers or the equivalent. This course would start early in 1959 and would be the same as the training program for the engineering officers of the NS *Savannah*, which was to start in the fall of 1958.

Heavy Water for India

In accordance with the new AEC policy permitting lease of heavy water to foreign and domestic users, the Government of India was informed that the United States could now act favorably on its request for 15 tons of heavy water for use in Zerlina, the zero energy research reactor being built at Trombay.

Technical Documents Exchange

During the July-September quarter, 56 classified and privileged documents were received from foreign countries: 31 from the United Kingdom and 25 from Canada. The United States transmitted 61 documents: 19 to the United Kingdom, 16 to Canada, 12 to Belgium, 9 to Australia, and 5 to the Netherlands.

Visit Summary

During the quarter, 46 United States scientists participated in 32 classified conferences in foreign countries, while 8 United Kingdom and Canadian representatives attended 3 classified meetings in the United States.

On an unclassified basis, arrangements were made during the quarter for 202 individuals representing 29 foreign countries to visit AEC field installations. Included in this total were two 12-man teams of Japanese industrial technicians sponsored by the International Cooperation Administration.

TRAINING AND EDUCATION

Puerto Rico Nuclear Center

The Puerto Rico Nuclear Center's first 1-year program in nuclear science and engineering, leading to a master of science degree, started in July at temporary facilities provided by the University of Puerto Rico. The Center, developed with the cooperation of the University of Puerto Rico to offer instruction and training in Spanish, also offers a 4-week radioisotope techniques training course. Reactor and laboratory facilities being constructed to provide better instruction will be completed in 1960.

Training Courses

The number of foreign nationals receiving nuclear energy training in AEC installations continued to increase during the July-September quarter.

The International School of Nuclear Science and Engineering (ISNSE) at Argonne National Laboratory and the 4-week radioisotope training course given by the Oak Ridge Institute of Nuclear Studies were filled to capacity, although the backlog of pending applications was cut down, partly as a result of the growth of the Puerto Rico Nuclear Center. The eighth session of ISNSE began on September 17 with an enrollment of 7 students from the United States and

50 students from 18 foreign countries. Attending this session are 10 participants sponsored by the International Atomic Energy Agency.

Three new courses open to foreign nationals were organized during the quarter. The course in radiochemical and radiation counting procedures to be given by the Health and Safety Laboratory of the New York Operations Office was scheduled to start on October 6. The laboratory is prepared to offer up to four sessions of this 6-week course each year, to about six students per course.

The other two new courses are to be given at the Oak Ridge National Laboratory starting in February 1959. The reactor hazards evaluation course is a 12-month course, while the reactor supervisors course is a 9-month course. Ten to 15 students can be accommodated in each course.

In addition to the formal courses offered by the AEC, special training is arranged for foreign students at other AEC installations, such as the University of California Radiation Laboratory and Brookhaven National Laboratory. The AEC also gives counsel on an individual basis to students seeking further study in nuclear science and technology in United States colleges, universities, hospitals, research institutions, and industrial plants.

DISARMAMENT

The conference of technical experts proposed by President Eisenhower to study methods of detecting violations of a possible agreement on the suspension of nuclear tests concluded its work on August 21. The meeting began on July 1 in Geneva and was attended by a delegation of Western scientists from Canada, France, the United Kingdom, and the United States and by delegations of scientists from Czechoslovakia, Poland, Romania, and the USSR.

The conference agreed unanimously to a final report which discussed basic methods for detection and identification of nuclear explosions, technical equipment of a control system, and conclusions on the nature of a control system. It was concluded that "it is technically feasible to set up with certain capabilities and limitations a workable and effective control system for the detection of violations of a possible agreement on the worldwide cessation of nuclear weapons tests."

On August 22 the President announced that the United States was prepared to enter negotiations for an agreement for the suspension of nuclear weapons tests and the actual establishment of an international control system, and that the United States was also prepared, "unless testing is resumed by the Soviet Union, to withhold further testing on its part of atomic and hydrogen weapons for a period of one year from the beginning of the negotiations." The President proposed October 31, 1958, as a date for beginning negotiations. On August 29, Premier Khrushchev announced that the USSR was prepared to begin negotiations on the date proposed by President Eisenhower.

The USSR also accepted a United States proposal for experts to meet in Geneva to discuss the technical aspects of preventing surprise attack. The USSR suggested November 10, 1958, as a starting date for the talks.

INTERNATIONAL MEETINGS

United Nations Scientific Committee on the Effects of Atomic Radiation

The report of the United Nations Scientific Committee on the Effects of Atomic Radiation was released to the public on August 10. An AEC statement commenting favorably on the re-

port was released at the same time. The AEC concurred in a recommendation of the Department of State that the United States support the continuation of the Scientific Committee.

Topical Conferences

AEC financial support in the amount of $6,325 was given to an unclassified conference on "Stopping Power," held at Gatlinburg, Tennessee, September 15–18. The National Science Foundation gave equal support to this conference, which dealt with the penetration of charged particles in matter and was attended by about 50 scientists representing 12 countries.

Second International Conference on the Peaceful Uses of Atomic Energy

The Second United Nations International Conference on the Peaceful Uses of Atomic Energy, held in Geneva, Switzerland, September 1–13, was the greatest scientific gathering of its kind ever convened. A total of 6,300 persons, including 2,700 accredited delegates from 69 countries and 9 specialized agencies of the United Nations, 3,600 official observers from 46 countries, and 911 accredited representatives of information media in 36 countries, participated in the sessions held in the United Nations' European headquarters in the Palais des Nations on the outskirts of Geneva.

The primary function of the Conference was the exchange of scientific and technical information. The growing volume of this information on the peaceful uses of atomic energy was demonstrated by the fact that more than twice as many papers were submitted in 1958 as were offered in 1955. Delegates from 48 governments and six intergovernmental organizations submitted 2,135 papers on all phases of nuclear science and technology. Even by scheduling five series of parallel technical sessions, the United Nations was able to allow time for the oral presentation of only 722 papers in 77 technical sessions during the 2-week period. All papers will be printed in the Proceedings of the Conference, which will be published by the United Nations in the spring of 1959.

The technical sessions were supplemented by an impressive array of technical exhibits prepared by 20 nations and displayed in a temporary exhibit building containing 90,000 square feet of floor space constructed on the Palais grounds especially for the Conference. The United Nations also sponsored the showing of more than 50 films provided by nine nations, at regularly scheduled hours during the Conference.

United States participation. The United States made a major contribution to every phase of the Conference. More than 700 of the 2,135 technical papers were submitted by the United States, as were 231 of the 722 papers presented orally. The United States was the only nation to present at least one oral paper in every one of the 77 technical sessions at the Conference.

Equally impressive was the United States contribution to the Technical Exhibit which was viewed by more than 100,000 persons during the 2-week period. The United States exhibit occupied roughly almost half of the total exhibit area utilized by the 20 nations represented. Every field of nuclear science and technology was included in the United States area exhibits. Most impressive to both the scientists and the general public was the large number of full-sized operating laboratory devices and experimental equipment, including two research and training reactors, a computer facility, a radioisotope laboratory, a hydrogen bubble chamber, a whole-body radiation counter, and seven experimental devices for research on controlled thermonuclear reactions.

The technical books, pamphlets, and films displayed by the United States also provided a large and significant body of technical information on the peaceful uses of atomic energy. At the Technical Information Center in the United States exhibit, scientists stood three abreast in lines waiting to receive more than 30,000 copies of technical literature distributed during the

Conference. The United States also gave the chief representatives of each country a 13-volume set of technical books written especially for the Conference.

The United States supplied 17 of the 51 technical films presented by the United Nations and also exhibited 28 short films on specialized subjects in four small theaters in the United States exhibit to more than 15,000 persons in 1,550 showings.

The United States furnished two of the six outstanding scientists who delivered lectures on topics of general interest on three evenings during the Conference.

Again, as in 1955, the United States participated in the Commercial Exposition sponsored by the city and canton of Geneva in the downtown area of Geneva during the Conference. More than 50 private companies engaged in the atomic energy industry in the United States joined the Atomic Energy Commission in assembling one of the largest exhibits presented by the 13 nations represented.

Conference organization. United Nations plans for the second Geneva Conference were formulated by the Secretary-General's Advisory Committee, on which the United States was represented by Dr. I. I. Rabi, Higgins Professor of Physics at Columbia University, who served in a similar capacity at the 1955 Conference.

Officers of the Conference, who presided at the opening and closing general sessions, were: President, Dr. Francois Perrin, French High Commissioner for Atomic Energy; Vice Presidents, Cesar Lattes (Brazil), Dr. W. B. Lewis (Canada), Dr. H. J. Bhabha (India), Academician V. S. Emelyanov (USSR), Sir John Cockcroft (United Kingdom), and Dr. I. I. Rabi (United States).

Administrative direction of the Conference was provided for the United Nations by Dr. Sigvard Eklund (Sweden), Conference Secretary-General, and Homi N. Sethna (India), Deputy Secretary-General.

The United States was represented at the Conference by 463 accredited delegates. Chairman of the United States delegation was Lewis L. Strauss, Special Assistant to the President on Atomic Affairs and former Chairman of the Atomic Energy Commission. Dr. Willard F. Libby, member of the Atomic Energy Commission, served as Vice Chairman. Other chief representatives were James R. Killian, Jr., Special Assistant to the President for Science and Technology; Robert McKinney, United States representative to the International Atomic Energy Agency; and Dr. Rabi. Special advisors to the United States chief representatives were Dr. Shields Warren, United States representative to the United Nations Scientific Committee on the Effects of Atomic Radiation, and John A. McCone, Chairman, Atomic Energy Commission.

Seven members of the Joint Committee on Atomic Energy served as special advisors to the United States Delegation: Representative Carl T. Durham, Chairman of the Joint Committee, Senator John O. Pastore, Senator Bourke B. Hickenlooper, and Representatives Craig Hosmer, James T. Patterson, Melvin Price, and James E. Van Zandt. Other Members of Congress who served as special advisors in Geneva were Representatives Frank J. Becker, A. S. J. Carnahan, John H. Dent, Peter Freylinghuysen, Jr., William J. Green, Walter H. Judd, Ludwig Teller, John M. Vorys, and William B. Widnall.

United States participation in the Conference was directed by Edward R. Gardner, Executive Director of the United States Delegation, and Director, Office of Special Projects, Atomic Energy Commission. Assisting him as Deputy Executive Director was Richard C. Hagan, Office of International Conferences, Department of State. The United States technical program at Geneva was planned and executed by Dr. L. D. P. King of the Los Alamos Scientific Laboratory, who served as Technical Director. The public information program for the United States

Delegation was directed by Luther Reid of the Department of State. Howard C. Brown, Jr., of the Division of Biology and Medicine, Atomic Energy Commission, served as Director for Administration. A total of 571 persons, not including local hires, was required to carry out the United States presentation.

Results of the Conference. In the opinion of the United States representatives and of spokesmen of many countries, the Conference was an outstanding success in bringing together for the use of all the nations of the world information on the scientific and technical advances made in the peaceful uses of atomic energy since the 1955 Conference. A vast amount of new technical information on all phases of peaceful uses of atomic energy was revealed. Although the Conference produced no sensational news of scientific "breakthroughs," it did supplement the world's store of technical data on the peaceful uses of atomic energy with information unknown or unavailable in 1955. New and promising uses of atomic energy were brought to light, and the tremendous increase in atomic energy activity in all parts of the world was described. The Conference served to temper the impression, widespread at the time of the 1955 Conference, that the production of economic power from fission and fusion would be obtained quickly. Although the delegates from many nations expressed their confidence in the ultimate achievement of economic power from the fission process, and even later from the fusion process, several of the smaller countries announced that earlier plans for the construction of nuclear power plants had been reduced in scope or extended further into the future. At the same time, however, the large and serious representation at the 1958 Conference from nations desirous of establishing their own programs demonstrated the ever-widening interest in attainment of economic civilian atomic power.

A detailed report on the Conference will be included in the Commission's Twenty-fifth Semiannual Report to the Congress.

The success of the Second Geneva Conference led to informal discussions of the desirability of a third scientific meeting of this type. While some delegates expressed the opinion that the Conference was too large and too ambitious in attempting to cover all of the rapidly growing field of atomic energy, many more recognized the great value of a general conference in bringing together scientists from many nations and disciplines. By the time the Conference closed it appeared that a third conference was a strong probability, with only the date to be determined. Francois Perrin, the Conference President, suggested that a third conference be held in 4 years, provided that satisfactory means could be found to limit its size. In their closing press conference, the United States chief representatives stated that they would recommend to their Government "that steps be taken at the next meeting of the appropriate agency of the United Nations to propose another conference of this general character in another three-year period." (End of UNCLASSIFIED section.)

Appendix A

CONSTRUCTION PROGRESS SCHEDULES

STATUS OF PRINCIPAL AEC FACILITIES UNDER CONSTRUCTION

Project name and location	Percent construction completion						Construction dates		Current estimated cost (in millions of dollars)
	Actual		Scheduled				Start	Scheduled or actual completion	
	June 30, 1958	Sept. 30, 1958	Dec. 31, 1958	Mar. 31, 1959	June 30, 1959	Sept. 30, 1959			
SPECIAL NUCLEAR MATERIALS									
OAK RIDGE									
Reduction of fire hazards, gaseous diffusion plants, Oak Ridge, Paducah, and Portsmouth (Phase I)	1	6	*Schedule being developed*				June 1958	*Sept. 1959*	12.7
ST. LOUIS									
Feed materials expansion	99	99	*100*				Mar. 1955	*Dec. 1958*•	61.8
SAVANNAH RIVER									
Productivity improvement and tritium facilities expansion programs	66	75	*80*	*84*	*85*	*86*	Dec. 1955	*Dec. 1961*•	98.5
Reactor areas	86	91	*93*	*94*	*94*	*94*	Dec. 1955	*Dec. 1961*•	25.9
Separation areas	60	68	*77*	*83*	*86*	*87*	Dec. 1955	*Dec. 1961*•	46.4
Feed materials	52	52	*52*	*53*	*55*	*56*	June 1956	*June 1961*•	14.7
Process development facilities	86	86	*86*	*86*	*86*	*87*	Feb. 1956	*June 1960*•	3.1
General site	58	91	*98*	*99*	*100*		May 1956	*June 1959*•	9.4
WEAPONS									
LIVERMORE									
Weapons development and engineering facilities	42	61	*82*	*93*	*97*	*99*	Jan. 1957	*Nov. 1959*	12.7
OAK RIDGE									
[redacted]	78	85	*90*	*93*	*97*	*99*	Aug. 1956	*Nov. 1959*	20.7
REACTOR DEVELOPMENT									
CAMDEN									
NS *Savannah* propulsion system	18	28	*45*	*63*	*73*	*85*	Feb. 1956	*Jan. 1960*	22.3
CHICAGO									
Fuels technology center	1	3	*Schedule being developed*				June 1958	*Oct. 1960*	17.0
ELK RIVER									
Elk River reactor—RCPA		1	*Schedule being developed*				Aug. 1958	*Dec. 1960*	9.3
HANFORD									
Plutonium recycle test reactor	1	4	*10*	*16*	*28*	*47*	Mar. 1958	*Aug. 1960*	15.0
IDAHO									
Large ship reactor	89	94	*99*	*100*			Apr. 1956	*Jan. 1959*	35.0

Large ship reactor	89	94	99	100			Apr. 1956	Jan. 1959	36.0
Modifications, additions and expansion, ANP-GE	26	29	32	35	43	56	Oct. 1956	Oct. 1960*	23.0
Flight engine test facility, ANP-GE	34	55	60	76	90	96	Sept. 1957	Dec. 1959	13.0
Experimental breeder reactor–II	3	7	20	40	59	79	Dec. 1957	Sept. 1960	29.1
NEVADA TEST SITE									
Nuclear rocket propulsion test facilities, phase I–Project ROVER	84	94	100				May 1957	Dec. 1958*	9.9
Nuclear rocket propulsion test facilities, phase II–Project ROVER		1	Schedule being developed				Sept. 1958	June 1960	9.8
Nuclear ramjet propulsion test facilities, phase II–Project PLUTO			Schedule being developed				Oct. 1958	Aug. 1959	6.3
SCHENECTADY									
Submarine advanced reactor	98	100					Oct. 1955	Aug. 1958*	23.2
Destroyer reactor plant		1	8	14	29	36	Aug. 1958	Oct. 1960*	35.0
WINDSOR									
Small submarine reactor	28	52	85	97	100		Feb. 1957	June 1959	13.8
PHYSICAL RESEARCH									
BROOKHAVEN									
Alternating gradient proton-synchrotron	42	47	61	72	81	87	Mar. 1954	July 1960	31.0
CAMBRIDGE									
Cambridge electron accelerator	21	32	54	73	84	92	Nov. 1956	Mar. 1960	8.2
PRINCETON									
Model "C" stellarator buildings	3	21	38	62	92	100	Feb. 1958	Sept. 1959*	8.6
Princeton proton accelerator	16	20	38	55	71	81	Sept. 1957	Jan. 1960	11.2
BIOLOGY AND MEDICINE									
BROOKHAVEN									
Medical research center	96	99	100				June 1956	Dec. 1958*	8.8
ADMINISTRATIVE AND OTHER									
GERMANTOWN									
Headquarters building addition	77	99	100				Sept. 1957	Oct. 1958*	3.3
PUERTO RICO									
Puerto Rico nuclear center		1	Schedule being developed				July 1958	June 1960*	3.0

*Completion date revised since preceding report.

Note: Costs shown are only those accruing to the AEC. In some instances projects shown are a part of larger budgeted items, or are a combination of two budgeted items.