

An hourglass-shaped graphic with a globe inside. The top bulb is dark blue, and the bottom bulb is light blue. The globe is a light blue color with darker blue outlines for continents. The hourglass is centered on the page.

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Nuclear Fuel Reprocessing: U.S. Policy Development

Anthony Andrews, Resources, Science, and Industry Division

March 27, 2008

Abstract. As part of the World War II effort to develop the atomic bomb, reprocessing technology was developed to chemically separate and recover fissionable plutonium from irradiated nuclear fuel. In the early stage of commercial nuclear power, reprocessing was thought essential to supplying nuclear fuel. Federally sponsored breeder reactor development included research into advanced reprocessing technology. Several commercial interests in reprocessing foundered due to economic, technical, and regulatory issues. President Carter terminated federal support for reprocessing in an attempt to limit the proliferation of nuclear weapons material. Reprocessing for nuclear weapons production ceased shortly after the Cold War ended. The Department of Energy now proposes a new generation of "proliferation-resistant" reactor and reprocessing technology.

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Nuclear Fuel Reprocessing: U.S. Policy Development

Anthony Andrews

Specialist in Energy and Energy Infrastructure Policy

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Summary

As part of the World War II effort to develop the atomic bomb, reprocessing technology was developed to chemically separate and recover fissionable plutonium from irradiated nuclear fuel. In the early stage of commercial nuclear power, reprocessing was thought essential to supplying nuclear fuel. Federally sponsored breeder reactor development included research into advanced reprocessing technology. Several commercial interests in reprocessing foundered due to economic, technical, and regulatory issues. President Carter terminated federal support for reprocessing in an attempt to limit the proliferation of nuclear weapons material. Reprocessing for nuclear weapons production ceased shortly after the Cold War ended. The Department of Energy now proposes a new generation of “proliferation-resistant” reactor and reprocessing technology.

Reprocessing refers to the chemical separation of fissionable uranium and plutonium from irradiated nuclear fuel. The World War II-era Manhattan Project developed reprocessing technology in the effort to build the first atomic bomb. With the development of commercial nuclear power after the war, reprocessing was considered necessary because of a perceived scarcity of uranium. Breeder reactor technology, which transmutes non-fissionable uranium into fissionable plutonium and thus produces more fuel than consumed, was envisioned as a promising solution to extending the nuclear fuel supply. Commercial reprocessing attempts, however, encountered technical, economic, and regulatory problems. In response to concern that reprocessing contributed to the proliferation of nuclear weapons, President Carter terminated federal support for commercial reprocessing. Reprocessing for defense purposes continued, however, until the Soviet Union's collapse brought an end to the Cold War and the production of nuclear weapons. The Department of Energy's latest initiative to promote new reactor technology using "proliferation-resistant" reprocessed fuel raises significant funding and policy issues for Congress. U.S. policies that have authorized and discouraged nuclear reprocessing are summarized below.

1946

The Atomic Energy Act of 1946 (P.L. 79-585) defined *fissionable materials* to include plutonium, uranium-235, and other materials determined to be capable of releasing substantial quantities of energy through nuclear fission.¹ The act also created the Atomic Energy Commission (AEC) and transferred production and control of fissionable materials from the Manhattan Project. As the exclusive producer of fissionable material, the AEC originally retained title to all such material for national security reasons.

1954

Congress amended the Atomic Energy Act, authorized the AEC to license commercial reactors, and eased restrictions on private companies using special nuclear material (fissionable material). Section 183 (Terms of Licenses) of the act, however, kept government title to all special nuclear material utilized or produced by the licensed facilities in the United States.

1956

Lewis Strauss, then chairman of the AEC, announced a program to encourage private industry's entry into reprocessing spent nuclear fuel.²

1957

The AEC expressed its intent to withdraw from providing nuclear reprocessing services for spent nuclear fuel in a *Federal Register* notice of March 22, 1957.

¹ In the amended Atomic Energy Act of 1954 (P.L. 83-703), the term *special nuclear material* superseded the term *fissionable material* and included uranium enriched in isotope 233, material the AEC determined to be special nuclear material, or any artificially enriched material. Laws of 83rd Congress, 2nd Session, 1118-21.

² U.S. House of Representatives, Committee on Science and Technology, Subcommittee on Investigations and Oversight, West Valley Cooperative Agreement Hearing, p. 233, July 9, 1981.

1959

The Davison Chemical Company, later called Nuclear Fuel Services, began extensive discussions with the AEC on commercial reprocessing.

1963

The AEC-sponsored Experimental Breeder Reactor (EBR II), constructed at the Argonne National Laboratory West near Idaho Falls, began operating. Irradiated fuel was reprocessed by “melt-refining.”

1964

The AEC was authorized to issue commercial licenses to possess special nuclear material subject to specific licensing conditions (P.L. 88-489).

1966

The AEC granted an operating permit for commercial reprocessing to Nuclear Fuel Services for the West Valley plant, near Buffalo, NY. The plant operated from 1966 until 1972, reprocessing spent fuel from the defense weapons program.³ Commercial spent fuel was never reprocessed. Stricter regulatory requirements forced the plant’s shutdown for upgrades. The plant was permanently shut down in 1976 after it was determined that the stricter regulatory requirements could not be met.⁴

1967

The AEC authorized General Electric Company (GE) to construct a spent fuel reprocessing facility in Morris, IL.⁵

1969

The AEC invited public comment on a proposed policy in the form of Appendix F to 10 C.F.R. Part 50 on siting a fuel reprocessing plant.⁶

1969

EBR II fuel reprocessing and refabrication operations were suspended.

³ U.S. Department of Energy, Plutonium Recovery from Spent Fuel Reprocessing by Nuclear Fuel Services at West Valley, New York from 1966 to 1972, February 1996, <http://www.osti.gov/opennet/document/purecov/nfsrepo.html>.

⁴ Congressional Budget Office, *Nuclear Reprocessing and Proliferation: Alternative Approaches and their Implications for the Federal Budget*, May 1977.

⁵ 65 *Federal Register* 62766-62767, October 19, 2000: *General Electric Company, Morris Operation; Notice of Docketing, Notice of Consideration of Issuance, and Notice of Opportunity for a Hearing for the Renewal of Materials License SNM-2500 for the Morris Operation Independent Spent Fuel Storage Installation*.

⁶ *Federal Register*, June 3, 1969.

1970

Allied-General Nuclear Services began constructing a large commercial reprocessing plant at Barnwell, SC.

1972

GE halted construction and decided not to pursue an operating license for its Morris reprocessing facility. Instead, GE applied for and received a license to store spent fuel.⁷

1974

The AEC determined that any decision to permit nuclear fuel reprocessing on a large scale would require an environmental impact statement under Section 101(2)(c) of the National Environmental Policy Act (U.S.C. 4332(2)(c)).

1974

The Energy Reorganization Act (P.L. 93-438), October 11, 1974, split the AEC into the Nuclear Regulatory Commission (NRC) and the Energy Research and Development Administration (ERDA). The responsibility for licensing nuclear facilities was transferred to the NRC.

1976

Exxon applied for a license to construct a large reprocessing plant but received no final action on its license application.

1976

In an October 28 nuclear policy statement, President Ford announced his decision that

the reprocessing and recycling of plutonium should not proceed unless there is sound reason to conclude that the world community can effectively overcome the associated risks of proliferation ... that the United States should no longer regard reprocessing of used nuclear fuel to produce plutonium as a necessary and inevitable step in the nuclear fuel cycle, and that we should pursue reprocessing and recycling in the future only if they are found to be consistent with our international objectives.⁸

With that announcement, agencies of the executive branch were directed to delay commercialization of reprocessing activities in the United States until uncertainties were resolved.

⁷ Comptroller General, *Federal Facilities for Storing Spent Nuclear Fuel—Are they Needed?* June 27, 1979.

⁸ Gerald R. Ford Presidential Documents, vol. 12, no. 44, pp. 1626-1627, 1976.

1977

In an April 7 press statement, President Carter announced, “We will defer indefinitely the commercial reprocessing and recycling of plutonium produced in the U.S. nuclear power programs.”⁹ He went on to say, “The plant at Barnwell, South Carolina, will receive neither federal encouragement nor funding for its completion as a reprocessing facility.” (It was actually Carter’s veto of S. 1811, the ERDA Authorization Act of 1978, that prevented the legislative authorization necessary for constructing a breeder reactor and a reprocessing facility.)¹⁰

1977

The NRC issued an order terminating the proceedings on the Generic Environmental Statement on Mixed Oxide Fuel and most license proceedings relating to plutonium recycling.¹¹ It stated, however, that it would reexamine this decision after two studies of alternative fuel cycles were completed.

1978

The Nuclear Nonproliferation Act (P.L. 95-242), March 10, 1978, amended the Atomic Energy Act of 1954 to establish export licensing criteria that govern peaceful nuclear exports by the United States, including a requirement of prior U.S. approval for re-transfers and reprocessing; and a guaranty that no material re-transferred will be reprocessed without prior U.S. consent.

1980

President Carter signed Executive Order 12193, Nuclear Cooperation With EURATOM (45 *Federal Register* 9885, February 14, 1980), which permitted nuclear cooperation with the European Atomic Energy Community (EURATOM) to continue to March 10, 1981, despite the agreement’s lack of a provision consistent with the intent of the Nuclear Nonproliferation Act requiring prior U.S. approval for reprocessing. This cooperation was extended through December 31, 1995, by a series of executive orders.¹² It has since expired and been replaced by a new agreement.

1981

President Reagan announced he was “lifting the indefinite ban which previous administrations placed on commercial reprocessing activities in the United States.”¹³

⁹ Jimmy Carter Library, Records of the Speech Writer’s Office, *Statement on Nuclear Power Policy*, April 7, 1977.

¹⁰ J. Michael Martinez, *The Journal of Policy History*, “The Carter Administration and the Evolution of American Nuclear Nonproliferation Policy, 1977—1981,” vol. 14, no. 3, 2002.

¹¹ *Allied-General Nuclear Services v. United States*, no. 87-1902 in the Supreme Court of the United States, Petition for Writ of Certiorari, October term, 1988.

¹² EO 12295, February 24, 1981; EO 12351, March 9, 1982; EO 12409, March 7, 1983; EO 12463, February 23, 1984; EO 12506, March 4, 1985; EO 12554, February 28, 1986; EO 12587, March 9, 1987; EO 12629, March 9, 1988; EO 12670, March 9, 1989; EO 12706, March 9, 1990; EO 12753, March 8, 1991; EO 12791, March 9, 1992; EO 12840, March 9, 1993; EO 12902, March 8, 1994; EO 12955, March 9, 1995.

¹³ “Announcing a Series of Policy Initiatives on Nuclear Energy,” Pub. Papers 903 (October 8, 1981) in *Allied-General* (continued...)

1981

Convinced that the project could not proceed on a private basis and that reprocessing was commercially impracticable, Allied halted the Barnwell project.¹⁴

1982

President Reagan approved the *United States Policy on Foreign Reprocessing of Plutonium Subject to U.S. Control* as National Security Decision Directive 39 (June 4, 1982). Although specific details of the directive have not been declassified, the policies approved pertain to the nonproliferation and statutory conditions for safeguards and physical security for a continued commitment by Japan to nonproliferation efforts.

1990

In the National Defense Authorization Act for Fiscal Year 1991 (P.L. 101-510, Sec. 3142), Congress declared under Findings and Declaration of Policy that

[a]t the present time, the United States is observing a de facto moratorium on the production of fissile materials, with no production of highly enriched uranium for nuclear weapons since 1964. While the United States has ceased operation of all of its reactors used for the production of plutonium for nuclear weapons, the Soviet Union currently operates as many as nine reactors for the production of plutonium for nuclear weapons.” Also, under Sec. 3143—Bilateral Moratorium on Production of Plutonium and Highly Enriched Uranium for Nuclear Weapons and Disposal of Nuclear Stockpiles, the law urged “an end by both the United States and the Soviet Union to the production of plutonium and highly enriched uranium for nuclear weapons.

(In its fullest sense, plutonium production implies reprocessing.)

1992

President G. H. W. Bush disapproved Long Island Power Authority’s attempt to enter into a contract with the French firm Cogema to reprocess the slightly irradiated initial core from the decommissioned Shoreham reactor.

1992

President G. H. W. Bush halted weapons reprocessing in a policy statement on nuclear nonproliferation declaring: “I have set forth today a set of principles to guide our nonproliferation efforts in the years ahead and directed a number of steps to supplement our existing efforts. These steps include a decision not to produce plutonium and highly enriched uranium for nuclear explosive purposes....”¹⁵

(...continued)

Nuclear Services v. United States.

¹⁴ Letter to James B. Edwards, Secretary of Energy, from Brian D. Force, Allied Corporation, October 15, 1981.

¹⁵ President’s statement, The White House, Office of the Press Secretary, Washington, DC, July 13, 1992.

1992

Energy Secretary Watkins announced the permanent closure of the Hanford, WA, PUREX reprocessing plant in December.

1993

President Clinton issued a policy statement on reprocessing stating that “[t]he United States does not encourage the civil use of plutonium and, accordingly, does not itself engage in plutonium reprocessing for either nuclear power or nuclear explosive purposes. The United States, however, will maintain its existing commitments regarding the use of plutonium in civil nuclear programs in Western Europe and Japan.”¹⁶

1995

On November 29, 1995, a new nuclear cooperation agreement with EURATOM was submitted to Congress. Although the Clinton Administration determined it met all the requirements of Section 123 a. of the Atomic Energy Act, some Members believed it did not meet the requirement of prior consent for reprocessing. The agreement entered into effect in 1996 without a vote.

2001

President Bush’s National Energy Policy included the recommendation that “[t]he United States should also consider technologies (in collaboration with international partners with highly developed fuel cycles and a record of close cooperation) to develop reprocessing and fuel treatment technologies that are cleaner, more efficient, less waste intensive, and more proliferation-resistant.”¹⁷

2006

As part of the ongoing Advanced Fuel Cycle Initiative (AFCI), the Department of Energy announced that it will initiate work toward conducting an engineering scale demonstration of the UREX+ separation process (operation planned for 2011) and developing an advanced fuel cycle facility capable of laboratory development of advanced separation and fuel manufacturing technologies. UREX refers to the process of chemically separating uranium from spent nuclear fuel. The AFCI is intended to develop proliferation resistant nuclear technologies in association with the Global Nuclear Energy Partnership (GNEP) for expanding nuclear power in the United States and around the world. The Department of Energy later requested an expression of interest from domestic and international industry in building a spent nuclear fuel recycling and transmutation facility that would meet GNEP goals.¹⁸

¹⁶ Fact Sheet—Nonproliferation And Export Control Policy, The White House, Office of the Press Secretary, September 27, 1993.

¹⁷ Report of the National Energy Policy Development Group, May 2001.

¹⁸ 71 *Federal Register* 44673-44676, August 7, 2006, *Notice of Request for Expression of Interest in a Consolidated Fuel Treatment Center to Support the Global Nuclear Energy Partnership*.

2007

In July 2007, DOE announced that four consortia had been selected to receive up to \$16 million for technical and supporting studies to support GNEP (AREVA Federal Services, LLC; EnergySolutions, LLC; GE-Hitachi Nuclear Americas, LLC; and General Atomics). DOE followed with an August announcement that it was making \$20 million available to conduct detailed siting studies for public or commercial entities interested in hosting GNEP facilities. The original GNEP partnership—China, France, Japan, Russia and the United States—expanded to include Australia, Bulgaria, Ghana, Hungary, Jordan, Kazakhstan, Lithuania, Poland, Romania, Slovenia, Ukraine, South Korea, Italy, Canada, and Senegal by year end.

Author Contact Information

Anthony Andrews
Specialist in Energy and Energy Infrastructure
Policy
aandrews@crs.loc.gov, 7-6843

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