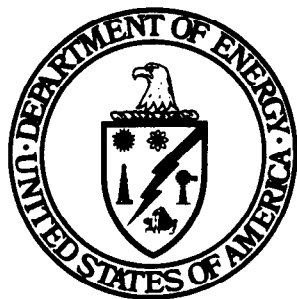


# **A HISTORY OF THE ATOMIC ENERGY COMMISSION**

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## Introduction

Almost a year after World War II ended, Congress established the United States Atomic Energy Commission to foster and control the peacetime development of atomic science and technology. Reflecting America's postwar optimism, Congress declared that atomic energy should be employed not only in the Nation's defense, but also to promote world peace, improve the public welfare, and strengthen free competition in private enterprise. After long months of intensive debate among politicians, military planners and atomic scientists, President Harry S. Truman confirmed the civilian control of atomic energy by signing the Atomic Energy Act on August 1, 1946.(1)

The provisions of the new Act bore the imprint of the American plan for international control presented to the United Nations Atomic Energy Commission two months earlier by U.S. Representative Bernard Baruch. Although the Baruch proposal for a multinational corporation to develop the peaceful uses of atomic energy failed to win the necessary Soviet support, the concept of combining development, production, and control in one agency found acceptance in the domestic legislation creating the United States Atomic Energy Commission.(2)

Congress gave the new civilian Commission extraordinary power and independence to carry out its awesome responsibilities. Five Commissioners appointed by the President would exercise authority for the operation of the Commission, while a general manager, also appointed by the President, would serve as chief executive officer. To provide the Commission exceptional freedom in hiring scientists and professionals, Commission employees would be exempt from the Civil Service system. Because of the need for great security, all production facilities and nuclear reactors would be government-owned, while all technical information and research results would be under Commission control, and thereby excluded from the normal application of the patent system.

In addition, the Act provided for three major advisory committees: a Congressional Joint Committee on Atomic Energy, a Military Liaison Committee, and a General Advisory Committee of outstanding scientists.(3)

## The First Commission

On January 1, 1947, the fledgling Atomic Energy Commission took over from the Manhattan Engineer District the massive research and production facilities built during World War II to develop the atomic bomb. The facilities were the product of an extraordinary mission accomplished in three years in almost complete secrecy. Under the direction of General Leslie R. Groves of the Army Corps of Engineers, the laboratory experiments of Enrico Fermi and other American and European scientists had been transformed into operating plants capable of producing a military weapon of devastating power. When the atomic bomb was dropped on Hiroshima on August 6, 1945, and three days later on Nagasaki, not only was a long and costly war brought to an end, but the world also became aware of a completely new and largely unexpected technology.(4)

As the first chairman of the agency created to control the peacetime development of the new technology, President Harry Truman appointed David E. Lilienthal, a lawyer

and former head of the Tennessee Valley Authority. During the preceding year, Lilienthal and Under Secretary of State Dean Acheson had co-authored the well-known Acheson-Lilienthal report which had formed the basis for the American plan for international control of atomic energy. Serving with Lilienthal on the Commission were Sumner T. Pike, a businessman from New England, William T. Waymack, a farmer and newspaper editor from Iowa, Lewis L. Strauss, a conservative banker and reserve admiral, and Robert F. Bacher, a physicist from Los Alamos and the only scientist on the Commission. Carroll L. Wilson, a young engineer who had helped Vannevar Bush organize the National Defense Research Committee during the war, was appointed general manager. Two floors of the New War Department Building in Washington provided a temporary home for the Commission. A few months later more permanent headquarters were found at 19th and Constitution Avenue, N.W., in the former wartime offices of the Joint Chiefs of Staff.

The new Commission faced a challenging future. World War II was quickly followed by an uneasy international situation commonly referred to as the Cold War, and Lilienthal and his colleagues soon found that most of the Commission's resources had to be devoted to weapon development and production. The requirements of national defense thus quickly obscured their original goal of developing the full potential of the peaceful atom. For two decades military-related programs would command the lion's share of the Commission's time and the major portion of the budget.(5)

## The Nuclear Arsenal

To meet the Nation's expanding requirements for fissionable material the Commission set about refurbishing the production and research facilities built during the war. A major overhaul of the original reactors and two new plutonium reactors were authorized for the Hanford, Washington plant. Oak Ridge was scheduled for an addition to the existing K-25 plant and a third gaseous diffusion plant for the production of uranium 235. The Commission decided to adopt the Army's practice of hiring private corporations to operate plants and laboratories, thereby extending into peacetime the contractor system previously used by the Government only in times of national emergency.

The first test of new weapons was conducted at Enewetak Atoll in April and May 1948. Operation *Sandstone* explored weapon designs and tested a new fission weapon to replace the clumsy tailor-made models used during World War II. By 1948 the Commission had both gun-type and implosion-type non-nuclear and nuclear components in stockpile and was well on the way toward producing an arsenal of nuclear weapons.

In early September 1949 a special Air Force unit detected a large radioactive mass over the Pacific, indicating that the Soviet Union had successfully detonated a nuclear device. The Soviet detonation not only ended the United States' monopoly of nuclear weapons, but also had an immediate effect on the Commission's planned expansion program. During the prolonged debate which followed the announcement of the Soviet event, Commissioner Lewis L. Strauss, supported by fellow Commis-

sioner Gordon Dean, urged the Commission to take a "quantum jump" by developing a thermonuclear weapon. Strong support for the Strauss' position came from the Congressional Joint Committee on Atomic Energy, and from scientists such as Edward Teller, Luis W. Alvarez, and Ernest O. Lawrence, who agreed that the development of the superbomb was absolutely essential to the security of the United States. The members of the General Advisory Committee, however, while concurring in the need for giving high priority to the development of atomic weapons for tactical purposes, recommended against an all-out effort to develop a hydrogen bomb. On January 31, 1950, President Truman settled the issue with his momentous decision that the Commission should expedite work on the thermonuclear weapon.(6)

### Production Expansion

David Lilienthal resigned on February 15th after three years as chairman of the Atomic Energy Commission. Although his dream of developing the full potential of the peaceful atom had not been fulfilled, the Commission under his leadership had become an effective government institution. Indeed, the future held great promise for the peaceful atom, but for the moment at least the military atom would continue to be in the ascendancy.

By mid July 1950 Gordon Dean had become chairman of the Commission, and the Nation was no longer in a twilight zone between peace and war. Following an attack by North Korean troops across the 38th parallel, President Truman ordered U.S. forces to the aid of South Korea. Suddenly increased military demands, added to the President's decision to develop the hydrogen bomb, threatened to exhaust the Commission's production capacity. Beginning in October 1950 the Commission embarked on a vast expansion program. During the next three years the construction of huge plants increased capacity at each step in the production chain. The new facilities included a feed materials production center at Fernald, Ohio; a plant to produce large quantities of lithium 6 at Oak Ridge; a gaseous-diffusion plant at Paducah, Kentucky; a whole new gaseous diffusion complex at Portsmouth, Ohio; two "Jumbo" reactors and a separation plant for producing plutonium at Hanford; and five heavy-water reactors at the Savannah River site in South Carolina for producing tritium from lithium 6 as well as plutonium. The three year three-billion-dollar expansion program represented one of the greatest federal construction projects in peacetime history.

In addition to having an impact on the Commission's expansion program, the Korean War also focused attention on the need for a continental test site. In December 1950, with the approval of the Department of Defense and the General Advisory Committee, the Commission selected the Las Vegas bombing and gunnery range as the site to conduct the January 1951 *Ranger* test series, the first atomic tests in the United States since the *Trinity* detonation at Alamogordo on July 16, 1945.(7)

The United States detonated the world's first thermonuclear device in the fall of 1952. Code-named *Mike*, the shot was part of the *Ivy* test series conducted at Enewetak. By the end of 1953 more than thirty weapon test devices had been successfully fired at Pacific or Nevada sites, the

result of extraordinary efforts by scientists and engineers at the Commission's Los Alamos weapon laboratory. A second weapon laboratory established at Livermore, California in early 1952, soon became the center of a weapon engineering and production network which included the Sandia Laboratory near Albuquerque, New Mexico, as well as new or expanded facilities in Iowa, Texas, Missouri, Ohio, and Colorado.(8)

### Organizing the National Laboratories

Fortunately the concentrated effort on weapon production did not mean a total neglect of the Commission's research laboratories. The Commission recognized the need to maintain the vitality of the national labs, and to encourage the university research teams and industry groups whose research on the peaceful uses of atomic energy would provide the technology of the future. The Metallurgical Laboratory at the University of Chicago had been reorganized by the Army in 1946 as the Argonne National Laboratory. The following year the Commission obtained a new site for the lab at Argonne, Illinois and determined that the laboratory should become a large multidisciplinary research center for the midwest. Under the direction of Walter H. Zinn, one of Enrico Fermi's principal assistants in developing the world's first reactor, Argonne very quickly became the Commission's center for reactor development.(9)

The Clinton Laboratories, built during World War II at Oak Ridge, Tennessee, became the regional research center for southeastern United States. Reorganized in 1948 as the Oak Ridge National Laboratory, Oak Ridge became the Nation's largest supplier of radioisotopes for medical, industrial and physical research, as well as a regional center for research in chemistry, physics, metallurgy, and biology. The laboratory also conducted the largest radiation genetics program in the world.

To provide regional research facilities for the northeast, the Commission approved a plan by Associated Universities, Inc. to build and operate a laboratory at Upton, New York. The Brookhaven National Laboratory provided research facilities in reactor physics, high-energy accelerators, and the biomedical sciences. A fourth center in the far west was established by expanding the facilities of the University of California Radiation Laboratory at Berkeley. In addition to the regional centers the Commission continued to support the wartime research laboratories at a number of colleges and universities, and awarded and administered hundreds of contracts with research institutions, universities and nonprofit organizations for basic research in the physical and biological sciences.(10)

### Reactor Development

Although by 1953 the vast production complex of the Atomic Energy Commission was almost totally dedicated to military purposes, the idea of a civilian nuclear power system based on American industry was very much alive. As early as 1947, Lilienthal had publicly encouraged a partnership with industry in developing the peaceful uses of atomic energy. The Commission had supported a modest but coherent plan for developing nuclear power and propulsion and had permitted a few industry committees

behind the Commission's security barriers to evaluate the opportunities for commercial development. On December 20, 1951, at the Commission's Idaho Test station, Zinn and a group of engineers from the Argonne National Laboratory succeeded in producing a token amount of electricity from an experimental fast breeder reactor. This historic accomplishment demonstrated in a practical way that the atomic nucleus could serve mankind as a source of power.(11)

Probably the most successful reactor program in the 1950's was the naval reactors project established and directed by Admiral Hyman G. Rickover. On June 14, 1952, at the keel-laying ceremony for the world's first nuclear powered ship, Chairman Gordon Dean noted that the propulsion of the submarine *Nautilus* would be the first practical utilization of atomic power, heretofore used primarily as an explosive. The Navy project later played a significant role in the widespread adoption of pressurized-water reactors by the nuclear power industry in the United States.(12)

By the end of 1952, technological developments had generated a broad interest in nuclear power in Congress as well as in industry, and the election of a Republican president brought further encouragement. Indeed, there was soon reason for optimism. Two outstanding accomplishments of the Eisenhower years, the 1953 Atoms-for-Peace plan, and the passage of the 1954 Atomic Energy Act were to have a significant impact on the Nation's nuclear program.(13)

### **Atoms for Peace**

Speaking before the United Nation's General Assembly on December 8, 1953, President Dwight D. Eisenhower declared that "peaceful power from atomic energy is no dream of the future. . .that capability, already proved, is here today."(14) The President's Atoms-for-Peace proposal became a major pronouncement of America's public policy concerning the international management of nuclear energy. With a sufficient supply of uranium to satisfy its own military needs, by 1954 the United States could turn its attention to the promotion of the peaceful uses of nuclear energy.(15)

Lewis Strauss had been President Eisenhower's special assistant for atomic energy prior to his appointment as Commission chairman in July 1953. Strongly committed to national security during his early years as a Commissioner, and supportive of Truman's decision to expedite the development of the thermonuclear weapon, Strauss was now in a position to work closely with Eisenhower in promoting the peaceful atom on a world-wide basis.

### **The Atomic Energy Act of 1954**

The President's Atoms-for-Peace speech also focused attention on the need for a fundamental revision of the Atomic Energy Act of 1946 to enable the Commission to share technical and scientific information with foreign governments. On February 17, 1954, the President asked Congress to pass legislation "making it possible for American atomic energy development, public and private, to play a full and effective part in leading mankind into a new era of progress and peace." Exhaustive hearings in the spring of 1954 and Congressional debate during the

early summer resulted in a new law which opened the door for an exchange of nuclear technology with other nations. Although industry did not gain the right to own fissionable material, liberal licensing provisions, greater access to technical data, and the right to own reactors provided the essential conditions for the private development of nuclear power in the United States.(16)

### **The Five Year Plan**

Even before Congress had passed the Atomic Energy Act of 1954, the Commission had launched a new program for power reactor development. In early 1954 Strauss announced plans to test the basic designs then under study by building five experimental reactors within five years. Of the five reactor prototypes planned, the one with the most immediate impact on nuclear power development was the Pressurized Water Reactor (PWR) at Shippingport, Pennsylvania. Based on the technology developed for nuclear propulsion systems for submarines, Shippingport was completed on schedule in late 1957 as the Nation's first full-scale nuclear generating station.

The other reactor experiments constructed under the five year program included the Sodium Reactor Experiment built by North American Aviation, a Commission contractor in southern California; the Experimental Boiling Water Reactor constructed at the Commission's Argonne National Laboratory; and new models of the fast breeder and homogeneous reactor experiments built in the early 1950's at the National Reactor Testing station in central Idaho, and the Oak Ridge National Laboratory in Tennessee. Of the five experiments in the program, the Shippingport and the Argonne boiling-water reactors encountered fewer technical problems, but each experiment contributed to the development of the technology needed to build full-scale nuclear power plants in the future.

### **Cooperation with Industry**

The terms of the Atomic Energy Act enabled the Commission to encourage private industry to build its own nuclear plants, using fissionable material leased from the Government. Industry responded to the Commission's January 1955 Power Demonstration Reactor Program with four proposals covering all but one of the Commission's five prototypes. Thus by the end of 1957, the Commission had seven experimental reactors in operation and American industry was participating in nine independent or cooperative projects capable of producing almost 800,000 kilowatts of electricity by the mid-1960's. For the moment at least, prospects for the future of the peaceful atom were extremely encouraging.(17)

### **International Participation**

In his Atoms-for-Peace proposal of December 8, 1953, President Eisenhower had proposed that the nuclear powers contribute portions of their stockpiles of normal uranium and fissionable materials to an international atomic energy agency, which would then allocate these materials toward peaceful uses. After three years of patient diplomatic negotiations, the International Atomic Energy Agency (IAEA) was formally inaugurated in Vienna, Austria on October 1, 1957. As head of the United States

delegation to the first IAEA conference, Lewis Strauss delivered the President's message of hope that the fissioned atom would now be transformed from a symbol of fear to one of hope. The new spirit of international cooperation had been in evidence even earlier when more than 1400 scientists from 73 nations attended the first United Nations sponsored International Conference on the Peaceful Uses of Atomic Energy, held in Geneva, Switzerland in August 1965. Similar conferences were held in 1958, 1964 and 1971.

In addition to sponsoring the International Atomic Energy Agency, the United States gave strong support to *Euratom*, the European atomic energy community consisting of West Germany, France, Italy, Belgium, the Netherlands and Luxembourg. Formally inaugurated in January 1958, *Euratom* undertook to establish an integrated program for developing an atomic energy industry in Europe similar to the European Coal and Steel Community. Prior to the establishment of either the International Atomic Energy Agency or *Euratom*, the Atomic Energy Commission had negotiated a series of bilateral agreements to provide research reactors, power reactor fuel and technical information to friendly nations, as well as training programs for nuclear scientists and technicians. Although no bilateral agreements were made with the Soviet Union, Commission Chairman John A. McCone and his Soviet counterpart, Professor Vasily S. Emelyanov, signed a Memorandum on Cooperation on November 24, 1959, covering exchanges of visits and information on several unclassified areas of peaceful nuclear application. Similar memoranda in the 1960's and early 1970's covered joint experiments in the fields of high energy physics, controlled thermonuclear research and fast breeder reactors.(18)

### Weapon Testing and Fallout

The detonation of the first shot in the *Castle* weapon test series in the spring of 1954, however, had threatened to cast a shadow over the glowing prospects for the peaceful atom, so recently kindled by Eisenhower's atoms-for-peace proposal. At the time of the *Bravo* shot on March 1, a Japanese fishing vessel had been within 82 nautical miles of the test area, close enough to receive a heavy dusting of radioactive fallout. By the time the ship, the *Fukuryu Maru* (or *Lucky Dragon*) returned to Japan the effects of the radiation exposure had become evident, and several members of the crew required hospitalization. The American and Japanese press accounts of the incident had made the public aware, probably for the first time, of the worldwide dangers of radiation from fallout.(19)

On February 15, 1955, with the approval of the President, Strauss released a major report on the "Effects of High-Yield Nuclear Explosions." The report did little to calm public apprehension, and mounting concerns found expression in numerous articles on radiation and fallout in scientific journals and other public media. Both the Committee on Armed Services and the Joint Committee on Atomic Energy held hearings in the spring of 1955 on problems associated with radioactive fallout. The following December the United Nations established a Scientific Committee on Radiation with the former director of the Commission's Division of Biology and Medicine, Shields Warren, as United States' representative.(20)

In January 1956 Commissioner Willard F. Libby revealed the existence of Project Sunshine, a study of global fallout from weapon testing which Libby had initiated in the fall of 1953 while serving on the General Advisory Committee. Commission laboratories and contractors had been analyzing data collected through a worldwide network monitoring the presence of strontium 90 in humans, foods and soils. Prior to 1953 public concern with radiation had focused primarily on workers in atomic energy projects. In 1957 the Joint Committee's hearings on the nature of radioactive fallout revealed for the first time the extent of the Commission's radiation research program. Millions of dollars were involved in more than 300 Commission-sponsored projects on various aspects of radiation and fallout.(21)

Testing of nuclear devices by the United States continued throughout the 1950's, although the Eisenhower Administration repeatedly expressed its willingness to suspend nuclear tests as part of a disarmament agreement. When the Conference of Experts convened in Geneva in the summer of 1958, the President announced that the United States was prepared to negotiate a test ban agreement and would voluntarily suspend all weapon testing after the completion of the *Hardtack* series in the fall. As a result an unpoliced moratorium period began on October 31, 1958, during which both the United States and the Soviet Union refrained from nuclear weapon experiments.(22)

### Limited Test Ban Treaty

Three years later the Soviet Union abruptly ended the moratorium by announcing, on August 31, 1961, that they intended to resume testing. By now John F. Kennedy was in the White House, and Glenn Seaborg had succeeded John McCone as chairman. One of the original members of the General Advisory Committee and the first scientist appointed as chairman of the Commission, Seaborg served during the entire decade of the 1960's.

Although the Soviet Union tested a large number of high-yield weapons in the atmosphere during the autumn of 1961, President Kennedy limited the Commission's weapon laboratories to underground tests until April 25, 1962, when the first shot in the *Dominic* series was conducted at Christmas Island in the Pacific. With technical support from Seaborg and the Commission, the President at the same time had been earnestly pursuing a test ban agreement with the Soviet Union. It had been a long and arduous task bearing little fruit. In an address to the Nation on March 2, 1962, Kennedy had explained that he deplored the necessity of beginning atmospheric testing again, but "a nation which is refraining from tests obviously cannot match the gains of a nation conducting tests."(23)

Finally, after months of negotiations, a limited test ban treaty was signed in Moscow on August 5, 1963, prohibiting nuclear explosion tests in the atmosphere, outer space, or under water, but permitting underground detonations provided no radioactive debris crossed the borders of the country in which the test was being conducted.

In the absence of further success in negotiating a comprehensive test ban treaty, President Kennedy, and later Presidents Johnson and Nixon, continued to authorize

underground tests in accordance with the 1963 treaty. Although the limitations of the treaty imposed severe technical problems, particularly in testing high-yield warheads, the Commission's laboratories nevertheless were highly successful in devising ways to improve and update nuclear weapons by testing underground.

### **Civilian Power: The Proliferation of the Peaceful Atom in the Sixties**

The signing of the Limited Test Ban Treaty in August 1963 also had an impact on the civilian power program. The cessation of weapon testing in the atmosphere gave new hope that the peaceful atom might soon command as large a share of the Commission's time and budget as the military atom had for so many years.

Although the imminence of economic nuclear power had been a main theme at the 1958 Geneva Conference, recurring technical difficulties in many of the prototype and demonstration plants in several European countries continued in the next few years to frustrate hopes for a practical new source of electrical power. In the United States, however, prospects were somewhat more encouraging. In March 1962 President Kennedy had requested the Atomic Energy Commission to take a "new and hard look at the role of nuclear power" in the Nation's economy. In submitting the Commission's report several months later, Seaborg noted optimistically that the Commission's ten-year civilian power program, adopted in 1958, was on the threshold of attaining its primary objective of competitive nuclear power by 1968. Suggested goals for the future included a concentration of resources in the most promising reactor systems, the early establishment of a self-sufficient and growing nuclear power industry, and increased emphasis on the development of improved converter or breeder reactors which would conserve natural uranium resources. The report was broadly circulated and stimulated public confidence in the economic prospects for civilian nuclear power.(24)

On November 22, 1963, Lyndon B. Johnson became President of the United States. One of Johnson's first and probably most significant acts was to order a 25 percent cutback in production of enriched uranium and the shut down of four plutonium piles, with the expectation that other nations might be challenged to do the same. Although verification was difficult, Chairman Khrushchev later announced production cutbacks in the Soviet Union.

Another milestone in civilian power development occurred on December 12, 1963, when the Jersey Central Power and Light Company announced that it had contracted for a large nuclear power reactor to be built at Oyster Creek near Toms River, New Jersey. According to the company's own evaluation, the plant would be competitive with a fossil fuel plant. For the first time an American utility company had selected a nuclear power plant on purely economic grounds without government assistance and in direct competition with a fossil-fuel plant. In a commencement address at Holy Cross College on June 10, 1964, President Johnson called it an "economic breakthrough."(25) Two months later private industry received further encouragement from Congress in the form of new legislation.

### **Private Ownership Legislation**

On August 26, 1964, President Johnson brought to an end an eighteen-year mandatory government monopoly of special nuclear materials by signing into law the "Private Ownership of Special Nuclear Materials Act." Enriched uranium for power reactor fuel would no longer have to be leased from the government. Private entities would be permitted to assume title to special nuclear materials. Although the new law provided for a transition period for the changeover from government to private ownership, after June 20, 1973 private ownership of power reactor fuels would become mandatory. The Act also authorized the Commission to offer uranium enriching services to both domestic and foreign customers under long-term contracts, beginning on January 1, 1969. Most of the Atomic Energy Commission's literature on reactor technology had been declassified as early as 1955. With the adoption of the Private Ownership Act in 1964, fissionable materials as well as reactors now entered the public domain, and a full-fledged nuclear industry became a possibility.(26)

But how would a full-fledged nuclear industry be regulated? Could one agency continue to regulate a single energy technology in a time of increasing energy needs? In a few years the energy crisis of 1973 would bring these questions into sharp focus.

### **Nuclear Power Capacity**

The Commission's 1962 report on civilian power had projected 5,000 megawatts of nuclear power capacity by 1970 and 40,000 by 1980. Within five years the outlook had changed so dramatically that in March 1967 the Commission issued a supplementary report doubling its previous predictions. Within a few years, however, even these revised statistics were exceeded. (By the end of 1974 two hundred and thirty-three nuclear central-station generating units, with a capacity of 232,000 megawatts, were either in operation, under construction, or on order in the United States.)(27)

### **The Breeder Reactor**

In addition to predicting dramatic increases in megawatt capacity, the Commission's 1967 report on civilian nuclear power reaffirmed the promise of the breeder reactor for meeting long-term energy needs, and gave the Liquid Metal Fast Breeder Reactor (LMFBR) the highest priority for civilian reactor development. A major boost was given to the program four years later by President Richard Nixon. In his "clean energy" message to Congress on June 4, 1971, the President called for the commercial demonstration of a breeder reactor by 1980, stating that "The breeder reactor could extend the life of our natural uranium fuel supply from decades to centuries, with far less impact on the environment than the power plants which are operating today."(28)

The fast breeder project included a demonstration plant in Oak Ridge, Tennessee—the Clinch River Breeder Reactor (CRBR)—and a test reactor in Richland, Washington—the Fast Flux Test Facility (FFTF). Clinch

River promised to be a major step in the transition from technology to large-scale demonstration of the fast breeder concept. The project was launched in August 1972 with the signing of a memorandum of understanding between the Commission and the principal utility participants, the Commonwealth Edison Company and the Tennessee Valley Authority. The Commission would be responsible for research and development of the demonstration plant while the Commonwealth Edison Company and the Tennessee Valley Authority would engineer, manufacture and proof test equipment and systems.(29)

### Licensing and Regulation

Under the terms of the Atomic Energy Act of 1954, Congress had given the Atomic Energy Commission the responsibility for regulating and licensing commercial atomic activities. As the Nation's electric power industry increasingly turned toward nuclear plants, the Commission found it necessary to modify its organizational structure to separate regulatory from non-regulatory functions. In 1961 the regulatory staff was separated from the General Manager's office and placed under a Director of Regulation who reported directly to the Commissioners. Two years later the regulatory and operational functions were separated physically when the regulatory staff was moved from the headquarters building in Germantown, Maryland to offices in Bethesda.(30)

Licensing procedures involved a series of technical reviews and public hearings, including an independent technical safety evaluation by the Advisory Committee on Reactor Safeguards. The Commission itself served as a final review board for all licenses granted, and maintained continuous surveillance of licensed reactors throughout their operating lifetime.

### Research

The weapon requirements for national defense in the early years had forced the Commission to postpone goals for an all-out program of research on the peaceful atom. As seen in the development of the power reactor, however, there was a gradual shift in emphasis during the Eisenhower era, and the trend continued to gain momentum during the Kennedy and Johnson Years. In 1966 the AEC budget for the first time was divided about equally between weapons and peaceful uses.

Research and development programs in the 1960's and early 1970's produced a significant fund of knowledge about radiation and its effects, and provided basic data needed to determine radiation protection standards and to assess the environmental impact of nuclear technology. Advances in medical diagnostic techniques based on the use of radioisotopes and radiation machines added to the skills of the medical profession, while immunological research provided the knowledge needed for successful transplants. Other medical breakthroughs included the treatment of Parkinson's Disease, the preservation of cells for transfusion, and the introduction of small accelerators to produce short-lived radioisotopes for immediate use in patients. Although Oak Ridge produced virtually all of the radioisotopes available for physical and biomedical as well as for industrial applications, the Commission gradually

transferred production, packaging, and shipping to commercial suppliers, while continuing to support research on new applications.(31)

During the 1960's the Commission produced a series of radioisotope-powered and reactor-powered electrical-generating units for space applications. The first such unit was launched into space from Vandenberg Air Force Base in California on April 3, 1965, under the Systems for Nuclear Auxiliary Power (SNAP) program. Newly discovered heavy isotopes, such as Californium-252, were found useful in both research and industry. In addition, significant progress was made in developing cardiac pacemakers for human use and ultimately artificial hearts using radioisotopic-power sources.(32)

Major research facilities such as high energy accelerators were constructed and operated by the AEC. Building on the accomplishments of the Berkeley Bevatron and the Brookhaven Cosmotron in the 1950's, the Commission supported even larger accelerators in the 1960's and 1970's, including the Alternating Gradient Synchrotron at Brookhaven, the Zero Gradient Synchrotron at Argonne, and the two-mile long Stanford Linear Accelerator. The Fermi National Accelerator Laboratory, completed in 1972, contained the world's most powerful proton synchrotron. The principal centers for research on controlled thermonuclear (fusion) reactors were Oak Ridge, Los Alamos, Livermore, and Princeton, although many universities and industrial facilities were involved on a smaller scale.

### Applied Technology

As nuclear technology developed, the Commission perfected special applications of nuclear power, such as nuclear explosives for earth moving and for extracting resources deep underground. *Gnome*, the first experiment in the *Plowshare* series, was conducted in December 1961 in a thick salt bed deposit near Carlsbad, New Mexico, while the first nuclear cratering experiment, *Project Sedan*, was completed the following July at the Nevada Test Site. *Project Gasbuggy* in 1967, *Rulison* in 1969, and *Rio Blanco* in 1973, tested methods for extracting natural gas from impermeable rock. In the early 1970's, the Commission directed applied technology projects toward environmental research, energy storage and transmission systems, synthetic fuels, and nonnuclear energy.

### Nonnuclear Research

The scientific and technological expertise gained by the national laboratories in developing nuclear energy made the Commission a logical contender for a strong role in developing new energy options. The doors of the national labs first opened to nonnuclear research in 1960 when the Commission, in a special report to the Joint Committee on Atomic Energy, acknowledged "that the strong capabilities of the laboratories are not the exclusive resources of the atomic energy field; they are held in trust for the Nation as a whole." Accordingly, work from other federal agencies would be accommodated whenever the skills of the national laboratories were needed.(33)

On August 11, 1971, largely in response to President Nixon's energy message of June 4, Congress authorized the Atomic Energy Commission to undertake research and



development projects geared to providing a variety of alternatives for meeting the Nation's energy needs. As a result the Commission's industrial contractors and national laboratories became involved in the areas of superconducting power transmission systems, energy storage, solar energy, geothermal resources, and coal gasification.(34)

### Reorganization

James R. Schlesinger took over the helm of the Atomic Energy Commission in August 1971, as its twenty-fifth year as an agency was drawing to a close. American troops were still in Vietnam and anti-war protests were widespread. The Nation faced increasing demands for energy, a leveling out of domestic oil production, limitations on coal use due to environmental concerns, inadequate natural gas supplies, and field delays in the licensing and construction of nuclear power plants. The rapid growth in atomic energy activities in the previous decade and changing perspectives in nuclear technology clearly pointed to the need for a substantial reorganization of the Commission's operational and regulatory functions. For nearly a quarter of a century the Commission had focused research and development toward responding to national defense requirements, funding and developing new uses for atomic energy, and fostering the growth of a competitive and viable nuclear industry. The next few years would see increasing attacks on the Commission's role as a regulatory overseer of the nuclear industry, particularly in the areas of quality of product and public safety.(35)

As a first order of business, Schlesinger led the Commission in a comprehensive review of the agency's functions and organization. An economist and former assistant director of the Bureau of the Budget, Schlesinger announced the results of the review in December 1971. The first broad reorganization in ten years would bring together various related programs previously scattered throughout the agency. Developmental and operational functions formerly under the jurisdiction of the general manager would now be under six assistant general managers for Energy and Development Programs, Research, Production and Management of Nuclear Materials, Environment and Safety Programs, National Security, and Administration. Reflecting expanding areas of Commission involvement were new divisions of Controlled Thermonuclear Research, International Security Affairs, and Applied Technology.(36) The second half of 1971 also saw a major revamping of the regulatory organization and functions.

### Calvert Cliffs Decision

The Nixon Administration believed that nuclear power, as an environmentally "clean" fuel, could help the Nation produce the increasing supply of energy needed for the future. On the other hand ponderous licensing procedures and increasing environmental considerations lengthened the time necessary to bring nuclear power plants on line, and increased costs to the industry, and ultimately to the consumer. As Commissioner Doub informed the Atomic Industrial Forum in October 1971, the Commission harbored no illusions as to the magnitude of the task of trying to match "the capabilities of a dynamic and complex technology to the urgent energy and environmental needs of the country."(37)

The Federal Court of Appeals' August 4, 1971 landmark decision concerning the Calvert Cliffs nuclear power plant became a pivot point for a major revamping of the Commission's licensing procedures. The Court ruled that the Atomic Energy Commission's regulations for implementing the National Environmental Policy Act of 1969 in licensing procedures did not comply in several respects with the Act, and that the Commission should make an independent review and evaluation of all environmental effects at every decision point in the nuclear power plant licensing process.

Moving swiftly to implement the Court's ruling, the Commission made substantive changes in environmental review procedures. Both the Commission and the license applicant would now be required to consider the total impact of the proposed plant on the environment, including water quality. In addition, a cost-benefit analysis would balance the benefits of building the facility against a variety of alternatives.(38) These changes in procedures affected virtually all nuclear power plants whether licensed for operation or under review.

To expedite the additional procedures which the Calvert Cliffs decision required, Schlesinger made significant changes in the Commission's regulatory organization, and added additional personnel to the staff to help with the expanded reactor licensing workload. Additional changes in 1972 further streamlined the regulatory staff. Three directors consolidated the functions previously performed by seven divisions. All licensing activities were centered in the largest of the three, the Directorate of Licensing, headed by John F. O'Leary, former Director of the Bureau of Mines.(39)

### The Commission's Last Days

Schlesinger left the Atomic Energy Commission in January 1973 to become head of the Central Intelligence Agency. He was succeeded as chairman by Dr. Dixy Lee Ray, a marine biologist from the state of Washington who had been appointed to the Commission by President Nixon in August 1972. The first woman to be chairman of the Atomic Energy Commission, Ray took over at a time when the Nation was faced with the monumental task of reconciling energy needs, environmental concerns and economic goals. More importantly for the Commission, criticism had begun to mount against an agency that regulated the very same energy source that it helped to produce and operate.

In June 1973, President Nixon directed the chairman of the Atomic Energy Commission to undertake an immediate review of federal and private energy research and development activities and to recommend an integrated program for the Nation.(40) The President's energy proposals to Congress the following January reflected the recommendations submitted by Chairman Ray in the December 1, 1973 report on "The Nation's Energy Future." Because of the energy crisis resulting from the October Arab oil embargo, the President had chosen to break tradition and present his energy request to Congress before delivering his State of the Union address. Both his proposal for a five-year \$10 billion energy research and

development program, and his determination to double the total federal commitment to energy research and development for fiscal year 1975, were in line with the recommendations made by the Commission chairman. The Ray report also supported the President's recommendation to establish an Energy Research and Development Administration.(41)

## Reactor Safety

In December 1973 the Commission announced new requirements for the performance of the emergency core cooling systems (ECCS) installed in light-water-cooled power reactors. Such systems provided the capability for emergency removal of heat from the reactor core in the event of a loss of the normal reactor coolant water. The Commission's action concluded a two-year public rule-making hearing which had served as a focal point for public discussion of opposing viewpoints on the safety of nuclear power plants. Six months of hearing sessions, between January 27, 1972 and July 25, 1973, had produced a voluminous transcript, a clear witness to the complexity of the technical issues involved in nuclear safety. A constant advocate of the public's right to know and fully understand the possible dangers of radiation, the Joint Committee on Atomic Energy had also held a hearing in early 1973 on the safety of nuclear power plants.

Clearly the handwriting on the wall was spelling out the numbered days of the AEC in 1973. Although nuclear power constituted a significant part of the answer to the Nation's need for additional sources of energy, it was by no means the only answer as had been predicted in the early decades of the Commission's existence.

## Summary

When President Ford signed the Energy Reorganization Act of 1974 on October 11, the Atomic Energy Commission's twenty-eight year stewardship of the Nation's nuclear energy program came to an end. On January 19, 1975, the Commission's research and development responsibilities were assumed by the Energy Research and Development Administration, and the regulatory and licensing functions by the Nuclear Regulatory Commission. Six thousand, three hundred and twenty Commission employees went to ERDA while one thousand nine hundred and seventy former regulatory personnel became part of the new Nuclear Regulatory Commission.

In the preceding twenty-eight years the Atomic Energy Commission had accomplished a large portion of the mission established by the Congress in 1946. First, through its weapon laboratories and production contractors, it had developed and stockpiled an array of sophisticated nuclear weapons which for nearly three decades had served as an important element in national defense. Also in the area of defense, the Commission had supported the development of nuclear propulsion reactors which made possible the creation of a fleet of reliable nuclear submarines and surface ships.

Although for many years military related programs commanded the major portion of the budget, the Commission had initiated and supported extensive research in the nuclear sciences. The research contract and the national laboratory had become key instruments in the widespread

development and application of nuclear technology for scientific, medical, and industrial purposes. Through participation in the International Atomic Energy Agency, international conferences and bilateral agreements, the United States shared the new technology with other nations.

The congressional mandate of 1946 also called for the use of atomic energy in a way that would strengthen free competition in private enterprise. Although the severe restrictions of the 1946 Act made atomic energy virtually a government monopoly, the Commission in less than a decade advanced nuclear technology to the point where industrial participation was feasible, and then encouraged the passage of new legislation in 1954 which made a nuclear industry possible. By the early 1970's nuclear power offered a promising option for meeting national and world energy needs.

In carrying out the Congressional mandate of 1946, the Atomic Energy Commission essentially worked its way out of existence. After concentrating on defense commitments in the early years, the Commission then focused on the development of a viable nuclear industry, only to come under fire in the late 1960's and 1970's for being in the position of regulating the same industry it helped to create.

This difficulty had been foreseen in 1961 when the functions of the agency were divided between the General Manager and the Director of Regulation. Then in 1963 the two functions were physically separated by being housed in different geographical locations. Finally, the legal separation of the developmental and regulatory functions, requested in 1973 by the Commission itself, was accomplished by the Energy Reorganization Act of 1974. The regulatory and licensing responsibilities became the exclusive focus of a new agency headed by a five-member board, the Nuclear Regulatory Commission, while the developmental functions were placed under a single administrator in a second agency, the Energy Research and Development Administration.

In the preceding decade the Atomic Energy Commission had lost much of its privileged status with Congress and the American public. The exclusive monopoly and the mantle of secrecy had been largely removed, and no longer did atomic energy seemingly provide the perfect formula for both military defense and civilian energy needs. Regulatory restrictions and environmental concerns were a large part of the reason for the demise of the AEC, but more important was the recognition that a single technology should not be the exclusive focus of one agency. The energy crisis would now require the coordination of all major energy programs in a new research and development agency, whose primary purpose would be to assist the Nation in achieving energy independence.

As a legacy to the new agency, the Atomic Energy Commission passed on its unique production facilities, its valuable network of national laboratories, and the proven technological skills, resourcefulness, and experience of its personnel. Three years later the Energy Research and Development Administration, like the Atomic Energy Commission before it, became part of an even larger organization. On October 1, 1977 Congress created a cabinet-level Department of Energy to coordinate Federal energy policies and programs.

## FOOTNOTES

1. Sect. 1(a), Atomic Energy Act of 1946 (Public Law 585) 78th Cong. 1st sess.
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3. Dr. Richard G. Hewlett, former Chief Historian of the AEC, believes that the most influential group in the early years was not the Commission itself but its General Advisory Committee consisting of such famous scientists as J. Robert Oppenheimer, James B. Conant, Enrico Fermi and Isador I. Rabi. Richard G. Hewlett, "The Advent of Nuclear Power, 1945-1968" (Paper delivered before the American Association for The Advancement of Science, Dallas, TX, Dec. 28, 1968), p. 4 (hereafter cited as Hewlett, "The Advent of Nuclear Power").
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7. Hewlett and Duncan, *Atomic Shield*, pp. 534-35, 563-64.
8. Hewlett and Duncan *Atomic Shield*, pp. 411, 424-30, 441; "The Eisenhower Imprint," unpublished ms., Department of Energy Historian's Office, pp. 3-4; "A History of the Expansion of AEC Production Facilities," Report by the General Manager, Aug. 16, 1963, pp. 13-20.
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15. For a discussion of Atoms for Peace as an instrument of foreign policy, see Jack M. Holl, "Eisenhower's Peaceful Atomic Diplomacy: Atoms for Peace in the Public Interest" (Paper delivered before the American Historical Association, Dallas, TX, Dec. 23-30, 1977), p. 1 (hereafter cited as Holl, "Eisenhower's Peaceful Diplomacy").
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17. Joint Committee on Atomic Energy, *Current Statement of the Atomic Energy Commission on the Five-Year Reactor Development Program*, May 4, 1955 (Washington: Government Printing Office, 1955).
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20. "A Report by United States Atomic Energy Commission on Effect of High-Yield Nuclear Explosions," Appendix 7, *Eighteenth Semiannual Report of the Atomic Energy Commission July 1955* (Washington: Government Printing Office, 1955), pp. 147-54; Senate Committee on Armed Services, *Civil Defense Program*, 84th Cong., 1st Sess., Feb. 22, 1955, p. 2; Joint Committee on Atomic Energy, *Health and Safety Problems Associated with Atomic Explosions*, April 15, 1955; AEC, *Major Activities in The Atomic Energy Programs, January-June 1956*, p. 16.
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- 179-80. Richard G. Hewlett, "Nuclear Weapon Testing and Studies Related to Health Effects: An Historical Summary" (unpublished ms., Oct. 1980), pp. 43-44.
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  27. AEC, *Civilian Nuclear Power, The 1967 Supplement to the 1962 Report to the President*, February, 1967; AEC, *1974 Annual Report to Congress*, p. 239.
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  31. AEC, *1974 Annual Report to Congress*, (Washington: Government Printing Office, 1974), pp. 24-26.
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  40. Richard M. Nixon, "Statement," June 29, 1973 in *Executive Energy Documents*, pp. 49-55; Statement by Dixy Lee Ray, Chairman of the AEC, AEC Press Release R-274, June 29, 1973.
  41. *The Nation's Energy Future*, A Report to President Richard M. Nixon, December 1973 (Washington: Government Printing Office, 1973) p. ix; "Proposals to Deal with the Energy Crisis," Jan. 23, 1974, in *Executive Energy Documents*, pp. 119-134; White House Fact Sheet, "Energy Research and Development," Oct. 11, 1973.

# APPENDIX I

## (Personnel)

### Joint Committee on Atomic Energy

<i>CHAIRMEN</i>	<i>DATES OF SERVICE</i>
Brien McMahon	1946 -
Burke B. Hickenlooper	1947 - 1948
Brien McMahon	1949 - 1952 (d. 7/28/52)
Carl T. Durham (Acting)	1952 -
W. Sterling Cole	1953 - 1954
Clinton P. Anderson	1954 - 1956
Carl T. Durham	1956 - 1958
Clinton P. Anderson	1959 -
Chet Holifield	1960 - 1961
John O. Pastore	1962 - 1964
Chet Holifield	1965 - 1966
John O. Pastore	1967 - 1968
Chet Holifield	1969 - 1970
John O. Pastore	1970 - 1972
Melvin Price	1973 -

### Military Liaison Committee

<i>CHAIRMEN</i>	<i>DATES OF SERVICE</i>
Lt. Gen. Lewis H. Brereton, USAF	1946 - 1948
Donald F. Carpenter	1948 -
William Webster	1948 - 1949
Robert F. LeBaron	1949 - 1954
Herbert B. Loper	1954 - 1960
Gerald W. Johnson	1961 - 1962
W.J. Howard	1963 - 1965
Carl Walske	1966 - 1969
Chet Holifield	1970 -
Carl Walske	1971 - 1972
Donald R. Cotter	1973 -

### General Advisory Committee

<i>CHAIRMEN</i>	<i>DATES OF SERVICE</i>
J. Robert Oppenheimer	1946 - 1952
Isidor I. Rabi	1952 - 1956
Warren C. Johnson	1956 - 1959
Kenneth S. Pitzer	1960 - 1961
Manson Benedict	1962 - 1963
L.R. Hafstad	1964 - 1967
Norman F. Ramsey	1968 -
Howard G. Vesper	1969 - 1972
Lombard Squires	1973 -

# AEC Commissioners

	<i>From</i>	<i>To</i>
Sumner T. Pike	Oct. 31, 1946	Dec. 15, 1951
David E. Lilienthal, <u>Chairman</u>	Nov. 1, 1946	Feb. 15, 1950
Robert F. Bacher	Nov. 1, 1946	May 10, 1949
William W. Waymack	Nov. 5, 1946	Dec. 21, 1948
Lewis L. Strauss	Nov. 12, 1946	Apr. 15, 1950
<u>Chairman</u>	July 2, 1953	June 30, 1958
Gordon Dean	May 24, 1949	June 30, 1953
<u>Chairman</u>	July 11, 1950	June 30, 1953
Henry DeWolf Smyth	May 30, 1949	Sept. 30, 1954
Thomas E. Murray	May 9, 1950	June 30, 1957
Thomas Keith Glennan	Oct. 2, 1950	Nov. 1, 1952
Eugene M. Zuckert	Feb. 25, 1952	June 30, 1954
Joseph Campbell	July 27, 1953	Nov. 30, 1954
Willard F. Libby	Oct. 5, 1954	June 30, 1959
John Von Neumann	Mar. 15, 1955	Feb. 8, 1957
Harold S. Vance	Oct. 31, 1955	Aug. 31, 1959
John S. Graham	Sept. 12, 1957	June 30, 1962
John Forrest Floberg	Oct. 1, 1957	June 23, 1960
John A. McCone, <u>Chairman</u>	July 14, 1958	Jan. 20, 1961
John H. Williams	Aug. 13, 1959	June 30, 1960
Robert E. Wilson	Mar. 22, 1960	Jan. 31, 1964
Loren K. Olson	June 23, 1960	June 30, 1962
Glenn T. Seaborg, <u>Chairman</u>	Mar. 1, 1961	Aug. 16, 1971
Leland J. Haworth	Apr. 17, 1961	June 30, 1963
John G. Palfrey	Aug. 31, 1962	June 30, 1966
James T. Ramey	Aug. 31, 1962	June 30, 1973
Gerald F. Tape	July 15, 1963	Apr. 30, 1969
Mary I. Bunting	June 29, 1964	June 30, 1965
Wilfred E. Johnson	Aug. 1, 1966	June 30, 1972
Samuel M. Nabrit	Aug. 1, 1966	Aug. 1, 1967
Francesco Costagliola	Oct. 1, 1968	June 30, 1969
Theos J. Thompson	June 12, 1969	Nov. 25, 1970
Clarence E. Larson	Sept. 2, 1969	June 30, 1974
James R. Schlesinger, <u>Chairman</u>	Aug. 17, 1971	Jan. 26, 1973
William O. Doub	Aug. 17, 1971	Aug. 17, 1974
Dixy Lee Ray	Aug. 8, 1972	
<u>Chairman</u>	Feb. 6, 1973	Jan. 18, 1975
William E. Kriegsman	June 12, 1973	Jan. 18, 1975
William A. Anders	Aug. 6, 1973	Jan. 18, 1975

## General Managers

Carroll L. Wilson	Dec. 31, 1946	Aug. 15, 1950
Marion Boyer	Nov. 1, 1950	Oct. 31, 1953
Kenneth D. Nichols	Nov. 1, 1953	Apr. 30, 1955
Kenneth F. Fields	May 1, 1955	June 30, 1958
Paul F. Foster	July 1, 1958	Nov. 30, 1958
A. R. Luedecke	Dec. 1, 1958	July 31, 1964
R. E. Hollingsworth	Aug. 11, 1964	Dec. 31, 1973
John A. Erlewine	Feb. 15, 1974	Dec. 31, 1974

APPENDIX I

# APPENDIX II

## Chronology

DATE	EVENTS
August 1, 1946	Atomic Energy Act of 1946 signed by President Truman.
January 1, 1947	Atomic energy program transferred from the Manhattan Engineer District to the Atomic Energy Commission.
September 1947	Start of construction on first of two new Hanford reactors.
March 1, 1948	Oak Ridge National Laboratory officially established to continue work of Clinton Laboratories established in 1943.
April-May 1948	Operation <i>Sandstone</i> , the first AEC nuclear test series conducted at Enewetak Atoll.
March 1, 1949	Announcement by AEC of selection of a site for the National Reactor Testing Station in Idaho.
August 29, 1949	Soviet Union detonated nuclear device.
January 31, 1950	President Truman directs Commission "to continue work on all forms of weapons, including the so-called hydrogen or super-bomb."
June 27, 1950	Truman orders U.S. forces to aid of South Korea.
December 20, 1951	Experimental Breeder Reactor No. 1 (EBR-1) first reactor to produce electric power from nuclear energy.
June 14, 1952	Keel of the world's first nuclear-powered ship, the submarine <i>Nautilus</i> , laid at Groton, Connecticut.
November 1952	World's first thermonuclear device detonated by U.S. at Enewetak.
December 8, 1953	Announcement by President Eisenhower of the Atoms-for-Peace program and proposal to establish an international agency to promote peaceful applications of atomic energy.
March 1, 1954	First shot in <i>Castle</i> weapon test series fired in Pacific.
August 30, 1954	President Eisenhower signed the Atomic Energy Act of 1954, a major revision of the 1946 Act. The new law made possible greater participation by private industry and more cooperation with other countries in developing the peaceful uses of nuclear energy.
January 10, 1955	Announcement by the AEC of the Power Demonstration Reactor Program, under which the AEC and industry would cooperate in the construction and operation of experimental power reactors.
August 8-20, 1955	First United Nations International Conference on the Peaceful Uses of Atomic Energy, in Geneva, Switzerland.
October 1, 1957	International Atomic Energy Agency inaugurated in Vienna, Austria. AEC Chairman Lewis Strauss announced U.S. offer to make 5,000 kilograms of uranium 235 available to the agency.
December 23, 1957	Full-power operation of the Shippingport Atomic Power Station, the world's first full-scale nuclear power plant, at Shippingport, Pennsylvania.
August 22, 1958	President Eisenhower announced moratorium on weapon testing to begin on October 31.
November 24, 1959	AEC Chairman John A. McCone and Professor Vasily S. Emelyanov signed Memorandum of Cooperation between U.S. and U.S.S.R.
March 1961	Regulatory functions separated from General Manager's Office and placed under a Director of Regulation.
August 31, 1961	Soviet Union broke moratorium and began testing nuclear weapons.
December 10, 1961	Project <i>Gnome</i> , the first Plowshare nuclear detonation, conducted in New Mexico.
April 25, 1962	First shot in <i>Dominic</i> series conducted at Christmas Island in the Pacific.
August 5, 1963	Limited test ban treaty between U.S., U.K., and U.S.S.R. signed in Moscow.
August 26, 1964	President Johnson signed Private Ownership of Special Nuclear Materials Act.
October 1964	The nuclear-powered surface ships, <i>Enterprise</i> , <i>Long Beach</i> and <i>Bainbridge</i> , completed "Operation Sea Orbit," a round-the-world cruise without logistic support of any kind.

- December 16, 1964 AEC issued a permit to Jersey Central Power and Light Company for the construction of a nuclear power plant at Oyster Creek, New Jersey. This was the first civilian power reactor to be built on a competitive basis with conventional plants and without government assistance.
- April 3, 1965 The first launching and operation of a nuclear reactor in space (SNAP-10A).
- March 5, 1970 Ratification of the Treaty for the Nonproliferation of Nuclear Weapons by the United States, the United Kingdom, and the Soviet Union and 45 other nations.
- June 4, 1971 President Nixon announced as a national goal a commitment to complete LMFBR demonstration plant by 1980.
- July 23, 1971 Calvert Cliffs decision regarding AEC licensing procedures for nuclear power plants.
- March 1972 Completion of National Accelerator Laboratory at Batavia, Illinois, world's most powerful proton synchrotron.
- October 17, 1973 Organization of Arab Petroleum Exporting Countries embargoed oil to the United States.
- December 1, 1973 AEC Chairman Dixy Lee Ray submitted report to President Nixon on "The Nation's Energy Future."
- October 11, 1974 Energy Reorganization Act of 1974 signed by President Ford.
- August 4, 1977 Department of Energy Reorganization Act signed by President Carter.



# APPENDIX III

## Laboratories and Production Facilities

### Atomic Energy Commission

<i>AEC facility</i>	<i>Location</i>	<i>Contractor-operator</i>
<b>Multiprogram Laboratories</b>		
Argonne National Laboratory .....	Chicago, Ill. ....	Univ. of Chicago and Argonne Universities Assn. Associated Universities, Inc.
Brookhaven National Laboratory .....	Upton, N.Y. ....	University of California
Lawrence Berkeley Laboratory .....	Berkeley, Ca. ....	University of California
Lawrence Livermore Laboratory .....	Livermore, Ca. ....	University of California
Los Alamos Scientific Laboratory .....	Los Alamos, N. Mex..	Nuclear Div., Union Carbide Corp.
Oak Ridge National Laboratory .....	Oak Ridge, Tenn. ....	Pacific Northwest Div. Battelle Memorial Inst.
Pacific Northwest Laboratory .....	Richland, Wash. ....	
<b>Engineering Development</b>		
Bettis Atomic Power Laboratory .....	Pittsburgh, Pa. ....	Westinghouse Electric Corp.
Hanford Engineering Development Lab. ....	Richland, Wash. ....	Westinghouse Hanford Co.
Knolls Atomic Power Laboratory .....	Schenectady, N.Y. ...	General Electric Co.
Liquid Metal Engineering Center .....	Santa Susana, Ca. ...	Atomics International Div. Rockwell Int'l Corp.
Idaho National Engineering Lab. ....	Idaho Falls, Id. ....	Aerojet Nuclear Co.
Naval Reactors Facility, INEL .....	Idaho Falls, Id. ....	Westinghouse Electric Corp.
Sandia Laboratories .....	Albuquerque, N. Mex. & Livermore, Ca. ...	Sandia Corp. (Western Electric-Bell System)
Savannah River Laboratory .....	Aiken, S.C. ....	E.I. du Pont de Nemours & Co
Shippingport Atomic Power Station .....	Shippingport, Pa. ...	Duquesne Light Co.
<b>Specialized Physical Research Laboratories</b>		
Ames Laboratory .....	Ames, Iowa .....	Iowa State U. of Sci. & Tech.
Fermi National Accelerator Laboratory .....	Batavia, Ill. ....	Universities Research Assn.
Notre Dame Radiation Lab. ....	South Bend, Ind. ....	Univ. of Notre Dame
Princeton Plasma Physics Lab. ....	Princeton, N.J. ....	Princeton University
Stanford Linear Accelerator Center .....	Palo Alto, Ca. ....	Stanford University
<b>Specialized Biomedical Research Laboratories</b>		
Comparative Animal Research Laboratory .....	Oak Ridge, Tenn. ....	University of Tennessee
Franklin McLean Memorial Research Inst, (formerly Argonne Cancer Res. Hosp.) .....	Chicago, Ill. ....	University of Chicago
Inhalation Toxicology Res. Inst. ....	Albuquerque, N. Mex.	Lovelace Foundation of Medical Education and Research
Laboratory of Nuclear Medicine & Radiobiology .....	Los Angeles, Ca. ....	Univ. of Calif. at L.A. (UCLA)
Laboratory of Radiobiology .....	San Francisco, Ca. ...	Univ. of Calif. Medical Center
MSU/AEC Plant Research Lab. ....	E. Lansing, Mich. ....	Michigan State University
ORAU Research Facilities .....	Oak Ridge, Tenn. ....	Oak Ridge Associated Universities
Puerto Rico Nuclear Center .....	Mayaguez and Rio Piedras, P.R. ....	University of Puerto Rico
Radiobiology Laboratory .....	Davis, Calif. ....	University of Calif. (Davis)
Radiobiology Laboratory .....	Salt Lake City, Utah .	University of Utah
Savannah River Ecology Lab. ....	Aiken, S.C. ....	University of Georgia
U. of Rochester Med. Lab. ....	Rochester, N.Y. ....	University of Rochester

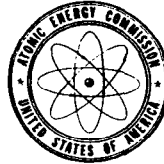
**Production, Development, and Fabrication Centers**

Burlington-AEC Plant.....	Burlington, Iowa . . . .	Mason & Hanger-Silas Mason Co., Inc.
Feed Materials Plant.....	Ashtabula, Ohio . . . .	Reactive Metals, Inc.
Feed Materials Plant.....	Fernald, Ohio . . . .	National Lead Co.
Feed Materials Plant.....	Paducah, Ky. . . . .	Nuclear Div., Union Carbide Corp.
Hanford Works . . . . .	Richland, Wash. . . . .	Atlantic-Richfield Hanford Co. and United Nuclear, Inc.
Idaho Chemical Processing Plant . . . . .	INEL, Idaho . . . . .	Allied Chemical Corp.
Kansas City Plant . . . . .	Kansas City, Mo. . . . .	Bendix Corp.
Mound Laboratory . . . . .	Miamisburg, Ohio . . . .	Monsanto Research Corp.
Nevada Test Site. . . . .	Mercury, Nev. . . . .	Reynolds Electrical & Engineering Co.; EG&G, Inc.; and Holmes & Narver Inc.
Oak Ridge Gaseous Diffusion Plant . . . . .	Oak Ridge, Tenn. . . . .	Nuclear Div., Union Carbide Corp.
Paducah Gaseous Diffusion Plant. . . . .	Paducah, Ky. . . . .	Nuclear Div., Union Carbide Corp.
Portsmouth Gaseous Diffusion Plant . . . . .	Portsmouth, Ohio . . . .	Goodyear Atomic Corp.
Pantex Plant . . . . .	Amarillo, Texas . . . . .	Mason & Hanger-Silas Mason Co. Inc.
Pinellas Plant. . . . .	Clearwater, Fla. . . . .	General Electric Co.
Rocky Flats Plant . . . . .	Golden, Colo. . . . .	Atomics International Div. Rockwell International Corp.
Savannah River Plant. . . . .	Aiken, S.C. . . . .	E.I. du Pont de Nemours & Co.
Y-12 Plant . . . . .	Oak Ridge, Tenn. . . . .	Nuclear Div., Union Carbide Corp.

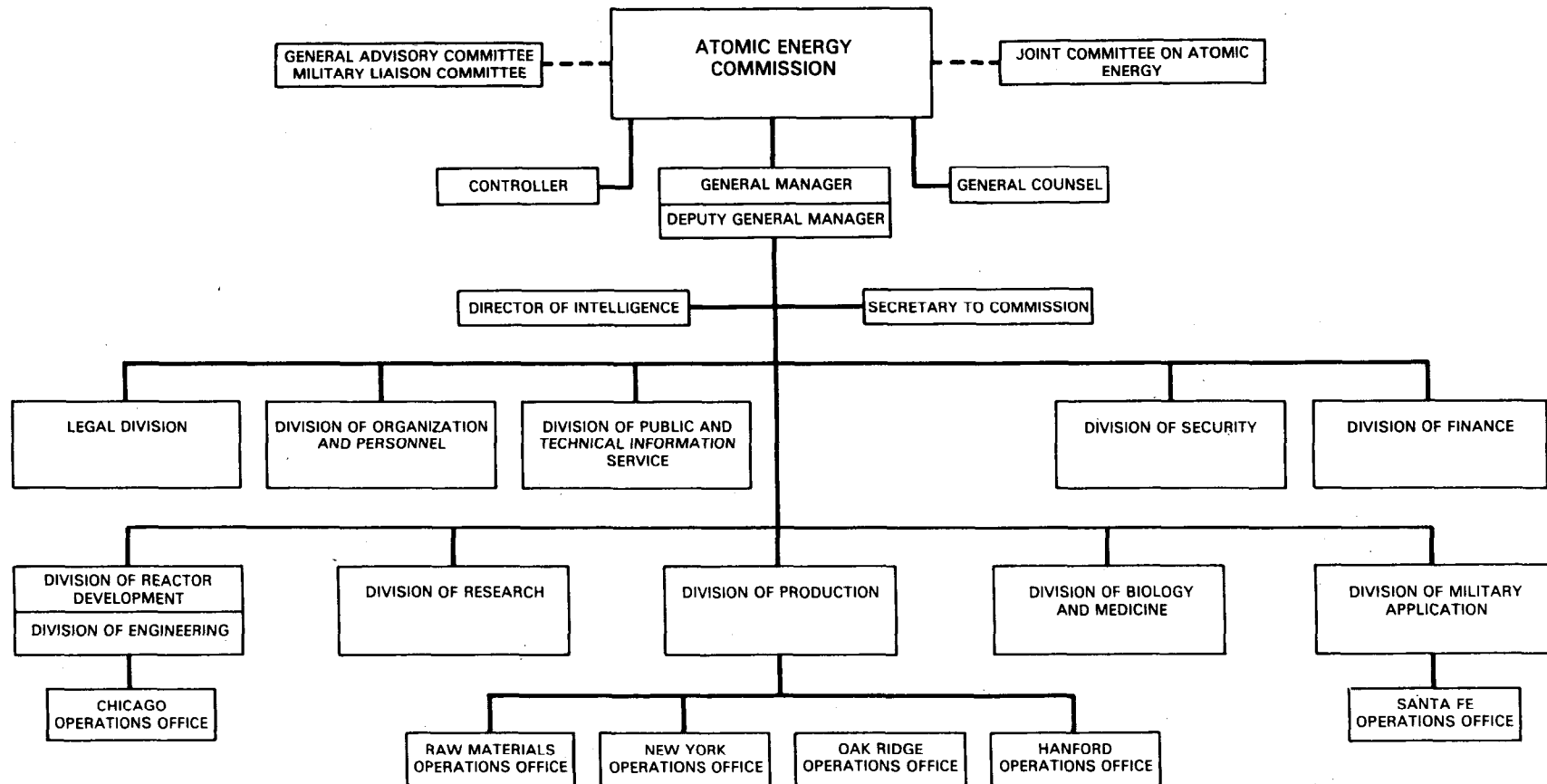
*1974 Annual Report to Congress*

# APPENDIX IV

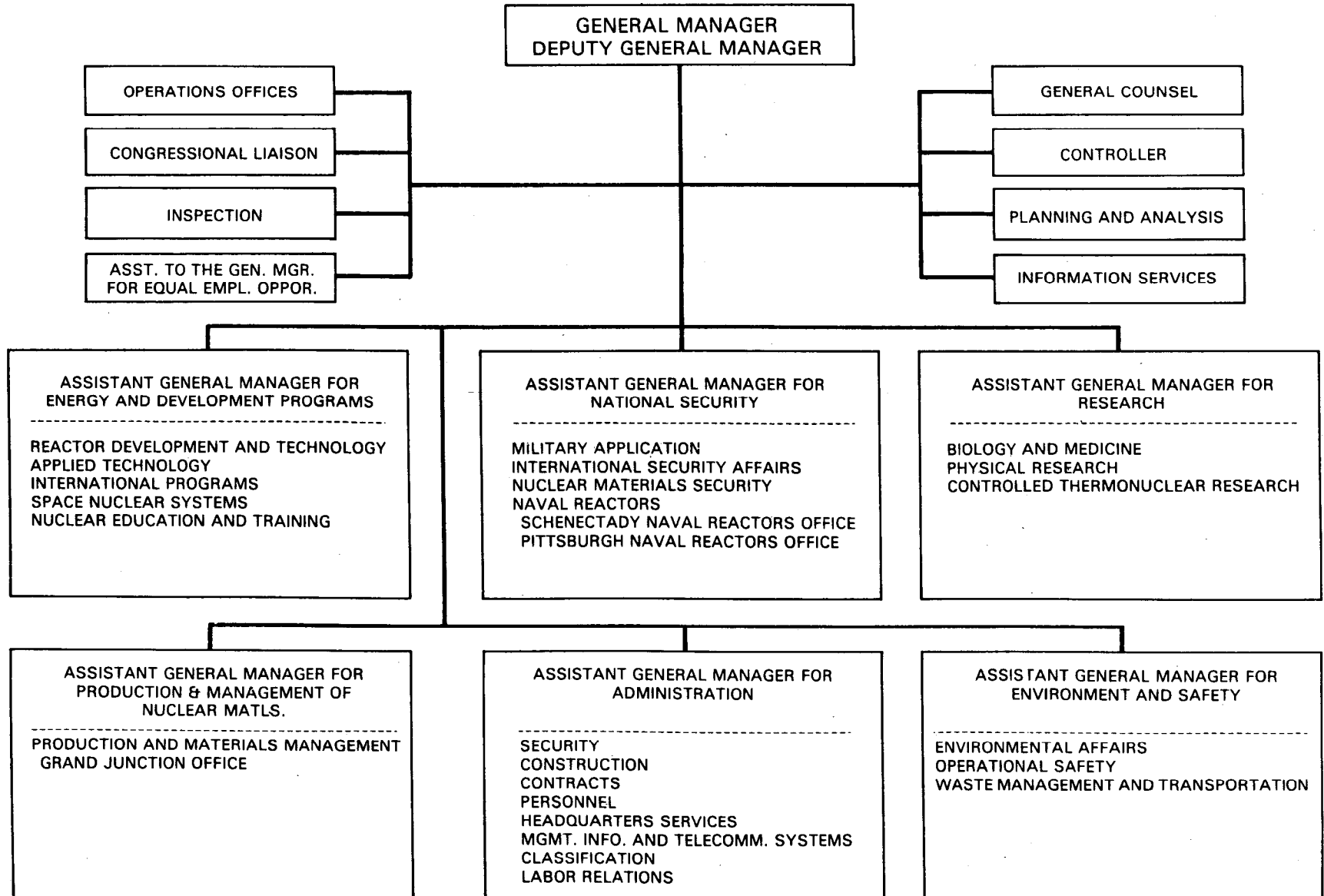
## Organization Charts



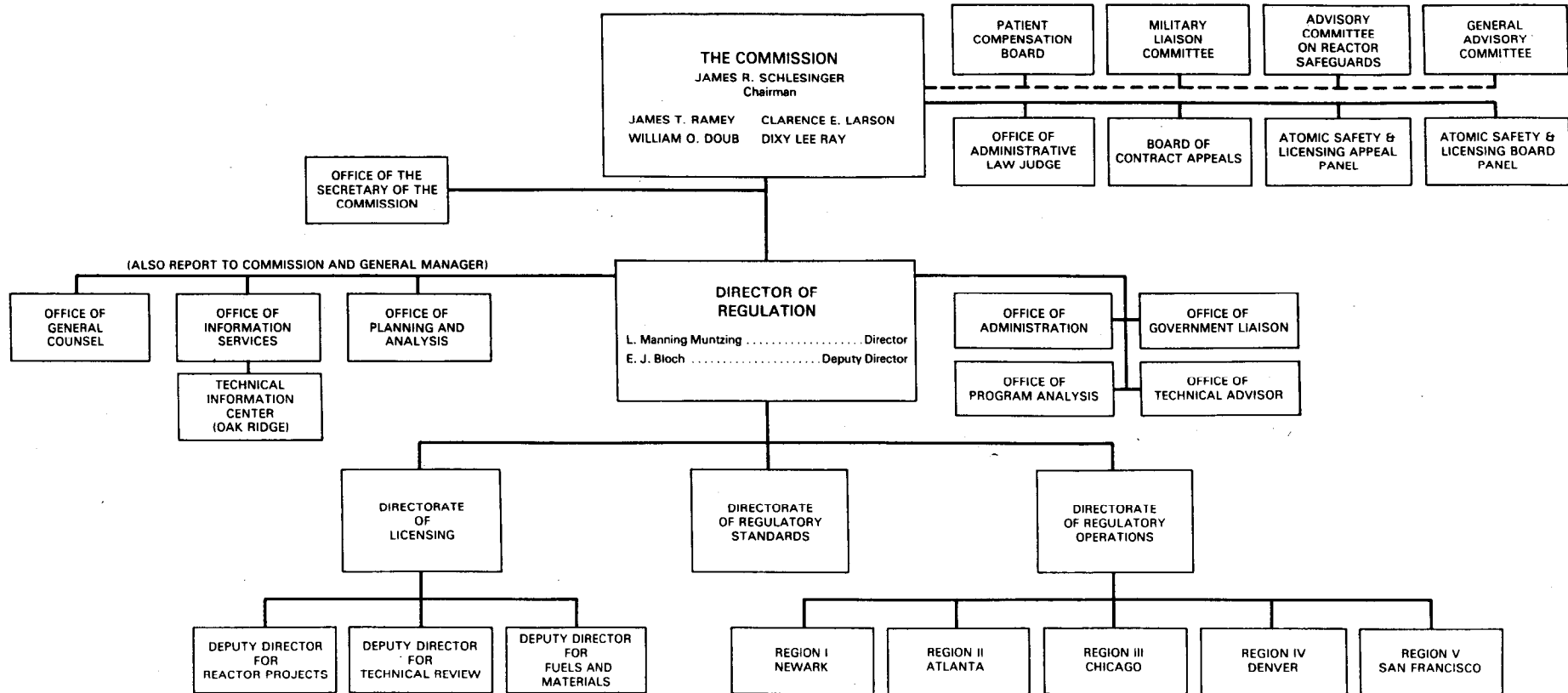
## U.S. ATOMIC ENERGY COMMISSION



# UNITED STATES ATOMIC ENERGY COMMISSION

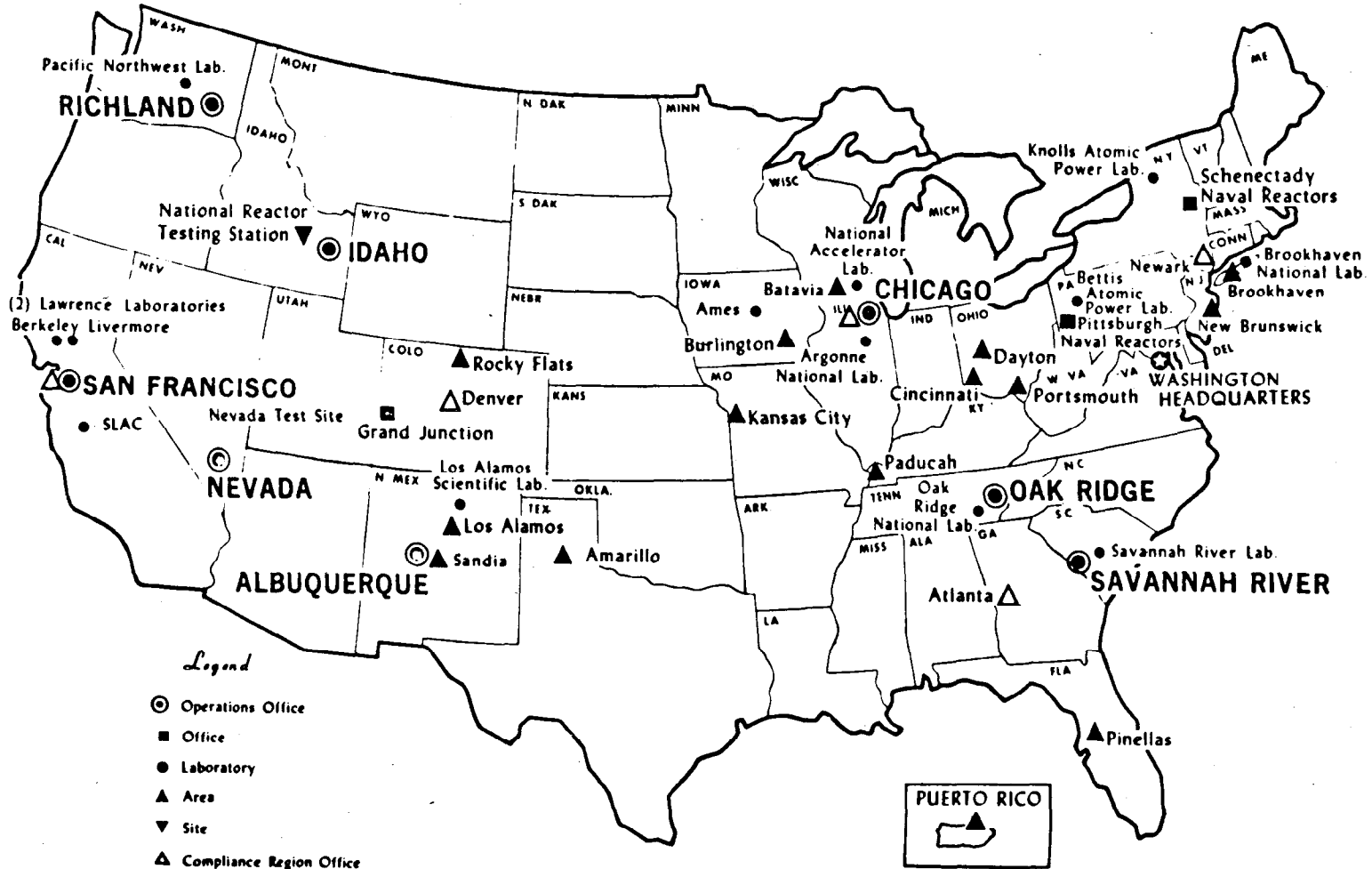


## ATOMIC ENERGY COMMISSION REGULATORY ORGANIZATION



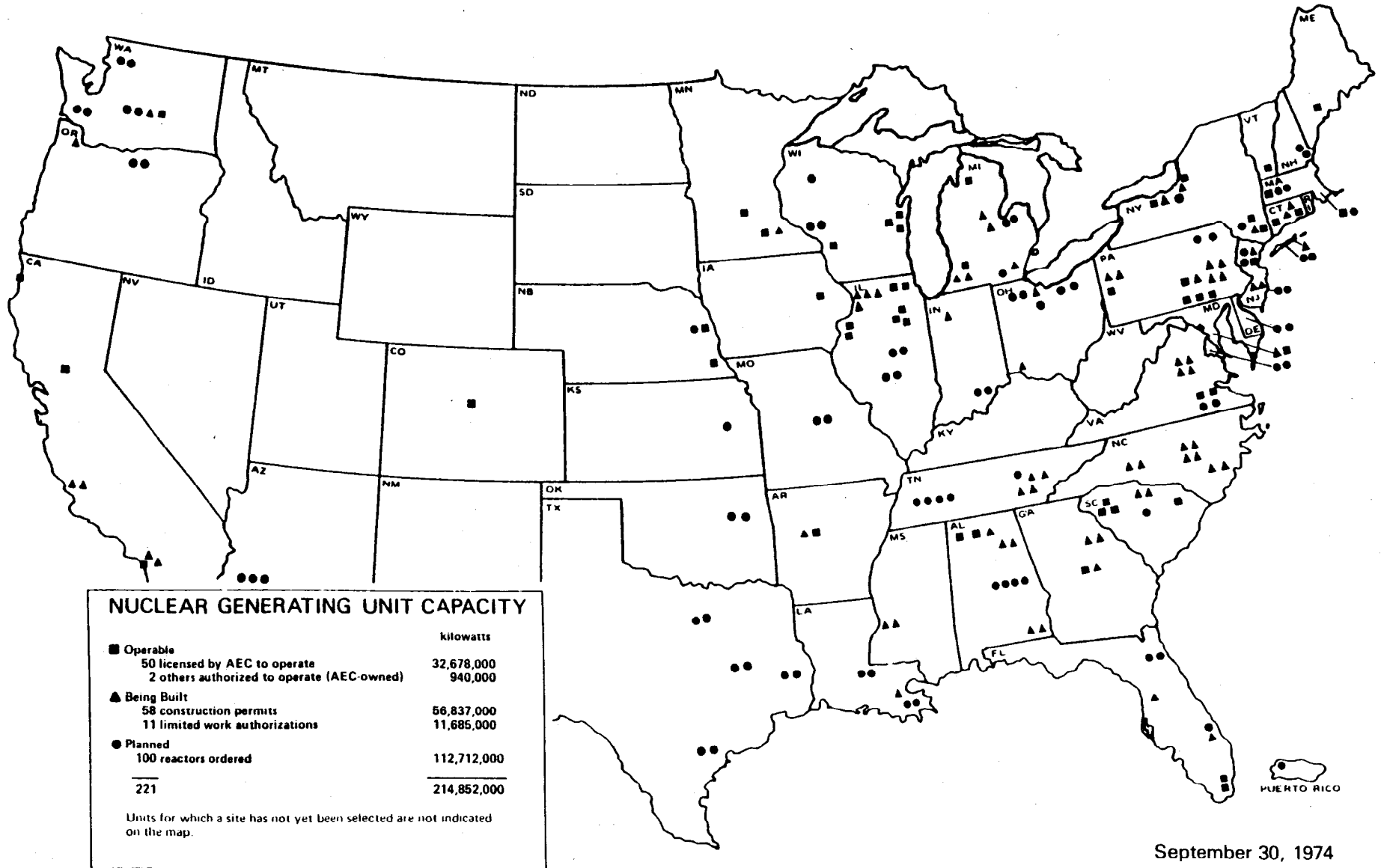
UNITED STATES  
 ATOMIC ENERGY COMMISSION

OFFICES AND LABORATORIES



December 1973

# NUCLEAR POWER REACTORS IN THE UNITED STATES



September 30, 1974



# APPENDIX V

## United States Announced Nuclear Detonations and Early Stockpile Data

1945 - 1974

Event or Series Name	Description	Dates
Trinity .....	First test of an atomic bomb	July 16, 1945
Hiroshima .....	First use in combat	August 6, 1945
Nagasaki .....	Second use in combat	August 9, 1945
Crossroads .....		June - July 1946
Sandstone .....		April - May 1948
Ranger .....		January - February 1951
Greenhouse .....		April - May 1951
Buster-Jangle .....		October - November 1951
Tumbler-Snapper .....		April - June 1952
Ivy .....		October - November 1952
	<i>Mike</i> , experimental thermonuclear device	October 31, 1952
Upshot-Knothole .....		March - June 1953
Castle .....		February - May 1954
	<i>Bravo</i> , experimental thermonuclear device	February 28, 1954
Teapot .....		February - May 1955
Wigwam .....		May 14, 1955
Redwing .....		May - July 1956
Plumbbob .....		May - October 1957
Hardtack .....		April - August 1958
Argus .....		August - September 1958
Hardtack .....		September - October 1958

NO TESTS CONDUCTED FROM OCTOBER 30, 1958 to SEPTEMBER 1961

Nougat .....		September 1961 - June 1962
Dominic I .....		April 1962 - June 1962
Storax .....		July 1962 - June 1963
	<i>Sedan</i> , excavation experiment	July 6, 1962
Dominic II .....	Three above ground tests.	July 1962

LIMITED TEST BAND TREATY, AUG. 5, 1963, PROHIBITED NUCLEAR  
DETONATIONS IN ATMOSPHERE, OUTER SPACE AND UNDER WATER

Niblick .....		August 1963 - June 1964
Whetstone .....		July 1964 - June 1965
Flintlock .....		July 1965 - June 1966
Latchkey .....		July 1966 - June 1967
Crosstie .....		July 1967 - June 1968
Bowline .....		July 1968 - June 1969
Mandrel .....		July 1969 - June 1970
Emery .....		October 1970 - June 1971
Grommet .....		July 1971 - May 1972
Toggle .....		July 1972 - June 1973
Arbor .....		October 1973 - June 1974
Bedrock .....		July 1974 -

## Total Announced Detonations by Year

1945.....3	1961..... 9
1946..... 2	1962.....89
1947..... 0	1963.....25
1948..... 3	1964.....28
1949..... 0	1965.....28
1950..... 0	1966.....40
1951.....16	1967.....28
1952.....10	1968.....33
1953.....11	1969.....28
1954..... 6	1970.....30
1955.....15	1971.....11
1956.....17	1972..... 8
1957.....24	1973..... 9
1958.....55	1974..... 7
1959..... 0	
1960..... 0	
	TOTAL 535

## Early Nuclear Weapon Stockpile Data

	<i>Fiscal Year</i>			
	1945	1946	1947	1948
<b>Number of nonnuclear components</b>				
1. Gun-type	0	0	0*	2*
2. Implosion-type	2	9	29*	53*
<b>Number of nuclear components</b>				
3. Gun-type	0	0	0	0
4. Implosion-type	2	9	13	50

**\*Numbers declassified in 1976**

# APPENDIX VI

## Financial Statistics

### U.S. Government Investment in the Atomic Energy Program

(From June 1940 Through January 18, 1975)

	(in millions)
<b>Appropriation Expenditures:</b>	
National Defense Research Council .....	\$ .5
Office of Scientific Research and Development .....	14.6
War Department (including Manhattan Engineer District) .....	<u>2,218.3</u>
	2,233.4
 <b>Atomic Energy Commission:</b>	
Fiscal years prior to 1966 .....	34,643.8
Fiscal year 1966 .....	2,402.9
Fiscal year 1967 .....	2,263.7
Fiscal year 1968 .....	2,466.6
Fiscal year 1969 .....	2,450.4
Fiscal year 1970 .....	2,455.0
Fiscal year 1971 .....	2,274.7
Fiscal year 1972 .....	2,392.1
Fiscal year 1973 .....	2,393.1
Fiscal year 1974 .....	2,307.5
Fiscal Year 1975 (through January 18) .....	<u>1,512.6</u>
Total AEC .....	57,562.4
<b>Total Appropriation Expenditures</b> .....	<b>59,795.8</b>
 <b>Unexpended Balance of Funds in U.S. Treasury</b>	
January 18, 1975 .....	<u>3,439.9</u>
<b>Total Funds Appropriated</b> .....	<b>63,235.7</b>
 <b>Less:</b>	
Collections paid to U.S. Treasury .....	58.0
Property and services transferred to other Federal agencies without reimbursement, net of such transfers received from other Federal agencies .....	462.0
Cost of operations from June 1940 through January 18, 1975 .....	<u>46,562.2</u>
<b>AEC Equity at January 18, 1975 as shown on Balance Sheet</b> .....	<b>\$16,153.5</b>

