UNITED STATES OF AMERICA

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1. GENERAL INFORMATION

The United States of America's (U.S.) nuclear power industry is large and comprehensive, covering all phases of the nuclear fuel cycle, from uranium exploration and mining through nuclear waste disposal. This document contains an overview of the U.S. nuclear industry, the Federal and State governments' role in the industry, and selected information about activities of the private sector. The U.S. nuclear industry is, mostly, privately owned and highly decentralised. There is a significant amount of diversity in power plant operations and a large array of privately operated companies supporting the nuclear plants. Federal and State governments also play a significant role in the affairs of the industry.

1.1. General Overview

The United States is the fourth largest country in the world in both area and population. The United States covers the entire midsection of North America, stretching from the Atlantic Ocean in the east to the Pacific Ocean in the west. It also includes Alaska, in the northwest corner of North America; and Hawaii, far out in the Pacific. Total area of the United States is over 3.5 million square miles (9.4 million square kilometres)

The climate of the United States varies greatly from place to place. Average annual temperatures range from 9 degrees Fahrenheit (-13 degrees Celsius) in Barrow, Alaska, to 78 degrees Fahrenheit (26 degrees Celsius) in Death Valley, California. Precipitation varies from a yearly average of less than 2 inches at Death Valley to about 460 inches at Mount Waialeale in Hawaii. In general, however, most parts of the United States have seasonal changes in temperature and moderate precipitation. The Midwest, the Middle Atlantic States, and New England experience warm summers and cold, snowy winters. In the South, summers are long and hot, and winters are mild. Along the Pacific Coast, and in some other areas near large bodies of water, the climate is relatively mild all year. The moderate climate in much of the United States has encouraged widespread population settlement.

The population in the United States as of 2000 is over 280 million people (Table 1). The Population density is nearly 30 persons per square kilometre, with 80% living in urban areas and 20% rural.

TABLE 1. POPULATION INFORMATION

	1960	1970	1980	1990	1998	1999	2000	Growth rate (%/a) 1980 to 2000
Population (millions)	179.3	203.3	226.5	248.7	270.3	272.7	281.4	1.1
Population density (inhabitants/km²)	19	23	24	27	29	30	30	1.1
Urban population as percent of total	70	74	74	76	79	80	80	0.4
Predicted population growth rate (%/a) 1999 to 2005	0.8							
Area (1000 km²)	9373.0							

Source. U.S. Census Bureau

1.2. Economic Indicators

Table 2 shows the historical Gross Domestic Product (GPD) statistics.

1.3. Energy Situation

Table 3 shows the US energy reserves and Table 4 the historical energy statistics

TABLE 2. GROSS DOMESTIC PRODUCT (GDP)

	1970	1980	1990	1998	1999	2000	Growth rate (%) 1980 to 2000
GDP (Billions of current US$)	1,039.7	2795.6	5,803.2	8,790.2	9,299.2	9,963.1	6.5
GDP (Billions of constant 1996 US$)	3,578.0	4900.9	6,707.9	8,515.7	8,875.8	9,318.5	3.3
GDP per capita (Current US$)	5,070	12,303	25,539	32,526	34,102	35,405	5.4
GDP by sector (%):							
Agriculture	N/A	N/A	1.9	1.4	1.3		-
Industry	N/A	N/A	22.5	20.7	20.5		-
Services	N/A	N/A	35.9	40.1	40.7		-
Construction and Utilities	N/A	N/A	10.1	9.4	9.7		-

Source: IAEA Energy and Economic Data Base; *U.S. Bureau of Economic Analysis

TABLE 3. ESTIMATED ENERGY RESERVES

Exajoule

	Solid (1)	Liquid (2)	Gas (2)	Uranium (3)	Hydro (4)	Total
Total amount in place	6097.97	158.30	178.40	114.9	350	6899.57

(1) This total represents recoverable reserves for coal.
(2) [3], Table 4-10.
(3) [12], Quantity recoverable at $80/kgU and used at current nuclear plant efficiency and burnup levels.
(4) [17], Projected annual generation for 2020 multiplied by a factor of 100.
Source: EIA Annual Energy Review 2000, DOE/EIA-0384 (2000), August 2001.

TABLE 4. ENERGY STATISTICS

Exajoule

	1960	1970	1980	1990	1998	1999	2000	Average annual growth rate (%) 1960 to 1980	Average annual growth rate (%) 1980 to 2000
Energy consumption (1)									
- Total (2)	47.60	71.59	82.75	88.82	99.78	101.91	103.91	2.8	1.1
- Solids (3)	11.77	14.39	18.86	22.47	25.33	25.94	25.71	2.4	1.2
- Liquids (4)	21.02	31.15	36.09	35.49	39.08	38.90	40.05	2.7	0.5
- Gases (5)	13.07	23.00	21.52	20.36	23.13	23.31	24.61	2.5	0.7
- Primary electricity (6)	1.76	3.06	6.30	10.67	11.97	12.77	15.55	6.6	4.6
Energy production (1)									
- Total	45.16	67.00	70.94	74.74	76.54	76.52	75.86	2.3	0.3
- Solids	12.81	16.92	22.24	26.03	27.50	27.60	23.91	2.8	0.4
- Liquids	17.30	24.17	21.63	18.81	16.63	16.00	15.96	1.1	- 1.5
- Gases	13.35	22.86	21.00	19.37	20.35	20.36	20.83	2.3	0
- Primary electricity (6)	1.70	3.04	6.07	10.60	12.12	12.63	15.16	6.6	4.7
Net imports (7)									
- Total	2.44	4.60	11.81	14.07	23.23	25.40	25.76	8.2	4.0
- Solids	-1.04	-2.53	-3.39	-3.54	-2.17	-1.66	-1.28	- 6.1	5.0
- Liquids	3.72	6.97	14.45	16.68	22.45	23.90	22.82	7.0	2.3
- Gases	-0.29	0.14	0.51	0.99	2.79	2.96	3.77	2.9	10.5
- Primary electricity	0.05	0.02	0.23	0.07	-0.15	0.14	0.45	7.7	3.4

(1) Electricity transmission and distribution losses are not deducted.
(2) Totals may be affected by independent rounding.
(3) Solids include coal, coal-coke net imports, and commercial wood.
(4) Liquids include petroleum products, natural gas plant liquids, crude oil burned as fuel, and alcohol fuels.
(5) Includes supplemental gaseous fuels.
(6) Primary electricity = Hydro + Geothermal + Nuclear + Wind + Solar + Biomass fuels other than commercial wood and alcohol fuels.
(7) Net imports = Consumption – Production. Exports appear as negative numbers.
Source: EIA Annual Energy Review 2000, DOE/EIA-0384 (2000), August 2001.

1.4. Energy Policy

The United States has a market-driven economy. Decisions affecting resources, prices, technology development, and other matters pertaining to energy are made primarily by the private sector. However, through funding of research and development, tax reduction allowances, and other mechanisms, the U.S. Government encourages development and use of certain types of energy resources. Additional features of U.S. government policy are contained in the Energy Policy Act of 1992. This legislation covers a wide variety of issues, such as energy efficiency standards, development of alternate fuels, and development of renewable energy.

2. ELECTRIC POWER SECTOR

2.1. Structure of the Electric Power Sector

The U.S. electric power industry is a combination of traditional electric utilities and non-traditional electricity-producing companies. The traditional electric utility industry is comprised of investor-owned, publicly owned, Federal, and co-operative electric utilities. Historically, there have generally been vertically integrated companies however; the industry is currently changing from regulated monopolies to a functionally unbundled industry with a more complex market for power generation. The Public Utilities Regulatory Policies Act (PURPA) of 1978 and the continued deregulation of the industry have led to the emergence of non-traditional electricity producing companies or non-utility power producers, now numbering over 2,100. Their capability shares were mostly distributed among 3 major industry groups: transportation and public utilities (47 percent), manufacturing (31 percent), and other (22 percent).

Investor-Owned Electric Utilities. Investor owned electric utilities, numbering 239, currently account for more than 75 percent of all U.S. electric utility megawatt-hours generated. Like all private businesses, the fundamental objective of an investor owned utility is to produce a regulated return for investors. As franchised monopolies, they are regulated and obligated to serve all customers in their service area. Most investor-owned electric utilities are operating companies that provide basic services for the generation, transmission, and distribution of electricity. The majority of investor-owned electric utilities perform all three functions.

Publicly Owned Electric Utilities. Publicly owned electric utilities in the United States are operated by non-profit local government agencies established to serve their communities and nearby consumers at cost, returning excess funds to the consumer in the form of community contributions, economic and efficient facilities, and lower rates. Publicly owned electric utilities include municipal, public power districts, State authorities, irrigation districts, and other State organizations. Most municipal electric utilities simply distribute power, although some larger ones produce and transmit electricity as well.

U.S. Federal Electric Utilities. Power produced by U.S. Federal electric utilities is not generated for profit. As required by law, preference in purchasing the electricity produced is given to publicly owned and co-operative utilities and to other non-profit entities. The Federal Government is primarily a producer and wholesaler of electricity.

Co-operative Electric Utilities. Co-operative electric utilities in the United States are owned by their members and are established to provide electricity to those members. The Rural Electrification Administration, U.S. Department of Agriculture, was established under the Rural Electrification Act of 1936 with the purpose of extending electric service to small rural communities and farms where it was more expensive to provide service. Co-operatives are incorporated under State law and are usually directed by an elected board of directors.

U.S. non-utility power producers are comprised of co-generators, small power producers, and Independent Power Producers, all which lack a designated franchise service area. Many co-generators and small power producers qualified under the Public Utility Regulatory Policies Act of 1978 (PURPA). These facilities are generally referred to as qualifying facilities (QFs). QFs receive certain benefits under PURPA. Co-generators are facilities that produce electricity and another form of useful thermal energy for industrial, commercial, heating, or cooling purposes. To receive status as a QF, the co-generator must meet certain ownership, operating, and efficiency criteria established by the Federal Energy Regulatory Commission (FERC). The FERC is responsible for the implementation of PURPA. About sixty two percent of the installed capacity of non-utility generating facilities is classified as a cogeneration QF facility. The greatest capacity share by fuel is natural gas, followed by petroleum only plus petroleum and natural gas combined. Renewables, including hydro, geothermal, solar, wind, wood and waste combined make up about 10 percent of the capacity.

The Independent Power Producers (IPPs) in the United States are wholesale electricity producers that are unaffiliated with franchised utilities in the area in which the IPPs are selling power. A facility that has QF status under PURPA is not an IPP. IPPs do not possess transmission facilities and do not sell in any retail service territory. A new class of IPPs – exempt wholesale generators (EWGs) – was established by the Energy Policy Act of 1992 (EPACT). This Act modified the Public Utility Holding Company Act (PUHCA) to create this new class of IPPs by exempting them from the corporate and geographic restrictions that PUHCA imposes. Public utility holding companies are allowed to own interest in IPP facilities and can form corporate subsidiaries to develop and operate independent power projects anywhere in the world.

The historical ownership pattern of electric generating units shown in 1998 – that of domination by utilities – continued during 2000, but with a shift toward non-utilities. Non-utilities purchased a total of 47,710 MW of capability from utilities in 2000; as a consequence that sector’s share of the industry rose significantly to 26 percent. At year’s end, the electric utility sector owned 602,400 MW of generating capability, accounting for the remainder of the industry’s total.

2.2. Policy and Decision Making Process

In the United States, public policy covering electric utilities is implemented through legislation and regulation of the industry. Because electricity generation is decentralized and the electric utility industry and non-utility generators are, mostly, privately owned, decision making in the industry is decentralized, but subject to Federal and State laws and regulations. There are 6 major pieces of Federal legislation covering the electric utility industry. These laws cover a multitude of factors including the structure of the industry, regulation of interstate commerce, environmental issues, and operating procedures (see Section 5.2 for a brief description of these laws).

Federal regulation of electric power is based on the Commerce Clause of the U.S. Constitution, which holds that only the Federal Government may regulate interstate commerce. Thus, not only is the Federal Government authorized to regulate interstate commerce, but also State governments are prohibited from doing so. In this way, Federal regulation complements State regulation by focusing on the interstate activities of electricity producers, leaving the regulation of intrastate activities to the States.

Until recently, two laws, the Federal Power Act, PURPA, and the EPACT have formed the basis for Federal involvement in the regulation of wholesale electric power transactions. The Federal Energy Regulatory Commission (FERC) is the primary agency responsible for enforcing Federal regulation of electric power transactions. Recently, the Energy Policy Act of 1992 (EPACT) instructed the FERC to order wholesale wheeling of electricity and also authorized the commission to set transmission rates. The concept of separating operators from owners of transmission systems originated in the California. The FERC endorsed the idea and subsequently issued FERC Order 888 in 1996. This Order defined the rules by which utilities may operate their transmission systems allowing a competitive wholesale market for electricity (that is, *open access* rules). This led to the creation of regional transmission groups or Independent System Operators (ISOs), over which FERC has jurisdiction. Order 889, issued by the FERC in 1996, established an electronic same-time information systems (OASIS) for available transmission capacity so that all customers would have equal, timely access to information. However, the concept of competition within the electric power industry is still in its infancy and various approaches to this complex subject are still in progress.

Regulation of most activities of privately owned electric utilities is conducted by the States (Federal, State, municipal, co-operative, and other utilities are often not regulated directly). The primary responsibility of State Public Utility Commissions (PUCs), which exist in all States with privately owned utilities, is to regulate the prices for electricity that privately owned utilities may charge to retail customers. Many of the changes of 1999 have been a result of the movement toward restructuring the electric power industry in many States. Once competition in the wholesale market was made possible through Federal legislation, interest was formed in retail competition, especially in regions of the country where prices are significantly above the national average (i.e., California and the New England States). As of the end of 2000, 23 States had enacted legislation and 1 other issued final regulatory orders that deregulate their electric power industry and will eventually allow retail customers their choice of where to purchase electricity.

2.3. Main Indicators

Table 5 shows the historical electricity production data and installed capacities and Table 6 the energy related ratios.

TABLE 5. NET ELECTRICITY GENERATION AND INSTALLED CAPACITY

								Average Annual Growth Rate (%)	
	1960	1970	1980	1990	1998	1999	2000	1960 to 1980	1980 to 2000
Electricity production (TW·h)									
- Total	755.5	1531.9	2286.4	3024.9	3617.9	3706.1	3791.9	5.7	2.6
- Thermal	609.0	1261.5	1753.8	2092.7	2603.1	2638.5	2749.1	5.4	2.3
- Hydro	145.8	247.7	276.0	289.5	318.9	313.2	269.0	3.2	-0.6
- Nuclear	0.5	21.8	251.1	577.0	673.7	728.3	753.9	36.2	5.7
- Geothermal	0.03	0.5	5.1	15.8	14.7	16.8	14.2	29.3	5.3
- Wind	0.0	0.0	0.0	3.0	3.0	4.5	4.9	N/A	N/A
Capacity of electrical plants (GW(e))									
- Total	167.1	336.4	578.6	735.0	775.9	794.9	818.5	6.4	1.7
- Thermal	130.9	265.5	444.2	536.7	572.4	592.0	615.8	6.3	1.6
- Hydro	35.8	63.8	81.7	93.4	99.4	99.0	99.1	4.2	1.0
- Nuclear	0.4	7.0	51.8	99.6	97.1	97.5	97.5	27.4	3.2
- Geothermal	0.01	0.1	0.9	2.7	2.9	2.9	2.9	25.3	6.0
- Wind	0.0	0.0	0.0	1.9	1.7	2.3	2.3	N/A	N/A

(1) Data prior to 1990 refers to electric utilities only, whereas data for 1990 and thereafter refers to the electric power industry.
Source: EIA Annual Energy Review 2000, DOE/EIA-0384 (2000), August 2001.

TABLE 6. ENERGY RELATED RATIOS

	1960	1970	1980	1990	1998	1999	2000
Energy consumption per capita (GJ/capita)	263	349	364	356	369	375	369
Electricity per capita (kW·h/capita)	4,181	7,469	10,063	12,124	13,390	13,905	13,475
Electricity production/Energy production (%)	6	8	12	15	17	17	20
Nuclear/Total electricity (%)	N/A	1	11	19	19	20	20
Ratio of external dependency (%)(1)	5	6	14	16	23	25	25
Load factor of electricity plants							
- Total (%)	52	52	45	47	53	53	53
- Thermal	53	54	45	45	52	51	51
- Hydro	46	44	39	35	37	36	31
- Nuclear	14	36	55	66	79	85	88

(1) Net import / Total energy consumption.
Source: IAEA Energy and Economic Database. [4, 18].

3. NUCLEAR POWER SITUATION

3.1. Historical Development

In 1942, the first sustained-fission reaction was achieved from a "pile" of graphite and natural uranium by Fermi and others involved in the ultra-secret Manhattan Project. This clearly marked the birth of nuclear power. Then, in July 1945, the United States demonstrated the awesome potential of nuclear weapons as the Hiroshima and Nagasaki bombings brought World War II to a close.

The early growth of commercial nuclear power was spurred by President Eisenhower's Atoms for Peace programme to permit nuclear power applications for peacetime purposes while still retaining a strong nuclear weapons technology. The Atomic Energy Act of 1954 made possible several reactor demonstration and development programmes. Numerous joint industry-government study groups were established to examine power reactor concepts. Also in 1954, the AEC proposed a "Five Year Power Reactor Development Programme," which called for building five separate reactor technologies. The programme prepared the way for private industrial participation in the nuclear power field. In 1957, the first nuclear power station in the United States began operation in Shippingport, Pennsylvania.

From the mid-1960's through the mid-1970's, utilities placed numerous orders for large reactor systems, many of which were cancelled or deferred as electricity demand projections were reduced and construction costs escalated. Although many units were cancelled or delayed, nuclear electricity generation continued to grow until 1979, the year of the accident at Three Mile Island. During 1979 and 1980 nuclear power output declined due to regulatory concerns associated with the accident. Since 1980 annual nuclear electricity generation has more than doubled, reaching 754 billion kW·h in 2000, which accounted for nearly 20 percent of total generation in that year.

3.2. Status and Trends of Nuclear Power

The growth of nuclear power can be attributed to the construction programmes in the 1960's and 1970's when nuclear power was considered to be a cheap and a widely accepted source of electricity. Due to the increases in nuclear generating capacity during this period of construction, nuclear power has become the second largest source of electricity generation. Recent years have seen the end of most new nuclear plant construction. This, combined with several plant retirements and some extended shutdowns for maintenance and refitting, has led to an end in the growth of U.S. nuclear generation capability, and even to a temporary reduction in nuclear capacity.

However, there has been a rebound in nuclear generating capacity in the past three years. Seven nuclear units that had been out of service for an extended period of time were restarted since 1998. In addition, the average capacity factor for all nuclear units increased from 66% in 1990 to 88% in 2000. Many individual units achieved a 95% or higher efficiency. There were 104 nuclear units operating in the U.S at the end of 2000. These units are located at 67 nuclear plants throughout the United States, most are located in the eastern U.S. and have a total net installed capacity of 97.5 MW(e). Table 7 shows the current status of nuclear power plants.

Although nuclear capacity has grown over three decades, the long-term (through 2020) nuclear power outlook in the United States is for nuclear capacity to decline, with no new nuclear units expected to come on-line unless there is a substantial decrease in construction costs. By 2020, as much as 27% of the current U.S. nuclear power capacity is anticipated to be taken out of service, reducing the share of nuclear power in the U.S. electric generating mix from its present 20%. There are several reasons for a projected decline in the United States: (1) nuclear generation is more capital-intensive than other forms of generation, with longer lead-times for licensing and construction; (2) higher financial risks, place nuclear power at a disadvantage to fossil-fuel plants; (3) safety and nuclear waste disposal are serious issues; (4) decontamination and decommissioning also are problematic issues for the nuclear industry; and (5) natural gas- and coal-fired plants are anticipated to be more economical than nuclear.

TABLE 7. STATUS OF NUCLEAR POWER PLANTS (December 31, 2000)

Station	Type	Capacity	Operator[1]	Status	Reactor Supplier[2]	Construction Date	Criticality Date	Grid Date	Commercial Date	Shutdown Date
ARKANSAS ONE-1	PWR	836	ENTERGY	Operational	B&W	01-Oct.-68	06-Aug.-74	17-Aug.-74	19-Dec.-74	
ARKANSAS ONE-2	PWR	858	ENTERGY	Operational	CE	01-Jul.-71	05-Dec.-78	26-Dec.-78	26-Mar-80	
BEAVER VALLEY-1	PWR	810	FIRSTENERGY	Operational	WEST	01-Jun.-70	10-May-76	14-Jun.-76	01-Oct.-76	
BEAVER VALLEY-2	PWR	810	FIRSTENERGY	Operational	WEST	01-May-74	04-Aug.-87	17-Aug.-87	17-Nov.-87	
BRAIDWOOD-1	PWR	1116	EXELON	Operational	WEST	01-Aug.-75	29-May-87	12-Jul.-87	29-Jul.-88	
BRAIDWOOD-2	PWR	1116	EXELON	Operational	WEST	01-Aug.-75	08-Mar-88	25-May-88	17-Oct.-88	
BROWNS FERRY-1	BWR	1065	TVA	Operational	GE	01-May-67	17-Aug.-73	15-Oct.-73	01-Aug.-74	
BROWNS FERRY-2	BWR	1118	TVA	Operational	GE	01-May-67	20-Jul.-74	28-Aug.-74	01-Mar-75	
BROWNS FERRY-3	BWR	1118	TVA	Operational	GE	01-Jul.-68	08-Aug.-76	12-Sept.-76	01-Mar-77	
BRUNSWICK-1	BWR	820	PROGRESS	Operational	GE	01-Sept.-69	08-Oct.-76	04-Dec.-76	18-Mar-77	
BRUNSWICK-2	BWR	811	PROGRESS	Operational	GE	01-Sept.-69	20-Mar-75	29-Apr..-75	03-Nov.-75	
BYRON-1	PWR	1114	EXELON	Operational	WEST	01-Apr.-75	02-Feb.-85	01-Mar-85	16-Sept.-85	
BYRON-2	PWR	1114	EXELON	Operational	WEST	01-Apr.-75	09-Jan.-87	06-Feb.-87	21-Aug.-87	
CALLAWAY-1	PWR	1127	AMERUE	Operational	WEST	01-Sept.-75	02-Oct.-84	24-Oct.-84	19-Dec.-84	
CALVERT CLIFFS-1	PWR	835	CONSTELL	Operational	CE	01-Jun.-68	07-Oct.-74	03-Jan.-75	08-May-75	
CALVERT CLIFFS-2	PWR	840	CONSTELL	Operational	CE	01-Jun.-68	30-Nov.-76	07-Dec.-76	01-Apr..-77	
CATAWBA-1	PWR	1129	DUKE	Operational	WEST	01-May-74	07-Jan.-85	22-Jan.-85	29-Jun.-85	
CATAWBA-2	PWR	1129	DUKE	Operational	WEST	01-May-74	08-May-86	18-May-86	19-Aug.-86	
CLINTON-1	BWR	946	AMERGEN	Operational	GE	01-Oct.-75	27-Feb.-87	24-Apr..-87	24-Nov.-87	
COLUMBIA-2	BWR	1117	ENERGYNW	Operational	GE	01-Aug.-72	19-Jan.-84	27-May-84	13-Dec.-84	
COMANCHE PEAK-1	PWR	1150	TXU	Operational	WEST	01-Oct.-74	03-Apr..-90	24-Apr..-90	13-Aug.-90	
COMANCHE PEAK-2	PWR	1150	TXU	Operational	WEST	01-Oct.-74	24-Mar-93	09-Apr..-93	03-Aug.-93	
COOPER	BWR	758	NPPD	Operational	GE	01-Jun.-68	21-Feb.-74	10-May-74	01-Jul.-74	
CRYSTAL RIVER-3	PWR	834	PROGRESS	Operational	B&W	01-Jun.-67	14-Jan.-77	30-Jan.-77	13-Mar-77	
DAVIS BESSE-1	PWR	873	FIRSTENERGY	Operational	B&W	01-Sept.-70	12-Aug.-77	28-Aug.-77	31-Jul.-78	
DIABLO CANYON-1	PWR	1073	PGEC	Operational	WEST	01-Aug.-68	29-Apr..-84	11-Nov.-84	07-May-85	
DIABLO CANYON-2	PWR	1087	PGEC	Operational	WEST	01-Dec.-70	19-Aug.-85	20-Oct.-85	13-Mar-86	
DONALD COOK-1	PWR	1000	IMPCO	Operational	WEST	01-Mar-69	18-Jan.-75	10-Feb.-75	27-Aug.-75	
DONALD COOK-2	PWR	1060	IMPCO	Operational	WEST	01-Mar-69	10-Mar-78	22-Mar-78	01-Jul.-78	
DRESDEN-2	BWR	784	EXELON	Operational	GE	01-Jan.-66	07-Jan.-70	13-Apr..-70	09-Jun.-70	
DRESDEN-3	BWR	784	EXELON	Operational	GE	01-Oct.-66	31-Jan.-71	22-Jul.-71	16-Nov.-71	
DUANE ARNOLD-1	BWR	520	NUCMAN	Operational	GE	01-Jun.-70	23-Mar-74	19-May-74	01-Feb.-75	
ENRICO FERMI-2	BWR	1101	DETED	Operational	GE	01-May-69	21-Jun.-85	21-Sept.-86	23-Jan.-88	

(1) See Table 7b. (2) See Table 7c.

Source: EIA Form 860-A and Form 860-B as of 31 December 2000.

TABLE 7. CONTINUED. STATUS OF NUCLEAR POWER PLANTS (December 31, 2000)

Station	Type	Capacity	Operator[1]	Status	Reactor Supplier[2]	Construction Date	Criticality Date	Grid Date	Commercial Date	Shutdown Date
FARLEY-1	PWR	847	SOUTH	Operational	WEST	01-Oct.-70	09-Aug.-77	18-Aug.-77	01-Dec.-77	
FARLEY-2	PWR	852	SOUTH	Operational	WEST	01-Oct.-70	05-May-81	25-May-81	30-Jul.-81	
FITZPATRICK	BWR	820	ENTERGY	Operational	GE	01-Sept.-68	17-Nov.-74	01-Feb.-75	28-Jul.-75	
FORT CALHOUN-1	PWR	476	OPPD	Operational	CE	01-Jun.-68	06-Aug.-73	25-Aug.-73	20-Jun.-74	
GRAND GULF-1	BWR	1204	ENTERGY	Operational	GE	01-May-74	18-Aug.-82	20-Oct.-84	01-Jul.-85	
H.B. ROBINSON-2	PWR	683	PROGRESS	Operational	WEST	01-Apr.-67	20-Sept.-70	26-Sept.-70	07-Mar-71	
HATCH-1	BWR	863	SOUTH	Operational	GE	01-Sept.-68	12-Sept.-74	11-Nov.-74	31-Dec.-75	
HATCH-2	BWR	878	SOUTH	Operational	GE	01-Feb.-72	04-Jul.-78	22-Sept.-78	05-Sept.-79	
HOPE CREEK-1	BWR	1124	PSEG	Operational	GE	01-Mar-76	28-Jun.-86	01-Aug.-86	20-Dec.-86	
INDIAN POINT-2	PWR	941	ENTERGY	Operational	WEST	01-Oct.-66	22-May-73	26-Jun.-73	15-Aug.-74	
INDIAN POINT-3	PWR	970	ENTERGY	Operational	WEST	01-Nov.-68	06-Apr..-76	27-Apr..-76	30-Aug.-76	
KEWAUNEE	PWR	498	NUCMAN	Operational	WEST	01-Aug.-68	07-Mar-74	08-Apr..-74	16-Jun.-74	
LASALLE-1	BWR	1077	EXELON	Operational	GE	01-Sept.-73	21-Jun.-82	04-Sept.-82	01-Jan.-84	
LASALLE-2	BWR	1087	EXELON	Operational	GE	01-Oct.-73	10-Mar-84	20-Apr..-84	19-Oct.-84	
LIMERICK-1	BWR	1134	EXELON	Operational	GE	01-Apr.-70	22-Dec.-84	13-Apr..-85	01-Feb.-86	
LIMERICK-2	BWR	1150	EXELON	Operational	GE	01-Apr.-70	12-Aug.-89	01-Sept.-89	08-Jan.-90	
MCGUIRE-1	PWR	1100	DUKE	Operational	WEST	01-Apr.-71	08-Aug.-81	12-Sept.-81	01-Dec.-81	
MCGUIRE-2	PWR	1100	DUKE	Operational	WEST	01-Apr.-71	08-May-83	23-May-83	01-Mar-84	
MILLSTONE-2	PWR	873	DOMINION	Operational	CE	01-Nov.-69	17-Oct-75	09-Nov.-75	26-Dec.-75	
MILLSTONE-3	PWR	1155	DOMINION	Operational	WEST	01-May-74	23-Jan.-86	12-Feb.-86	23-Apr.-86	
MONTICELLO	BWR	578	NUCMAN	Operational	GE	01-Jun.-67	10-Dec.-70	05-Mar-71	30-Jun.-71	
NINE MILE POINT-1	BWR	610	CONSTELL	Operational	GE	01-Apr.-65	05-Sept.-69	09-Nov.-69	01-Dec.-69	
NINE MILE POINT-2	BWR	1142	CONSTELL	Operational	GE	01-Aug.-75	23-May-87	08-Aug.-87	11-Mar-88	
NORTH ANNA-1	PWR	893	DOMINION	Operational	WEST	01-Feb.-71	05-Apr.-78	17-Apr.-78	06-Jun.-78	
NORTH ANNA-2	PWR	897	DOMINION	Operational	WEST	01-Nov.-70	12-Jun.-80	25-Aug.-80	14-Dec.-80	
OCONEE-1	PWR	846	DUKE	Operational	B&W	01-Nov.-67	19-Apr.-73	06-May-73	15-Jul.-73	
OCONEE-2	PWR	846	DUKE	Operational	B&W	01-Nov.-67	11-Nov.-73	05-Dec.-73	09-Sept.-74	
OCONEE-3	PWR	846	DUKE	Operational	B&W	01-Nov.-67	05-Sept.-74	18-Sept.-74	16-Dec.-74	
OYSTER CREEK	BWR	619	AMER	Operational	GE	01-Jan.-64	03-May-69	23-Sept.-69	01-Dec.-69	
PALISADES	PWR	760	NUCMAN	Operational	CE	01-Feb.-67	24-May-71	31-Dec.-71	31-Dec.-71	
PALO VERDE-1	PWR	1243	ANPP	Operational	CE	01-May-76	25-May-85	10-Jun.-85	28-Jan.-86	
PALO VERDE-2	PWR	1243	ANPP	Operational	CE	01-Jun.-76	18-Apr.-86	20-May-86	19-Sept.-86	
PALO VERDE-3	PWR	1247	ANPP	Operational	CE	01-Jun.-76	25-Oct-87	28-Nov.-87	08-Jan.-88	

(1) See Table 7b. (2) See Table 7c.

Source: EIA Form 860-A and Form 860-B as of 31 December 2000.

TABLE 7. CONTINUED. STATUS OF NUCLEAR POWER PLANTS (December 31, 2000)

Station	Type	Capacity	Operator[1]	Status	Reactor Supplier[2]	Construction Date	Criticality Date	Grid Date	Commercial Date	Shutdown Date
PEACH BOTTOM-2	BWR	1093	EXELON	Operational	GE	01-Jan.-68	16-Sept.-73	18-Feb.-74	05-Jul.-74	
PEACH BOTTOM-3	BWR	1093	EXELON	Operational	GE	01-Jan.-68	07-Aug.-74	01-Sept.-74	23-Dec.-74	
PERRY-1	BWR	1169	FIRSTENERGY	Operational	GE	01-Oct-74	06-Jun.-86	19-Dec.-86	18-Nov.-87	
PILGRIM-1	BWR	669	ENTERGY	Operational	GE	01-Aug.-68	16-Jun.-72	19-Jul.-72	01-Dec.-72	
POINT BEACH-1	PWR	505	NUCMAN	Operational	WEST	01-Jul.-67	02-Nov.-70	06-Nov.-70	21-Dec.-70	
POINT BEACH-2	PWR	507	NUCMAN	Operational	WEST	01-Jul.-68	30-May-72	02-Aug.-72	01-Oct-72	
PRAIRIE ISLAND-1	PWR	525	NUCMAN	Operational	WEST	01-May-68	01-Dec.-73	04-Dec.-73	16-Dec.-73	
PRAIRIE ISLAND-2	PWR	524	NUCMAN	Operational	WEST	01-May-69	17-Dec.-74	21-Dec.-74	21-Dec.-74	
QUAD CITIES-1	BWR	762	EXELON	Operational	GE	01-Feb.-67	18-Oct-71	12-Apr.-72	18-Feb.-73	
QUAD CITIES-2	BWR	762	EXELON	Operational	GE	01-Feb.-67	26-Apr.-72	23-May-72	10-Mar-73	
R.E. GINNA	PWR	498	RGE	Operational	WEST	01-Apr.-66	08-Nov.-69	02-Dec.-69	01-Jul.-70	
RIVER BEND-1	BWR	936	ENTERGY	Operational	GE	01-Mar-77	31-Oct-85	03-Dec.-85	16-Jun.-86	
SALEM-1	PWR	1106	PSEG	Operational	WEST	01-Jan.-68	11-Dec.-76	25-Dec.-76	30-Jun.-77	
SALEM-2	PWR	1106	PSEG	Operational	WEST	01-Jan.-68	08-Aug.-80	03-Jun.-81	13-Oct-81	
SAN ONOFRE-2	PWR	1070	SCE	Operational	CE	01-Mar-74	26-Jul.-82	20-Sept.-82	08-Aug.-83	
SAN ONOFRE-3	PWR	1080	SCE	Operational	CE	01-Mar-74	29-Aug.-83	25-Sept.-83	01-Apr.-84	
SEABROOK-1	PWR	1162	NAES	Operational	WEST	01-Jul.-76	13-Jun.-89	29-May-90	19-Aug.-90	
SEQUOYAH-1	PWR	1122	TVA	Operational	WEST	01-May-70	05-Jul.-80	22-Jul.-80	01-Jul.-81	
SEQUOYAH-2	PWR	1117	TVA	Operational	WEST	01-May-70	05-Nov.-81	23-Dec.-81	01-Jun.-82	
SHEARON HARRIS-1	PWR	860	PROGRESS	Operational	WEST	01-Jan.-74	03-Jan.-87	19-Jan.-87	02-May-87	
SOUTH TEXAS-1	PWR	1250	STP	Operational	WEST	01-Sept.-75	08-Mar-88	30-Mar-88	25-Aug.-88	
SOUTH TEXAS-2	PWR	1250	STP	Operational	WEST	01-Sept.-75	12-Mar-89	11-Apr.-89	19-Jun.-89	
ST. LUCIE-1	PWR	839	FPL	Operational	CE	01-Jul.-70	22-Apr.-76	07-May-76	21-Dec.-76	
ST. LUCIE-2	PWR	839	FPL	Operational	CE	01-Jun.-76	02-Jun.-83	13-Jun.-83	08-Aug.-83	
SURRY-1	PWR	801	DOMINION	Operational	WEST	01-Jun.-68	01-Jul.-72	04-Jul.-72	22-Dec.-72	
SURRY-2	PWR	801	DOMINION	Operational	WEST	01-Jun.-68	07-Mar-73	10-Mar-73	01-May-73	
SUSQUEHANNA-1	BWR	1090	PP&L	Operational	GE	01-Nov.-73	10-Sept.-82	16-Nov.-82	08-Jun.-83	
SUSQUEHANNA-2	BWR	1094	PP&L	Operational	GE	01-Nov.-73	08-May-84	03-Jul.-84	12-Feb.-85	
THREE MILE ISLAND-1	PWR	786	AMERGEN	Operational	B&W	01-May-68	05-Jun.-74	19-Jun.-74	02-Sept.-74	

(1) See Table 7b. (2) See Table 7c.

Source: EIA Form 860-A and Form 860-B as of 31 December 2000.

TABLE 7. CONTINUED. STATUS OF NUCLEAR POWER PLANTS (December 31, 2000)

Station	Type	Capacity	Operator[(1)]	Status	Reactor Supplier[(2)]	Construction Date	Criticality Date	Grid Date	Commercial Date	Shutdown Date
TURKEY POINT-3	PWR	693	FPL	Operational	WEST	01-Apr.-67	20-Oct-72	02-Nov.-72	14-Dec.-72	
TURKEY POINT-4	PWR	693	FPL	Operational	WEST	01-Apr.-67	11-Jun.-73	21-Jun.-73	07-Sept.-73	
VERMONT YANKEE	BWR	500	VYNPC	Operational	GE	01-Dec.-67	24-Mar-72	20-Sept.-72	30-Nov.-72	
VIRGIL C. SUMMER-1	PWR	952	SCEG	Operational	WEST	01-Mar-73	22-Oct-82	16-Nov.-82	01-Jan.-84	
VOGTLE-1	PWR	1148	SOUTH	Operational	WEST	01-Aug.-76	09-Mar-87	27-Mar-87	01-Jun.-87	
VOGTLE-2	PWR	1149	SOUTH	Operational	WEST	01-Aug.-76	28-Mar-89	10-Apr.-89	20-May-89	
WATERFORD-3	PWR	1075	ENTERGY	Operational	CE	01-Nov.-74	04-Mar-85	18-Mar-85	24-Sept.-85	
WATTS BAR-1	PWR	1118	TVA	Operational	WEST	01-Dec.-72	01-Jan.-96	06-Feb.-96	05-May-96	
WOLF CREEK	PWR	1170	WOLF	Operational	WEST	01-Jan.-77	22-May-85	12-Jun.-85	03-Sept.-85	
MAINE YANKEE	PWR	860	MYAPC	Shut Down	CE	01-Oct-68	23-Oct-72	08-Nov.-72	28-Dec.-72	Aug. -97
MILLSTONE-1	BWR	641	DOMINION	Shut Down	GE	01-May-66	26-Oct-70	29-Nov.-70	01-Mar-71	Jul. -98
HADDAM NECK	PWR	560	CYAPC	Shut Down	WEST	01-May-64	24-Jul.-67	07-Aug.-67	01-Jan.-68	04-Dec-96
BIG ROCK POINT	BWR	67	CPC	Shut Down	GE	01-May-60	27-Sept.-62	08-Dec.-62	29-Mar-63	Aug. -97
ZION-1	PWR	1040	EXELON	Shut Down	WEST	01-Dec.-68	19-Jun.-73	28-Jun.-73	31-Dec.-73	Jan. -98
ZION-2	PWR	1040	EXELON	Shut Down	WEST	01-Dec.-68	24-Dec.-73	26-Dec.-73	17-Sept.-74	Jan. -98
BONUS	BWR	17	DOE/PRWR	Shut Down	GNEPRWRA	01-Jan.-60	01-Jan.-64	14-Aug.-64		01-Jun.-68
CVTR	PHWR	17	CVPA	Shut Down	WEST	01-Jan.-60	01-Mar-63	18-Dec.-63		01-Jan.-67
DRESDEN-1	BWR	197	EXELON	Shut Down	GE	01-May-56	15-Oct-59	15-Apr.-60	04-Jul.-60	31-Oct-78
ELK RIVER	BWR	22	RCPA	Shut Down	AC	01-Jan.-59	01-Nov.-62	24-Aug.-63	01-Jul.-64	01-Feb.-68
ENRICO FERMI-1	FBR	65	DETED	Shut Down	UEC	01-Aug.-56	23-Aug.-63	05-Aug.-66		29-Nov.-72
FORT ST. VRAIN	HTGR	330	PSCC	Shut Down	GA	01-Sept.-68	31-Jan.-74	11-Dec.-76	01-Jul.-79	29-Aug.-89
HUMBOLDT BAY	BWR	63	PGEC	Shut Down	GE	01-Nov.-60	16-Feb.-63	18-Apr.-63	01-Aug.-63	02-Jul.-76
INDIAN POINT-1	PWR	257	CONED	Shut Down	B&W	01-May-56	02-Aug.-62	16-Sept.-62	01-Oct-62	31-Oct-74
LACROSSE	BWR	48	DPC	Shut Down	AC	01-Mar-63	11-Jul.-67	26-Apr.-68	07-Nov.-69	30-Apr.-87
PATHFINDER	BWR	59	NSP	Shut Down	AC	01-Jan.-59	01-Jan.-64	25-Jul.-66		01-Oct-67
PEACH BOTTOM-1	HTGR	40	EXELON	Shut Down	GA	01-Feb.-62	03-Mar-66	27-Jan.-67	01-Jun.-67	01-Nov.-74
RANCHO SECO-1	PWR	873	SMUD	Shut Down	B&W	01-Apr.-69	16-Sept.-74	13-Oct-74	17-Apr.-75	07-Jun.-89
SAN ONOFRE-1	PWR	436	SCE	Shut Down	WEST	01-May-64	14-Jun.-67	16-Jul.-67	01-Jan.-68	30-Nov.-92
THREE MILE ISLAND-2	PWR	880	GPU	Shut Down	B&W	01-Nov.-69	27-Mar-78	21-Apr.-78	30-Dec.-78	28-Mar-79
TROJAN	PWR	1095	PORTGE	Shut Down	WEST	01-Feb.-70	15-Dec.-75	23-Dec.-75	20-May-76	09-Nov.-92
YANKEE NPS	PWR	167	YAEC	Shut Down	WEST	01-Nov.-57	19-Aug.-60	10-Nov.-60	01-Jul.-61	01-Oct-91

[(1)] See Table 7b. [(2)] See Table 7c.

Source: EIA Form 860-A and Form 860-B as of 31 December 2000.

TABLE 7b. TABLE OF OPERATORS

Code	Operator Name
AMERUE	AMERENUE
AMERGEN	AMERGEN ENERGY CO.
ANPP	ARIZONA NUCLEAR POWER PROJECT
CONED	CONSOLIDATED EDISON CO.
CONSTELL	CONSTELLATION NUCLEAR GROUP
CPC	CONSUMERS POWER CO.
CVPA	CAROLINAS-VIRGINIA NUCLEAR POWER ASSOC.
CYAPC	CONNECTICUT YANKEE ATOMIC POWER CO.
DETED	DETROIT EDISON CO.
DOE/PRWR	DOE & PUERTO RICO WATER RESOURCES
DOMINION	DOMINION GENERATION
DPC	DAIRYLAND POWER COOPERATIVE
DUKE	DUKE POWER CO.
ENERGYNW	ENERGY NORHWEST
ENTERGY	ENTERGY NUCLEAR
EXELON	EXELON GENERATION LLC
FIRSTENERGY	FIRST ENERGY NUCLEAR OPERATING CO.
FPL	FLORIDA POWER & LIGHT CO.
GPU	GENERAL PUBLIC UTILITIES
IMPCO	INDIANA MICHIGAN POWER CO.
MYAPC	MAINE YANKEE ATOMIC POWER CO.
NAES	NORTH ATLANTIC ENERGY SERVICE CORP.
NPPD	NEBRASKA PUBLIC POWER DISTRICT
NUCMAN	NUCLEAR MANAGEMENT CO.
NSP	NORTHERN STATES POWER
OPPD	OMAHA PUBLIC POWER DISTRICT
PGEC	PACIFIC GAS & ELECTRIC CO.
PORTGE	PORTLAND GENERAL ELECTRIC CO.
PP&L	PENNSYLVANIA POWER & LIGHT CO.
PROGRESS	PROGRESS ENERGY
PSCC	PUBLIC SERVICE CO. OF COLORADO
PSEG	PUBLIC SERVICE ELECTRIC & GAS CO.
RCPA	RURAL COOPERATIVE POWER ASSOC.
RGE	ROCHESTER GAS & ELECTRIC CORP.
SCE	SOUTHERN CALIFORNIA EDISON
SCEG	SOUTH CAROLINA ELECTRIC & GAS CO.
SMUD	SACRAMENTO MUNICIPAL UTILITY DISTRICT
SOUTH	SOUTHERN NUCLEAR OPERATING CO.
STP	STP NUCLEAR OPERATING CO.
TXU	TXU ELECTRIC GENERATION CO.
TVA	TENNESSEE VALLEY AUTHORITY
VYNPC	VERMONT YANKEE NUCLEAR POWER CORPORATION
WOLF	WOLF CREEK NUCLEAR OPERATION CORP.
YAEC	YANKEE ATOMIC ELECTRIC CO.

TABLE 7c. TABLE OF NUCLEAR STEAM SUPPLY SYSTEM SUPPLIERS

Code	NSSS Supplier Name
AC	ALLIS CHALMERS
B&W	BABCOCK & WILCOX CO.
CE	COMBUSTION ENGINEERING CO.
GA	GENERAL ATOMIC CORP.
GE	GENERAL ELECTRIC COMPANY (US)
GNEPRWRA	GENERAL NUCLEAR ENGINEERING & PUERTO RICO WATER RESOURCES
UEC	UNITED ENGINEERS AND CONTRACTORS
WEST	WESTINGHOUSE ELECTRIC CORPORATION

During 2000, two reactors that had been shut down for an extended period, Cook 1 and 2, were returned to service, leaving only Browns Ferry 1 in an extended outage. The operating licenses for six reactors were extended in 2000 and 2001, which increased interest in the process from other operators

The future of nuclear power will depend on several factors: resolution of the nuclear waste problem, reduction in nuclear capital costs, and improvement of the public's perception of nuclear power. The NRC has revised its regulations to streamline the licensing process for future nuclear power reactors, a change that should shorten lead-times and improve the economics of new reactor technology.

3.3. Current Policy Issues

Federal Government policies concerning civilian nuclear power are carried out primarily by the U.S. Department of Energy (DOE). Two DOE programmes of significant importance are new reactor technology and radioactive waste management.

In the early 1980s, DOE's Advanced Light Water Reactor Programme (ALWR) aimed to make commercially standardized advanced light water reactors available at the earliest possible time. This programme co-funded design certification rulemaking proceeding for securing the Nuclear Regulatory Commission (NRC) certification for the General Electric Advanced Boiling Water Reactor (ABWR) and the Combustion Engineering System 80+ Advanced Pressurized Water Reactor. In the summer of 1994, the NRC gave final design approval to the ABWR and the System 80. In the mid-1990s, design work was co-funded for smaller (600 megawatts) light-water reactors incorporating passive features. Westinghouse's AP-600 received final design approval in 1998 while the General Electric Simplified Boiling Water Reactor, is further away from certification.

The Nuclear Energy Research Advisory Committee (NERAC) was established on October 1, 1998, to provide independent advice to the Department of Energy (DOE) and Office of Nuclear Energy, Science and Technology (NE) on complex science and technical issues that arise in the planning, managing, and implementation of DOE’s nuclear energy programme. NERAC periodically reviews the elements of the NE programme and based on these reviews provides advice and recommendations on long-range plans, priorities, and strategies to effectively address the scientific and engineering aspects of the research and development efforts. In addition, the committee will provide advice on national policy and scientific aspects on nuclear energy research issues as requested by the Secretary of Energy or the Director, NE.

The Department of Energy (DOE) created the Nuclear Research Initiative (NERI) to address and help overcome the principal technical and scientific issues affecting the future use of nuclear energy in the United Stated. NERI is also expected to help preserve the nuclear science and engineering infrastructure within our Nation’s universities, laboratories, and industry; to advance the state of nuclear energy technology to maintain a competitive position worldwide. DOE believes that in funding creative research ideas at the Nation’s science and technology institutions and companies, solutions to important nuclear issues will be realized, and a new potential for nuclear energy in the United States will emerge.

In response to advice of the President's Committee of Advisors on Science and Technology (PCAST) in its 1999 "Report on International Cooperation on Energy Innovation," DOE established the International Nuclear Energy Research Initiative (I-NERI) to serve as a key mechanism for coordinating international research and development (R&D) for implementing Generation IV. The purpose of I-NERI is to establish agency-level bilateral agreements for international collaboration in developing Generation IV energy systems.

The Nuclear Energy Plant Optimizer (NEPO) Programme is a U.S. Department of Energy (DOE) research and development (R&D) programme focused on performance of currently operating U.S. nuclear power plants. The primary areas of focus for the R&D programme are plant aging and optimization of electrical production. The NEPO Programme is also a public-private R&D partnership with equal or greater matching funds coming from industry. The NEPO Programme was initiated in fiscal year (FY) 2000.

The Nuclear Engineering Education Research (NEER) Programme sponsors nuclear research at U.S. colleges and universities with nuclear engineering programmes, options, or research reactors. The purpose of the programme is to support basic research in nuclear engineering, assist in nuclear engineering student development, and strengthen the academic community's nuclear engineering infrastructure.

The DOE's Office of Civilian Radioactive Waste Management (OCRWM) is responsible for disposal of the Nation's spent nuclear fuel and high-level radioactive waste. Successful implementation of a waste disposal programme is one of the most important issues affecting the nuclear power industry in the United States. Currently, the plan is to store the radioactive waste in a deep geologic repository. Yucca Mountain Nevada has been selected as a possible site, and extensive testing is under way to determine the suitability of the site. In April of 1997, DOE completed its Exploratory Studies Facility (ESF) tunnel at the Yucca Mountain site. The ESF will serve as an underground laboratory for determining whether the site can provide a suitable geologic repository for the long-term storage of spent-fuel and other high-level nuclear waste. The total fiscal year 1999 funding for the programme is $307.8 million. The goal is to complete the technical work necessary to determine whether the site is suitable. The project's long-term objective is to initiate repository operations in 2010.

4. NUCLEAR POWER INDUSTRY

For the most part, nuclear power plants in the United States are privately owned, subject to safety regulations administered by the Federal Government and the State Governments in which plants are located. Economic regulations are also administered by the Federal and State governments, but they apply to the entire electric power industry, and are not unique to the nuclear segment. Regulation of the industry has already been discussed in a previous section. The following paragraphs briefly discuss the other segments of the industry. Annex 1 of this document contains a list of selected companies that are active in the nuclear power industry.

4.1. Suppliers to Nuclear Power Plants

Nuclear Steam Supply Systems

Nuclear steam supply systems currently operating in the United States were supplied by four companies. Westinghouse Corporation built the majority of pressurized water reactors (PWR). ABB Combustion Engineering (CE) and Babcock & Wilcox (B&W) have also built several PWRs. Babcock & Wilcox supplied nuclear steam generators, replacement nuclear steam generators, and nuclear heat exchangers (Westinghouse and CE are now part of Westinghouse BNFL and Framatome ANP now owns B&W). General Electric produced all of the present U.S. boiling water reactors (BWR).

There are presently three new reactor designs approved for construction in the U.S.; the System 80+ and AP600 of Westinghouse BNFL, and the Advanced Boiling Water Reactor (ABWR) from General Electric. In addition, three designs are in early pre-certification stages at the Nuclear Regulatory Commission. These are the AP1000 by Westinghouse BNFL, ESKOM's Pebble Bed Gas Reactor also sponsored by Exelon and Westinghouse BNFL, and the GT-MHR Gas Reactor by General Atomic.

Equipment and Service Suppliers

Many companies in the U.S. provide equipment and services to the nuclear power industry. These services cover the entire nuclear fuel cycle spectrum, from suppliers of main components to providers of routine equipment and services found in most power plants.

To help assure high quality products, the American Society of Mechanical Engineers (ASME) has a certification programme for nuclear equipment suppliers. To obtain an ASME nuclear certificate of authorization, the company must comply with quality assurance requirements set forth by the ASME. This programme is also open to foreign companies. Currently there are over 200 foreign and U.S. companies holding ASME nuclear certificates of authorization.

4.2. Operation of Nuclear Power Plants

Plant Operation

The104 operating nuclear units are mostly privately owned and are operated by over 29 companies having nuclear power reactor licenses granted by the NRC.

Training Services

Various training services are also available. Over 20 private companies are involved in training for nuclear plant operators. Perhaps one of the most widely used training programmes in the United States is sponsored by the Institute of Nuclear Power Plant Operations (INPO). The institute was founded in 1979, as industry's response to the Three Mile Island accident, to promote the highest levels of safety and reliability in commercial nuclear power plants. Among its many activities, INPO manages a nuclear utility training accreditation programme.

4.3. Fuel Cycle and Waste Management Service Supply

All activities of the commercial nuclear fuel cycle are conducted in the United States, with the exception of spent fuel reprocessing.

Uranium Production and Uranium Conversion

There were six conventional uranium mills and fourteen non-conventional plants in the United States at the end of 2000. Five of the mills were inactive at yearend, but uranium concentrate was produced at two mills from mine water during part of that year. Three in-situ leach plants were operated during the year and produced uranium concentrate. During 2000, 4.0 million pounds of uranium concentrate (U_3O_8) were produced in the United States. Because the nuclear industry in the United States is not expected to grow in the near to intermediate future, and for other economic factors such as the relatively low market price of uranium, companies actively involved in uranium production and uranium conversion in the United States are few.

Uranium Enrichment

In 1993 the uranium enrichment business in the United States was transferred from DOE to a private company, the U.S. Enrichment Corporation. This company was created by the Energy Policy Act of 1992 with the objective to privatize the U.S. enrichment business in order to help make it more competitive in the worldwide enrichment industry. The USEC operates one of two enrichment facilities (which are currently rented from DOE); at Paducah, Kentucky. A second facility at Portsmouth, Ohio has been placed in standby status. Both facilities employ gaseous diffusion technology.

In 1996, the United States Enrichment Corporation (USEC) signed a five-year contract with Techsnabexport regarding the sale of low-enriched uranium (LEU), which will be derived from highly enriched uranium (HEU) taken from dismantled Russian nuclear warheads. By 2004, uranium derived from Russian HEU could supply 13 million pounds of U.S. commercial requirements. In addition, the U.S. Department of Energy announced plans to sell or transfer inventories of HEU, LEU, and natural uranium that have been declared surplus to national defence needs. However, the penetration of surplus defence materials into the U.S. uranium market is restricted by legislation and trade policies.

Fuel Fabrication

Three companies are currently operating uranium fuel fabrication facilities in the United States. These facilities are designed for fabrication of light-water reactor fuel.

Nuclear Waste Management

Currently, most spent fuel from commercial nuclear reactors is stored onsite at the nuclear plant. A small amount has been shipped to offsite storage facilities. Numerous private companies provide the necessary equipment and services to support management and storage of spent fuel. The spent fuel inventory in the United States was 41 thousand metric tons of uranium as of December 1999. A 2000 EIA projection predicted that by 2010, the reactors in the United States will discharge 2 thousand metric tons annually and the spent fuel discharged over the next 10 years will amount to 23 thousand metric tons of uranium. As mentioned elsewhere in this paper, the U.S. DOE has the responsibility to construct a permanent repository for commercial spent fuel. The DOE is currently in the process of establishing a site to accomplish this task.

4.4. Research and Development Activities

Research and Development (R&D) in the nuclear industry is conducted by both private industry and the Federal Government. Private companies are actively involved in R&D covering reactor technology, enrichment technology (i.e. advanced laser isotope separation, AVLIS), and nuclear fuel design. One of the main mechanisms for private funding of research is through membership in the Electric Power Research Institute (EPRI). EPRI, through membership fees, conducts R&D in many nuclear-related areas as well as other areas of the electric power industry.

The Federal Government supports R&D through specific budget allocations and through the national laboratories operated by the U.S. DOE. The DOE operates 26 laboratories and institutes, many of which conduct research in various aspects of the nuclear fuel cycle.

In response to a 1997 Presidential Advisory Committee recommendation, the DOE created the Nuclear Energy Research Initiative (NERI) in 1998 to address and help overcome the principal technical and scientific obstacles to the future use of nuclear energy in the United States. NERI is also expected to help preserve the nuclear science and engineering infrastructure within our Nation's universities, laboratories, and industry to advance the state of nuclear energy technology and to maintain a competitive position worldwide. Specific obstacles the R&D is to address include issues involving proliferation, economics, nuclear waste, and safety. Technologies to be addressed include the following:

- work on proliferation-resistant reactors or fuel cycles;
- new reactor designs with higher efficiency, reduced cost, and enhanced safety;
- lower output power reactors for applications where larger reactors may not be advantageous;
- new techniques for on-site and surface storage and for permanent disposal of nuclear waste;
- advanced nuclear fuel and;
- fundamental nuclear science and technology.

Another proliferation-resistant reactor design is the IRIS Reactor. Westinghouse will conduct this project, with collaboration from the University of California at Berkeley, the Massachusetts Institute of Technology, and the Polytechnic Institute of Milan, Italy. The IRIS plant design will feature enhanced safety systems with a high degree of inherent safety including an integral pool configuration and a very high level of natural circulation, possibly up to 100 percent of full power.

4.5. International Co-operation in the Field of Nuclear Power

The U.S. Department of Energy (DOE) and the Republic of Korea’s Ministry of Science and Technology (MOST) signed the first-ever bilateral I-NERI agreement on May 16, 2001. Director for

Nuclear Energy, Science and Technology, William D. Magwood, IV, signed the agreement for DOE. Dr. Chung-Won Cho, Director General of Korea's Atomic energy Bureau signed for MOST. The occasion for the signing was the Opening Plenary Session of the 22^{nd} Annual Republic of Korea-United States of America Joint Standing Committee on Nuclear Energy Cooperation.

The U.S. Department of Energy in 2001 has signed a formal charter by the United States and other governments of leading nuclear nations, including Argentina, Brazil, Canada, France, Japan, Republic of Korea, and the United Kingdom, establishing the Generation IV International Forum (GIF), as an international collective dedicated to the development by 2030 of the next generation of nuclear reactor and fuel cycle technologies. The charter provides the framework to plan and conduct international cooperative research on advanced nuclear energy systems that are safe, reliable, economic, and proliferation resistant.

The U.S. Department of Energy (DOE) and the Commissariat à l'Energie Atomique (CEA) of France signed a bilateral agreement in 2001 to jointly fund innovative U.S.-French research in advance reactors and fuel cycle development. The DOE and CEA are expected to award merit-selected research grants later this summer to joint U.S.-French research teams. The joint research projects will support the recommendation in the Bush Administration's Nuclear Energy Policy to pursue research that will develop next generation nuclear reactor technologies.

Because the nuclear power industry in the United States is decentralized and consists mainly of private companies, information on all co-operative efforts between organizations in the United States and other countries is not available. However, some of the major co-operative efforts can be presented.

The U.S. government signed an agreement with North Korea establishing under international law the Korean Energy Development Organization (KEDO). The main purpose of KEDO, a multi-national body consisting of three members (Japan, South Korea, and the United States), is to funding to supply two light water reactors to North Korea. Also under the agreement, the IAEA will oversee the dismantling of the existing North Korea nuclear programme.

The U.S. Nuclear Regulatory Commission was involved with several international initiatives in Fiscal Year 1997. The Commission worked to help found the International Nuclear Regulatory Association (INRA), a new organization of senior regulators in eight nations operating a substantial majority of the world's civil nuclear reactors.

The Commission worked to support the U.S.-Russia Joint Commission on Technological Cooperation in Energy and Space, chaired by then Vice President Al Gore and then Russian Prime Minister Chernomyrdin (the Gore-Chernomyrdin Commission). Nuclear safety and security has been an important component of this bilateral initiative since its inception.

The United States has also actively participated in the policy and implementation aspects of nuclear initiatives under the Group of Seven (G-7) industrialized nations, the Group of 24 Nuclear Safety Coordination (G-24NUSAC) mechanism, and the Nuclear Safety Account administered by the European Bank for Reconstruction and Development (EBRD/NSA). These institutions have focused on coordinating multi-layered international efforts to enhance nuclear safety in countries with Soviet-designed nuclear power reactors. The NRC is currently working with other nations with major nuclear power programmes to further nuclear safety research. These nations include France, Germany, Japan, and the United Kingdom.

The United States is continuing nuclear safety cooperation with the New Independent States of the former Soviet Union and countries of central and Eastern Europe. These activities include strengthening their regulatory organizations, training foreign inspectors, and working in the area of operational safety and risk reduction. States receiving assistance include Armenia and Kazakhstan.

Other efforts to help regulatory organizations in Russia, Ukraine and Kazakhstan include work to improve their regulatory programmes and systems for protecting, controlling, and accounting for nuclear materials within the framework of agreements signed by the United States with these countries in the fall of 1993.

The United States has also played a leading role in resolving implementation issues for the International Convention on Nuclear Safety, which entered into force in October of 1996. The United States also participated in the successful negotiation of the Joint Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management, as well as the Convention on Supplementary Compensation for Nuclear Damage. Both of these were opened for signature at the International Atomic Energy Agency (IAEA) General Conference in September 1997.

5. NUCLEAR LAWS AND REGULATIONS

5.1. Regulatory Framework

Regulation of the nuclear power industry is exercised by the U. S. Nuclear Regulatory Commission (NRC). Its mission is to ensure adequate protection of the public health and safety, the common defence and security, and the environment. The NRC's scope of responsibility includes regulation of commercial nuclear power plants; non-power research, test and training reactors; fuel cycle facilities; medical, academic, and industrial uses of nuclear materials, and disposal of nuclear materials and waste.

The NRC accomplishes its purpose by the licensing and regulatory oversight of nuclear reactor operations and other activities involving the possession and use of nuclear materials and waste; by the safe-guarding of nuclear materials and facilities from theft and/or sabotage; by the issuance of rules and standards; and by inspection and enforcement actions.

Of particular importance to the future of the nuclear industry is NRC's nuclear power plant licensing process. The Energy Policy Act of 1992 (EPACT) specified a new nuclear power plant licensing process, which the NRC can use for any new applicant for a nuclear plant. Under the new licensing procedure outlined in the EPACT, the applicant (i.e. an entity that seeks to build a new reactor) will use off-the shelf reactor designs that will have been approved and certified by the NRC. After reviewing the application and holding one or more public hearings, the NRC may issue a combined construction and operating license (the previous process was to issue a construction permit and a full power operating license separately and at different times). Because the applicant is using an NRC-certified design, safety issues related to the design will have been resolved, and the main concern will be the quality of the construction of the reactor.

Before authorizing power operation, the NRC will perform comprehensive testing and acceptance procedures on the reactor. Codified in part 52 of Title 10, Code of Federal Regulations, the new licensing process is in place and ready to be used when certification of the new designs is completed. The new license procedure is said to be a more predictable process with less uncertainty, and less financial risk to the applicant.

5.2. Main National Laws and Regulations

The U.S. Congress has enacted several laws, which together create a comprehensive regulatory programme governing the design, construction, and operation of nuclear energy plants. Transportation and disposal of radioactive waste is a major concern of the industry and the public, and there is specific legislation to address these activities as well.

The nuclear industry in the United States is affected by the legislation outlined in Table 8, which covers the entire electric power industry, and the major legislation outlined in Table 9, which affects the nuclear power industry specifically. These laws are by no means exhaustive of the national legislation affecting the nuclear industry. It should also be noted that, although the Federal Government has an extensive role in the nuclear industry, there is also an appropriate regulatory role for the individual states.

TABLE 8. IMPORTANT LEGISLATION COVERING THE ELECTRIC POWER INDUSTRY

The Public Utility Holding Company Act of 1935 (PUHCA) (Public Law 74-333)
PUHCA was enacted to break up the large and powerful trusts that controlled the Nation's electric and gas distribution networks. PUHCA gave the Securities and Exchange Commission the authority to break up the trusts and to regulate the reorganised industry in order to prevent their return. PUHCA was recently overhauled since many argued that PUHCA's regulations were impediments to the development of an efficient electricity market.

The Federal Power Act of 1935 (Title II of PUHCA)
This act was passed at the same time as the Public Utilities Holding Company Act. It was passed to provide for a Federal mechanism, as required by the Commerce Clause of the Constitution, for interstate electricity regulation. Prior to this, electricity generation, transmission and distribution were almost always a series of intrastate transactions.

The Public Utility Regulatory Policies Act of 1978 (PURPA) (Public Law 95-617)
PURPA was passed in response to the unstable energy climate of the late 1970's. PURPA sought to promote conservation of electric energy. Additionally, PURPA created a new class of non-utility generators, small power producers, from which, along with qualified co-generators, utilities are required to buy power.

The Energy Tax Act of 1978 (ETA) (Public Law 95-618)
This act, like PURPA, was passed in response to the unstable energy climate of the 1970's. The ETA encouraged conversion of boilers to coal and investment in cogeneration equipment and solar and wind technologies by allowing a tax credit on top of the investment tax credit. It was later expanded to include other renewable technologies. However, the incentives were curtailed as a result of tax reform legislation in the mid-1980's.

The Clean Air Act Amendments of 1990 (Public Law 101-549)
These amendments established a new emissions-reduction programme. The goal of the legislation was to reduce annual sulphur dioxide emissions by 10 million tons and annual nitrogen oxide emission by 2 million tons from 1980 levels for all man-made sources. Generators of electricity will be responsible for large portions of the sulphur dioxide and nitrogen oxide reductions. The programme instituted under the Clean Air Act Amendments of 1990 employs a unique, market-based approach to sulphur dioxide emission reductions, while relying on more traditional methods for nitrogen oxide reductions.

Source: Country Information.

Two important issues of national concern are the disposal of spent fuel and decommissioning of retired nuclear plants. Because the costs of these activities are high, the funding of them is an important issue. People who use electricity generated at nuclear power plants are paying for the disposal of spent fuel. Under a general contract with nuclear-generating utilities, the Federal Government collects a fee of one mill (one-tenth of a cent) per kilowatt-hour from utility companies for nuclear-generated electricity. This money goes into the Nuclear Waste Fund, which is used to pay for all aspects of nuclear waste disposal, including the geologic repository, transportation of the waste, and support of State and local government involvement in the project. On an annual basis, DOE evaluates the adequacy of the fees collected for nuclear waste disposal. Expenditures of all waste fund monies are subject to Congressional oversight and authorization.

Accumulating adequate funds to cover decommissioning costs is a challenge. The NRC has established minimum funding levels to plan for decommissioning, however State utility commissions have the major role in determining the actual timing, amounts, and other conditions of decommissioning financing. Under NRC rules, the minimum financial assurance that licensees must provide to decommission each reactor is determined by a sliding scale that considers primarily the type and size (as measured in megawatts-thermal) of a reactor. In 1986 dollars, the minimum financial assurance for decommissioning a PWR ranges from roughly $86 million for the smallest reactors, to $105 million for the largest, and the minimum financial assurance for a BWR ranges from roughly $115 million to $135 million. These regulations contain additional requirements to adjust annually the escalations in labour, energy, and low-level waste burial costs (the most significant components of decommissioning expenses).

TABLE 9. IMPORTANT LEGISLATION AFFECTING THE NUCLEAR POWER INDUSTRY

The Energy Policy Act of 1992 (EPACT) (Public Law 102-486) This law created a new category of electricity producer, the exempt wholesale generator, which circumvented PUHCA's impediments to the development of non-utility electricity generation. The law also allowed FERC to open up the national electricity transmission system to wholesale suppliers. Seven of EPACT's 30 Titles contain provision related to nuclear power and/or uranium.
Atomic Energy Act of 1954, as amended (Public Law 83-703) The Atomic Energy Act of 1954 was enacted to encourage private enterprise to develop and utilize nuclear energy for peaceful purposes. This act amended the Atomic Energy Act of 1946 to allow non-federal ownership of nuclear production and utilization facilities if an operating license was obtained from the Atomic Energy Commission (AEC). This act enabled the development of the commercial nuclear power industry in the United States.
Energy Reorganization Act of 1974 (Public Law 93-438) This Act separated the licensing and related functions of the AEC from energy development and related functions. The Nuclear Regulatory Commission (NRC) succeeded AEC as an independent regulatory authority to assure the safety and licensing of nuclear reactors and other facilities associated with processing, transport and handling of nuclear materials. The NRC is still today the main regulatory agency of the US nuclear power industry.
Low-level Radioactive Waste Policy Act of 1980, as amended (Public Law 96-573) This Act was an important step toward the development of new disposal capacity for low-level radioactive waste. Each state was made responsible for providing, either by itself or in co-operation with other states, for the disposal of low-level radioactive waste generated within the state. To carry out this policy, the Act authorizes the states to enter into compacts to provide for the establishment and operation of regional disposal facilities for low-level waste, subject to NRC licensing approval.
Nuclear Waste Policy Act of 1982, as amended (Public Law 97-425) This Act established Federal responsibility for the development of repositories for the disposal of high-level radioactive waste and spent nuclear fuel. This Act was amended in 1987 requiring the US Department of Energy to begin evaluating the suitability of Yucca Mountain in Nevada as the nation's permanent high-level waste repository. This activity is currently in progress.

Source: Country Information.

5.3. International, Multilateral and Bilateral Agreements

Agreements for co-operation provide the legal framework of U.S. trade with other countries in the peaceful uses of nuclear energy. Agreements establish binding national commitments enforceable under international law, and set the ground rules for civilian nuclear commerce between nations. The guiding principle is that the United States will co-operate in peaceful nuclear trade as long as the other signatory abides by the agreement's conditions governing the safeguarding and continued peaceful use of nuclear material and technology transferred from the United States, and grants the United States certain consent rights over such material's use, alteration and retransfer.

The United States has entered into agreements with 29 countries for peaceful nuclear co-operation. Similar agreements have been entered with international organizations including the European Atomic Energy Agency (EURATOM), and the International Atomic Energy Agency (IAEA). In addition, the United States has entered into numerous trilateral agreements with IAEA and other countries for the application of safeguards by the IAEA to equipment, devices, and materials supplied under bilateral agreements for co-operation in the use of commercial nuclear power.

AGREEMENTS WITH THE IAEA

• Amendments to Articles VI and XIV of the Agency Statute		Not Ratified
• Agreement on privileges and immunities		Non-Party
• NPT related safeguards agreement INFCIRC/288	Entry into force:	9 December 1980

• Tlatelolco related agreement	Entry into force:	6 April 1989
• Additional protocol	Signature:	12 May 1998
• Improved procedures for designation of safeguards inspectors	Accepted:	14 September 1988

OTHER RELEVANT INTERNATIONAL TREATIES etc.

• Non-Proliferation Treaty	Entry into force:	5 March 1970
• Convention on physical protection of nuclear material	Entry into force:	8 February 1987
• Convention on early notification of a nuclear accident	Entry into force:	20 October 1988
• Convention on assistance in the case of a nuclear accident or a radiological emergency	Entry into force:	20 October 1988
• Vienna convention on civil liability for nuclear damage		n.a.
• Paris convention on third party liability in the field of nuclear energy		Non Party
• Joint protocol relating to the application of Vienna & Paris conventions		Non Party
• Protocol to amend Vienna convention on civil liability for nuclear damage		n.a.
• Convention on supplementary Compensation for nuclear damage	Signature:	29 September 1997
• Convention on nuclear safety	Entry into force:	10 July 1999
• Joint convention on the safety of spent fuel management and on the safety of radioactive waste management	Signature:	29 September 1997
• ZANGGER Committee		Member
• Nuclear Export Guidelines		Adopted
• Acceptance of NUSS Codes	Summary: Codes are appropriate safety standards in Agency assisted projects; valuable guidance for national regulatory requirements; useful reference in safety assessment. Use of codes for above purposes supported. Generally consistent with US requirements.	
• Nuclear Suppliers Group		Member

BILATERAL AGREEMENTS

The bilateral agreements are listed in Table 10.

TABLE 10. LIST OF AGREEMENTS FOR PEACEFUL NUCLEAR COOPERATION

Agreement	Date Signed	Effective Date	Termination Date	Citation
Argentina	June 25, 1969	July 25, 1969	July 24, 1999	TIAS No. 6721, 20 UST 2587
Australia	July 5, 1979	January 16, 1981	January 15, 2011	TIAS No. 9893, 32 UST 3227
Austria -amendment	July 11, 1969 June 14, 1974	January 24, 1970 October 8, 1974	January 23, 2014 January 23, 2014	TIAS No. 6815, 21 UST 10 TIAS No. 7912, 25 UST 2337
Bangladesh	September 17, 1981	June 24, 1982	June 23, 1992	TIAS No. 10339, —UST—
Brazil	July 19, 1972	September 20, 1972	September 19, 2002	TIAS No. 7439, 23 UST 2477
Canada -amendment -amendment -amendment -amendment	June 15, 1955 June 26, 1956 June 11, 1960 May 25, 1962 April 23, 1980	July 21, 1955 March 4, 1957 July 14, 1960 July 12, 1962 July 9, 1980	January 1, 2000 - - - -	TIAS No. 3304, 6 UST 2598 TIAS No. 3771, 8 UST 275 TIAS No. 4518, 11 UST 1780 TIAS No. 5102, 13 UST 1400 TIAS No. 9759, 32 UST 1079
Czech Republic		February 13, 1992	February 12, 2022	
China	July 23, 1985	December 30, 1985 June 29, 1998	December 29, 2015 June 29, 2003	TIAS No.12027, —UST—[1]
Colombia	January 9, 1981	December 30, 1985	September 6, 2013	TIAS No. 10722, —UST—
Egypt	June 29, 1981	December 29, 1981	December 28, 2021	TIAS No. 10208, 33 UST 2915
EURATOM[2] -Additional Agreement[3] -amendment -amendment -amendment	May 29/June 18, 1958 June 11, 1960 May 21 & 22, 1962 August 22 & 27, 1963 September 20, 1972	August 27, 1958 July 25, 1960 July 9, 1962 October 15, 1963 February 28, 1973	- December 31, 1995 - December 31, 1995 -	TIAS No. 4091, 9 UST 1116 TIAS No. 4650, 11 UST 2589 TIAS No. 5104, 13 UST 1439 TIAS No. 5444, 14 UST 1459 TIAS No. 7566, 24 UST 472
Finland[4]	April 8, 1970	July 7, 1970	December 6, 2000	TIAS No. 5446, 14 UST 1484
Ghana (with Argonne Laboratory)		October 30, 1995	-	
Hungary		February 13, 1992	February 12, 2022	
India -waiver of certain obligations	August 8, 1963 November 30, 1982	October 25, 1963 November 30, 1982	October 24, 1993 December 29, 1991[8]	TIAS No. 5446, 14 UST 1484 TIAS No. 10614, —UST—
Indonesia	June 30, 1980	December 30, 1981	December 29, 1991[8]	TIAS No. 10219, 33 UST 3194
IAEA[5] -amendment -amendment	May 11, 1959 February 12, 1974 January 14, 1980	August 7, 1959 May 31, 1974 May 6, 1980	- August 6, 2014 -	TIAS No. 4291, 10 UST 1424 TIAS No. 7852, 25 UST 1199 TIAS No. 9762, 32 UST 1424
Japan -amendment -amendment -with Japan Atomic Energy Research Institute	February 26, 1968 February 24, 1972 March 28, 1973	July 17, 1988 April 26, 1972 December 21, 1973 July 17, 1988[9] July 17, 1995	July 17, 2018 - July 9, 2003 July 17, 2005	TIAS No. 6517, 19 UST 5214 TIAS No. 7306, 23 UST 275 TIAS No. 7758, 24 UST 1102

TABLE 10. LIST OF AGREEMENTS FOR PEACEFUL NUCLEAR COOPERATION

Agreement	Date Signed	Effective Date	Termination Date	Citation
Korea -amendment -Cooperative Laboratory Relationship	November 24, 1972 May 15, 1974	March 19, 1973 June 26, 1974 June 14, 1996	March 18, 2014 March 18, 2014 June 14, 2001	TIAS No. 7583, 24 UST 775 TIAS No. 7842, 25 UST 1102
Morocco	May 30, 1980	May 16, 1981	May 15, 2001	TIAS No. 10018, 32 UST 5823
Norway	January 12, 1984	July 2, 1984	July 1, 2014	TIAS No. —, —UST—[6]
Peru	June 26, 1980	April 15, 1982	April 14, 200	TIAS No. 10300, 33 UST 4246
Philippines	June 13, 1968	July 19, 1968	July 18, 1998	TIAS No. 6522, 19 UST 5389
Poland		August 3, 1992	September 2, 2022	
Portugal	May 16, 1974	June 26, 1974	June 25, 2014	TIAS No. 7844, 25 UST 1125
Russian Federation - Civilian Nuclear Reactor Safety		September 16, 1996	September 16, 2001	
Slovakia		February 23, 1992	February 12, 2022	
South Africa -amendment -amendment -amendment	July 8, 1957 June 12, 1962 July 17, 1967 May 22, 1974	August 22, 1957 August 23, 1962 August 17, 1967 June 28, 1974 December 4, 1997	August 21, 2007 - - August 21, 2007 December 4, 2002	TIAS No. 3885, 8 UST 1367 TIAS No. 5129, 13 UST 1812 TIAS No. 6312, 18 UST 1671 TIAS No. 7845, 25 UST 1158
Spain	March 20, 1974	June 28, 1974	June 27, 2014	TIAS No. 7841, 25 UST 1063
Sweden	December 19, 1983	April 11, 1984	April 10, 2014	TIAS No. —, —UST—[7]
Switzerland -amendment	December 30, 1965 November 2, 1973	August 8, 1966 January 29, 1974	August 7, 1996 -	TIAS No. 6059, 17 UST 1004 TIAS No. 7773, 25 UST 913
Taiwan[8] -amendment	April 4, 1972 March 15, 1974	June 22, 1972 June 14, 1974	June 21, 2014 June 21, 2014	TIAS No. 7364, 23 UST 945 TIAS No. 7834, 25 UST 913
Thailand	May 14, 1974	June 27, 1974	June 26, 2014	TIAS No. 7850, 25 UST 1181
Ukraine		May 16, 1998	May 4, 2028	

[1] Text of agreement available in House Document 99-86, 99th Congress, 1st Session (July 24, 1985).

[2] The members of EURATOM are Belgium, Denmark, Germany, France, Greece, Italy, Ireland, Luxembourg, Netherlands, Portugal, Spain and the United Kingdom.

[3] This agreement incorporates by reference certain provision of the expired "Joint Programme" Agreement, signed November 8, 1958 TIAS No. 4173, 10 UST 75, amended TIAS No. 5103, 13 UST 1403. By exchange of notes of December 16 and 17, 1985, TIAS No. —, —UST—, the United States and EURATOM agreed for administrative convenience that material, equipment or devices that had been subject to the Joint Programme Agreement would be held subject to the Additional Agreement.

[4] A new agreement with Finland was signed on May 2, 1985.The text of this agreement is available in House Document 99-71, 99th Congress, 1st Session (May 21, 1985); expires March 26, 2022.

[5] A separate table lists U.S. supply agreements concluded pursuant to the U.S.-IAEA co-operation agreement.

[6] Text of agreement available in House Document 98-164, 98th Congress, 2nd Session (January 26, 1984).

[7] Expired June 23, 1992; agreement on extension has been concluded and is being processed internally by the respective Governments.

[8] Agreement on extension has been concluded and is being processed internally by the respective Governments.

[9] 30 year term, with provision for continuation thereafter unless terminated by either party.

REFERENCES

[1] Energy Information Administration, *World Nuclear Outlook 1994*, DOE/EIA-0436(94), Washington DC, (December 1994).

[2] Congressional Research Service, Library of Congress, *State Regulation of Nuclear Power: An Overview of Current State Regulatory Activities*, Prepared for the Committee on Interior and Insular Affairs U.S. House of Representatives, Washington DC, (1992) and *Compilation of Selected Energy Related Legislation, Nuclear Energy and Radioactive Waste*, Prepared for the Committee on Energy and Commerce, House of Representatives, Washington DC, (January 1994).

[3] Energy Information Administration, *Annual Energy Review 2000*, DOE/EIA (http://www.eia.doe.gov/aer).

[4] Energy Information Administration, *Country Analysis Brief - United States 1999*, DOE/EIA (http://ww.eia.doe.gov/emeu/cabs/usa/html).

[5] Energy Information Administration, *Nuclear Power Generation and Fuel Cycle Report 1998*, DOE/EIA (http://www.eia.doe.gov/cneaf/nuclear/n_pwr_fc/data98/prefix3.html).

[6] United States Department of Energy, *Yucca Mountain Project*, (http://www.ymp.gov/money/2000budget/part1.htm).

[7] Energy Information Administration, *Electric Power Annual 2000 Volume I*, DOE/EIA-0348(2000)/1.

[8] Energy Information Administration, *Electric Power Annual 1999 Volumes I & II*, DOE/EIA-0348(99)/1&2.

[9] Energy Information Administration, *United States Energy INFOcard*, DOE/EIA (http://www.eia.doe.gov/neic/infocard97.html).

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[11] Energy Information Administration, *Impacts of Electric Power Industry Restructuring on the U.S. Nuclear Power Industry*, DOE/EIA (http://www.eia.doe.gov/cneaf/electricity/chg_str_fuel/html/chapter2.html).

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[15] U.S. Nuclear Regulatory Commission, *Briefing on NRC International Activities – Public Meeting Transcript*.

[16] American Public Power Association, “1999 Annual Directory & Statistical Report”.

[17] Energy Information Administration, *Annual Energy Outlook 2000*.

[18] North American Electric Reliability Council, “*Generating Availability*” Reports, 1997, 1998,1999.

Appendix

DIRECTORY OF THE MAIN ORGANIZATIONS, INSTITUTIONS AND COMPANIES INVOLVED IN NUCLEAR POWER RELATED ACTIVITIES

NATIONAL ATOMIC ENERGY AUTHORITY

United States Department of Energy (USDOE) Forrestal Building Washington DC 20585	Tel: 202-586-6210 Fax: 202-586-6789 http://www.energy.gov

NATIONAL REGULATORY AUTHORITY

United States Nuclear Regulatory Commission One White Flint North 11555 Rockville Pike Rockville, MD 20852-2730	Tel: 301-415-7000 Fax: 301-415-2395 http://www.nrc.gov/nrc.html

OTHER ORGANIZATIONS[1]

Operators/Owners of Nuclear Power Plants

Connecticut Yankee NPP	http://www.connyankee.com/
Cooper Nuclear Station (Brownville, Nebraska, USA)	http://www.nppd.com/pwrprod/cns.htm
Illinois Power	http://www.illinova.com/Illinova.nsf
Millstone NPP	http://www.dom.com/operations/station-nuc/millstone.html
Northeast Utilities	http://www.nu.com/
Public Service of New Hampshire (PSNH)	http://www.psnh.com/
Seabrook Nuclear Power Station (New Hampshire, USA)	http://www.psnh.com/about/seabrook.shtml
Tennessee Valley Authority (TVA)	http://www.tva.gov/
Yankee Atomic Electric Company (YAEC)	http://www.yankee.com/

Nuclear Research Institutes

Argonne National Laboratory	http://www.anl.gov/
Armed Forces Radiobiology Research Institute (AFRRI)	http://www.afrri.usuhs.mil/
Brookhaven National Laboratory	http://www.bnl.gov/

[1] The links given below are provided by the Secretariat to facilitate searches by the reader. It consist of an arbitrary selection of links available at the IAEA library and is neither complete nor expresses any preference.

Department of Nuclear Engineering
University of California, Berkeley — http://www.nuc.berkeley.edu/

Electric Power Research Institute — http://www.epri.com/

General Atomics — http://www.gat.com/

Idaho National Engineering Laboratory — http://www.inel.gov/

Lawrence Berkeley Laboratory — http://www.lbl.gov/

Lawrence Livermore National Laboratory — http://www.llnl.gov/

Los Alamos National Laboratory — http://www.lanl.gov/worldview/

Los Alamos Neutron Science Center (LANSCE) — http://www.lansce.lanl.gov/index_ext.htm

Modular Pebble Bed Reactor (MPBR) — http://id.inel.gov/Pebble_Bed/

Oak Ridge National Laboratory — http://www.ornl.gov/ornlhome/home.htm

Sandia National Laboratory — http://www.sandia.gov/

Savannah River Site — http://www.srs.gov/

University of Wiscons Reactor Laboratory — http://www.engr.wisc.edu/groups/rxtr.lab/

Hardware Manufactures/Vendors and Service providers

Canberra (US based company) — http://www.canberra.com/

GE Reuter-Stokes (General Electric) — http://www.ge.com/powersystems/reuter-stokes/index.htm

NFS Radiation Protection Systems (NFS-RPS) — http://www.nfsrps.com/

Framatome Technologies Group (FTG) — http://www.framatech.com/home.htm

World Nuclear Fuel Market (WNFM) — http://www.wnfm.com/

Consultants/Engineering

Electric Power Services Inc. — http://www.epsint.com/

Engineering Information Inc.
(commercial Internet Portal) — http://www.ei.org/

ETCetera — http://www.etceteraweb.com/

GPU Nuclear Corporation — http://www2.gpu.com/home/

Kalthoff International — http://www.kalthoff.com/

KEMA Consulting — http://www.kemaconsulting.com/index.htm

NAC International	http://www.nacintl.com/
New York Nuclear and Washington Nuclear	http://www.nynco.com/
The Uranium Exchange Company	http://www.uxc.com/
Unicom	http://www.ucm.com/homepage/homepage.asp
Westinghouse	http://www.westinghouse.com/
BNFL Inc. (U.S. subsidiary of British Nuclear Fuels plc)	http://www.bnflinc.com/
Compagnie Générale des Matières Nucléaires (COGEMA)	http://www.cogema-inc.com/
Duke Energy Corporation	http://www.dukepower.com/
NUKEM Nuclear Technologies	http://www.nukem.com/
Welding Services Inc.	http://www.weldingservices.com/

Professional Organizations

American Nuclear Society (ANS)	http://www.ans.org/
Federation of American Scientists (FAS)	http://www.fas.org/

Universities

Cornell University	http://www.info.cornell.edu/
Duke University	http://www.duke.edu/
Idaho State University The Radiation Information Network (USA)	http://www.physics.isu.edu/radinf/
Louisiana State University (LSU)	http://www.lsu.edu/
MIT Department of Nuclear Engineering (MIT-DNE)	http://web.mit.edu/ned/www/
North Carolina State University	http://www.ncsu.edu/index.regular.html
Stanford University	http://www.stanford.edu/
University of California	http://www.ucop.edu/ucophome/system/
University of California, Davis	http://www.ucdavis.edu/
University of California, San Diego (UCSD)	http://infopath.ucsd.edu/
University of Washington Nuclear Physics Laboratory	http://www.npl.washington.edu/
University of Wisconsin	http://wiscinfo.wisc.edu/