UNITED STATES OF AMERICA

UNITED STATES OF AMERICA

1. GENERAL INFORMATION

The United States of America's (U.S.) nuclear power industry is large and generally comprehensive. The nuclear industry covers most phases of the nuclear fuel cycle, from uranium exploration and mining to nuclear waste disposal, but does not include reprocessing. The U.S. nuclear industry is, mostly, privately owned and decentralised. There is a significant diversity in power plant operations and many privately companies operate nuclear plants. Federal and State governments also play a significant role in the affairs of the industry. Federal government or local regional agencies own nine operable power reactors.

1.1. General Overview

The United States, the world's fourth largest country in area and population, covers the midsection of North America, stretching from the Atlantic Ocean to the Pacific Ocean plus Alaska and Hawaii. The total area of the United States is over 3.5 million square miles (9.4 million square kilometres). Climate varies greatly across the nation. 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. Rainfall varies from less than 2 inches annually at Death Valley to about 460 inches at Mount Waialeale in Hawaii. Most of the United States sees seasonal temperature changes and moderate precipitation. The Midwest, the Middle Atlantic States, and New England experience warm summers and cold, snowy winters. Summers are long, hot, and often humid in the South while winters are mild. Along the Pacific Coast, and in some other areas near large bodies of water, the climate is relatively mild all year. Hawaii is tropical. The moderate climate in much of the United States has encouraged widespread population settlement.

The population in the United States as of 2001 was nearly 280 million people (Table 1). Population density is nearly 30 persons per square kilometre, with 80% living in urban areas.

TABLE 1. POPULATION INFORMATION

	1960	1970	1980	1990	1998	1999	2000	2001	Growth rate (%/a) 1980 To 2000
Population (millions)	179.3	203.3	226.5	248.8	269.6	272.0	274.5	278.9	1.0
Population density (inhabitants/km²)	19	22	24	27	29	29	29	30	1.1
Urban population as percent of total	70	74	74	76	79	80	80	NA	0.4

Predicted population growth rate (%/a) 1999 to 2005	.9
Area (1000 km²)	9373.0

Source. U.S. Census Bureau (April data, civilian population)

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	2001	Growth rate (%) 1980 to 2001
GDP (Billions of current US$)	1,039.7	2795.6	5,803.2	8,781.5	9,274.3	9,824.6	10,082.2	6.3
GDP (Billions of constant 1996	3,578.0	4900.9	6,707.9	8,508.9	8,859.0	9,191.4	9,214.5	3.1
GDP per capita (Current US$)	5,114	12,343	23,325	32,572	34,097	35,791	36,150	5.2
GDP by sector (%):								
Agriculture	N/A	N/A	1.9	1.5	14	1.4	N/A	-
Industry	N/A	N/A	17.9	16.3	16.1	15.9	N/A	-
Services	N/A	N/A	51.1	56.2	56.6	57.4	N/A	-
Construction and Utilities	N/A	N/A	12.7	12.7	12.9	13.1	N/A	-

Source: IAEA Energy and Economic Data Base; *U.S. Bureau of Economic Analysis (www.bea.gov)

Note: Industry is manufacturing; services includes finance, retail sales and wholesale sales; construction and utilities includes transportation

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 2002, DOE/EIA-0383 (2002), December 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 first by the private sector within the context of government regulations. However, through funding of research and development, tax reduction allowances, regulation, and other mechanisms, the U.S. and local governments encourage the development and use of selected energy resources. Favoured resources can vary by jurisdiction. Additional features of U.S. government policy are contained in the Energy Policy Act of 1992. This legislation covers a wide variety of issues, including 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 less traditional electricity-producing companies. The electric utilities include investor-owned, publicly owned, Federal, and co-operative firms. Historically, companies were vertically integrated though structures are changing in many regions from regulated monopolies to more complex, unbundled arrangements. The Public Utilities Regulatory Policies Act (PURPA) of 1978 and the continued deregulation of the industry encouraged the emergence of non-utility power producers. These now number over 2,100. Their capability shares were predominately distributed among three major industry groups: transportation and public utilities, manufacturing, and "other".

Approximately three quarters of the electricity generated by utilities is generated by investor-owned utilities. These utilities are, for the most part, franchised monopolies that have an obligation to provide electricity all customers within a service area. Most provide for the generation, transmission, and distribution of electricity, though the distinctions among these services are breaking down as the electric industry becomes more deregulated. There shares are publicly traded and their areas of business operation are expanding into new areas, sometimes unrelated to the provision of electricity or even energy.

TABLE 4. ENERGY STATISTICS

Exajoule

	1960	1970	1980	1990	1998	1999	2000	2001	Average annual growth rate (%) 1960 to 1980	Average annual growth rate (%) 1980 to 2001
Energy consumption [(1)]										
- Total [(2)]	47.60	71.59	82.75	88.82	99.84	102.10	104.22	101.63	2.8	1.0
- Solids [(3)]	11.77	14.39	18.86	22.47	22.86	22.87	23.67	23.00	2.4	0.9
- Liquids [(4)]	21.02	31.15	36.09	35.49	38.97	40.05	40.52	40.45	2.7	0.5
- Gases [(5)]	13.07	23.00	21.52	20.36	23.15	23.43	24.38	23.20	2.5	0.4
- Primary electricity [(6)]	1.76	3.06	6.30	10.67	14.86	15.72	15.64	15.05	6.6	4.2
Energy production [(1)]										
- Total	45.16	67.00	70.94	74.74	77.09	76.18	75.55	76.48	2.3	0.4
- Solids	12.81	16.92	22.24	26.03	25.25	24.46	23.87	24.93	2.8	0.5
- Liquids	17.30	24.17	21.63	18.81	16.52	15.80	15.79	15.65	1.1	- 1.5
- Gases	13.35	22.86	21.00	19.37	20.69	20.41	23.29	21.02	2.3	0
- Primary electricity [(6)]	1.70	3.04	6.07	10.60	14.63	15.50	15.35	14.88	6.6	4.4
Net imports [(7)]										
- Total	2.44	4.60	11.81	14.07	23.70	25.05	26.59	28.03	8.2	4.2
- Solids	-1.04	-2.53	-3.39	-3.54	-1.91	-1.31	-1.21	-0.78	NA	NA
- Liquids	3.72	6.97	14.45	16.68	22.09	22.35	23.61	24.65	7.0	2.6
- Gases	-0.29	0.14	0.51	0.99	3.23	3.69	3.82	3.94	NA	10.2
- Primary electricity	0.05	0.02	0.23	0.07	0.29	0.32	0.37	0.22	7.9	-0.2

[(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; EIA Monthly Energy Review, July 2002, DOE/EIA-0035 (2002/7), July 2002.

A number of utilities in the United States are publicly -owned with the most visible being the federally-owned Tennessee Valley Authority (TVA), one of the nation’s largest utilities. (The TVA is also one of the larger nuclear power generating organizations.) Several other federal publicly -owned utilities also exist with responsibilities varying widely but often crossing state borders. Publicly -owned utilities also include municipal operations, public power districts, irrigation districts, and various State organizations. Many municipal electric utilities only distribute power, though some larger ones produce and transmit electricity as well. Federal Government utilities primarily produce and wholesale electricity.

Numerous co-operative electric utilities were established to provide electricity to their members. The Rural Electrification Administration of the U.S. Department of Agriculture was established in 1936 to extend electric service to rural communities and farms. Co-operatives are incorporated under State law and are usually directed by an elected board of directors.

Non-utility power producers include co-generators, small power producers, and independent power producers. These lack a designated franchise service area though they might provide power to specific clients under contract. Many are generally referred to as qualifying facilities (QFs) because they receive certain benefits under Public Utility Regulatory Policies Act of 1978 (PURPA). 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) such as producing electricity and other forms of useful thermal energy for industrial, commercial, heating, or cooling purposes. A large portion 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. Renewable energy, including hydro, geothermal, solar, wind, wood and waste combined make up about a tenth of the capacity.

Independent power producers (IPPs) in the United States include wholesale electricity producers that are often unaffiliated with franchised utilities in the area in which they sell power. Utility-owned facilities within some jurisdictions might be required to behave as if they were IPPs. Thus distinctions among utility and IPP facilities are often unclear. The Energy Policy Act of 1992 (EPACT) established a new class of IPPs – exempt wholesale generators (EWGs) or "merchant plants". EPACT exempted EWGs from the corporate and geographic restrictions of earlier legislation. Public utilityies are allowed to own IPP facilities through holding companies and have formed subsidiaries to develop and operate independent power projects throughout the world.

The historical pattern of an industry dominated by electric utilities continues, but has shifted shift toward a much more significant role for non-utilities, including affiliates of former utilities. The distinction between utility and non-utility has thus become very difficult to make.

2.2. Policy and Decision Making Process

Public policy toward electric utilities is implemented through legislation and regulation of the industry. The decision making process in the industry is decentralized, because electricity generation is decentralized and generators are, mostly, privately -owned, though subject to Federal and State laws and regulations. There are at least six major pieces of Federal legislation that cover factors including the structure of the industry, interstate commerce (transmission), environmental issues, and operating procedures (see Section 5.2 for a brief description of these laws). Federal involvement in electric power regulation is based on a clause of the U.S. Constitution that only the Federal Government may regulate interstate commerce. Thus, not only does the Federal Government regulate interstate commerce, but State governments are prohibited from doing so. Federal regulation thus complements State and local regulation by focusing on the interstate activities of electricity producers, but leaving the regulation of intrastate activities to the States and other jurisdictions.

Three laws, the Federal Power Act, PURPA, and the Energy Policy Act of 1992 (EPACT) have formed the basis for Federal regulation of wholesale electric power transactions. The Federal Energy Regulatory Commission (FERC) is the primary agency responsible for this Federal regulation. EPACT instructed FERC to order wholesale wheeling of electricity and authorized FERC to set transmission rates. California originated the concept (within the U.S.) of separating operators from owners of transmission systems. FERC endorsed the idea in 1996 when it issued FERC Order 888 that defined rules under which utilities might operate their transmission systems, while allowing for a competitive wholesale electricity market (i.e., *open access* rules). This encouraged the creation of regional transmission groups or Independent System Operators (ISOs) under FERC jurisdiction. FERC Order 889 of 1996, established an electronic same-time information systems (OASIS) for available transmission capacity to give all customers equal, timely access to information. The concept of competition within the electric power industry is however still in its infancy and approaches to this complex subject are still evolving.

The States regulate most activities of privately -owned electric utilities. Federal, State, municipal, co-operative, and other utilities are often not directly regulated. Public Utility Commissions (PUCs), which exist in most States, regulate the prices for electricity that privately owned utilities might charge to retail customers. Since 1999 utilities and regulators in many States have moved in toward restructuring. Once competition in the wholesale market was permitted through Federal legislation, interest arose in retail competition, especially in regions of the country where prices significantly exceeded the national average (i.e., California and the New England States). The process has not been smooth and several other States have taken a more deliberative approach toward deregulation, especially following unanticipated price spikes in California and elsewhere. Nonetheless, the overall trend remains toward increased market deregulation though through quite varied routes.

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

	1960	1970	1980	1990	1998	1999	2000	2001	Average Annual Growth Rate (%) 1960 to 1980	Average Annual Growth Rate (%) 1980 to 2000
Electricity production (TW·h)										
- Total	755.5	1531.9	2286.4	3024.9	3617.9	3704.5	3799.9	3757.8	5.7	2.5
- Thermal	609.0	1261.5	1753.8	2092.7	2603.1	2642.6	2753.0	2760.3	5.4	2.3
- Hydro	145.8	247.7	276.0	289.5	318.9	313.4	273.1	208.1	3.2	0.4
- Nuclear	0.5	21.8	251.1	577.0	673.7	728.3	753.9	768.8	36.2	5.3
- Geothermal	0.03	0.5	5.1	15.8	14.7	15.0	14.2	13.9	29.3	4.9
- Wind	0.0	0.0	0.0	3.0	3.0	4.5	5.0	5.8	N/A	N/A
Capacity of electrical plants (GW(e))										
- Total	167.1	336.4	578.6	734.1	775.9	785.9	812.7	844.6	6.4	1.7
- Thermal	130.9	265.5	444.2	527.8	563.9	572.6	599.8	629.7	6.3	1.6
- Hydro	35.8	63.8	81.7	96.4	98.7	99.0	98.9	98.9	4.2	1.0
- Nuclear	0.4	7.0	51.8	99.6	97.1	97.4	97.9	98.1	27.4	3.2
- Geothermal	0.01	0.1	0.9	2.7	2.9	2.8	2.8	2.8	25.3	6.0
- Wind	0.0	0.0	0.0	1.8	1.7	2.3	2.4	4.1	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 2001, DOE/EIA-0384 (2002), August 2001; Monthly Energy Review, DOE/EIA-0035 (2002/07), July 2002; EIE 879. Growth rates are a fitted line and not based solely on beginning and end points.

TABLE 6. ENERGY RELATED RATIOS

	1960	1970	1980	1990	1998	1999	2000	2001
Energy consumption per capita (GJ/capita)	265	352	365	357	370	375	380	364
Electricity per capita (kW·h/capita)	4,214	7,535	10,094	12,158	13,420	13,619	13,843	13474
Electricity production/Energy production (%)	6	8	10	12	13	13	13	13
Nuclear/Total electricity (%)	N/A	1	11	19	19	20	20	21
Ratio of external dependency (%)(1)	5	6	14	16	23	25	25	28
Load factor of electricity plants								
- Total (%)	52	52	45	47	53	53	53	NA
- Thermal	53	54	45	45	52	51	51	NA
- Hydro	46	44	39	35	37	36	31	NA
- Nuclear	14	36	56	66	78	85	88	NA

(1) Net import / Total energy consumption.
Source: IAEA Energy and Economic Database. [4, 18] ; Monthly Energy Review, DOE/EIA-0035 (2002/07), July 2002.

2.4. Impact of Open Electricity Market in the Nuclear Sector

Restructuring of the electric power industry to provide customers a choice among competitive energy providers varies in each of the fifty states and the District of Columbia. The Energy Information Administration publishes a chart of the present status of electricity restructuring in each State on <http://www.eia.doe.gov/cneaf/electricity/chg_str/regmap.html>. As of September 2002, programs to provide retail access to competitive energy providers were active in 17 States and the District of Columbia. Restructuring programs were delayed in six States and suspended in California. Twenty-six states do not have retail choice programs. However, virtually all states had some elements of restructuring within their wholesale electricity supply systems and no state has fully abandoned a government role in electricity supply. Moreover, the Federal Electricity Regulatory Commission (FERC) requires a degree of open access to electricity transmission facilities, though in practice open transmission access is limited by available transmission facilities.

One early concern regarding nuclear-based power generation was the existence of "stranded costs" within the industry. Stranded costs are basically cost structures, including debts, which accepted and passed along to consumers under a regulated system but which are not involved in pricing under a restructured system. Among those restructuring states, which had nuclear power generating facilities, most have built allowances for nuclear power stranded costs into their reorganization programs. Moreover, most nuclear power generators have proven to have lower operating costs than competing generation facilities. (Hydroelectricity is the notable exception to this generalization.) This has resulted in high rates of capacity utilization (averaging near 90% among operable units) at existing nuclear facilities and generally profitable operation under restructuring.

While operating nuclear power plants have managed to meet the requirements of any restructuring, the question of whether restructured markets favour or discourage nuclear power investments has yet to be resolved. Two reasons for this situation stand out. First, existing licensed designs for nuclear power have been "too expensive" to yet attract serious investor attention in the United States. Also, historic construction periods, perhaps seven years or more, have been too long to attract investor attention in a competitive environment where short-term profits are a major concern and prolonged dilutions of earnings diminish corporate common stock values. In addition to these factors, new investments in the U.S. electricity market as a whole have nearly ceased during 2001-2002 in the face of a slow economy.

Vendors of nuclear power plants now claim that designs in the earlier stage of licensing, plus actions related to existing licensed designs, will reduce both the capital costs and construction times for new nuclear reactors. Added to this is the Department of Energy's Nuclear Power 2010 (NP2010) program that proposes an increased degree of federal government support for nuclear generation over the coming decade. Included in the NP2010 program are efforts to improve the investment conditions that affect private nuclear power investments. The next few years will determine if these efforts are effective."

3. NUCLEAR POWER SITUATION

3.1. Historical Development

The early growth of the U.S. commercial nuclear power was spurred by President Eisenhower's Atoms for Peace programme to encourage civilian nuclear power applications for peacetime purposes while retaining a strong nuclear weapons technology. The Atomic Energy Act of 1954 made possible several reactor demonstration and development programmes and created the Atomic Energy Commission (AEC) to supervise nuclear developments. 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. Numerous joint industry-government study groups were established to examine power reactor concepts. The first nuclear power station in the United States began operation in Shippingport, Pennsylvania during 1957.

Utilities placed many orders for large reactor systems between the mid-1960s until roughly the time of the Three Mile Island event in 1979. Many orders were later cancelled or deferred as anticipated electricity demand declined and nuclear construction costs grew. Many previously initiated construction projects continued after 1979 with the last new reactor in the United States, Watts Bar 1, completed in 1996. No additional plants were ordered. Four construction permits (Watts Bar 2, Bellefonte 1 and 2, and WNP 1) have recently been extended though there is no active plan to resume construction at these sites. Annual nuclear electricity generation has more than tripled since 1980 to 769 billion kW·h in 2001, which accounted for over 20 percent of total generation in that year. This has been heavily influenced by growth in nuclear plant productivity as measured by an increase in capacity factors from 56% in 1980 to 90% in 2001.

3.2. Status and Trends of Nuclear Power

The present size of the nuclear power industry is due to construction programmes of the 1960's and 1970's when nuclear power was seen as a cheap and widely accepted source of electricity. Increases in nuclear generating capacity during 1969-1996 made nuclear power the second largest source of electricity generation in the U.S. Better utilization of generating capacity has permitted nuclear power to maintain this relative position despite the end of new plant construction during the 1990s and extended shutdowns of several reactors for maintenance and refitting. Several nuclear reactors were permanently closed during the 1990s though many were small or prototype units.

There has been a rebound in interest in nuclear generation in recent years. Several reactors that had been out of service for extended periods have been restarted since 1998. The average capacity factor has increased from 66% in 1990 to 90% in 2001. Many individual units have achieved 95% or higher capacity factors. There were 104 licensed nuclear reactors in the U.S at the end of 2001. (One of the licensed reactors, Browns Ferry 1, has not "operated" since 1985. The plant's owner/operator, the Tennessee Valley Authority, intends to restart Brown's Ferry 1 by 2007) These units are located at 65 nuclear sites (plants) throughout the United States with most located in the eastern half of the U.S. These have a total net summer capacity of 98.1 MW(e). Table 7 shows the current status of nuclear power plants.

Benefiting from over 40 years of operational experience and steadily improving performance by licensees, the U.S. has changed the way that it regulates, mainly by developing a more risk-informed and performance-based regulatory approach. To encourage a sustained high level of safety performance of U.S. nuclear plants, important oversight processes have incorporated risk insights from quantitative risk analysis. Efforts are also continuing to revise regulations to focus requirements on plant programs and activities that are most risk significant.

The increasing need for additional power in the U.S. and the improved economic and safety performance of nuclear power plants over the past decade have caused licensees to pursue renewing their operating licenses for an additional 20 years of operation. Since 2000, the operating licenses for 10 reactors have been extended and applications to extend the licenses of approximately another 40 reactors are expected through 2004. Expectations are that essentially all operating reactors in the U.S. will ultimately apply to renew their operating licenses.

Licensees have also been implementing power uprates since the 1970s as a way to increase the power output of their nuclear power plants. Power uprates can be classified in three categories: (1) measurement uncertainty recapture power uprates that are less than 2 percent and are achieved by implementing enhanced techniques for calculating reactor power, (2) stretch power uprates that are typically up to 7 percent and do not generally involve major plant modifications, and (3) extended power uprates that are greater than stretch power uprates, require significant modification to major balance-of-plant equipment, and have been approved for increases up to 20 percent. As of September 2002, the NRC has approved 81 power uprates adding about 3850 Megawatts electric to the electrical generating capacity in the United States. This is equivalent to more than 3 nuclear power plants. Based on a July 2002 survey, nuclear power plants are expected to request 51 additional power uprates, which if approved would add another 1970 MWe to the nations electric generating capacity.

Three utilities, Dominion, Exelon and Entergy, have announced intentions to seek early site permits subsequent to the issuance of the Energy Information Administration's (EIA) most recent Annual Energy Outlook 2002. These firms have not set a timetable for actual construction. The Administration's 2001 National Energy Policy identified nuclear energy as a key part of the Nation's energy mix. During 2002, the U.S. Department of Energy set a target of 2010 for the completion of two new nuclear power plants under its Nuclear Power 2010 program. The Nuclear Energy Institute (NEI) has also established a target of 50 GW of new U.S. capacity by 2020 in its Vision 2020 plan. Much of the difference in these views and those of parties who see no new builds relates to the cost of building new nuclear power units. Plant vendors assert that construction costs of new designs could match or undercut the costs of building new coal-fired units. These claims for as yet unbuilt designs have not been verified through experience, so the difference in view is unresolved.

The future of nuclear power will depend on several factors including successfully dealing with the nuclear waste, the reduction of nuclear capital costs, and favourable government policies. Progress has been made on each during 2002 including federal approval of a long-term waste disposal site at Yucca Mountain and vendor and utility efforts to reduce the costs of building new nuclear power plants. The NRC has also 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. The U.S. government goal is that these and similar actions would be sufficient to restart the construction of nuclear power plants in the United States during this decade.

3.3. Current Policy Issues

Federal Government policies concerning commercial nuclear power are carried out through the U.S. Department of Energy (DOE). Active DOE programs involve new reactor technologies, reinitiating power plant construction, and radioactive waste management.

DOE's Advanced Light Water Reactor Programme (ALWR) of the 1980s sought to create standardized light water reactors available at the earliest possible time. This programme helped secure NRC certification for General Electric’s Advanced Boiling Water Reactor (ABWR) and the Combustion Engineering’s System 80+ Advanced Pressurized Water Reactor. The NRC gave final design approval to the ABWR and the System 80+ during the summer of 1994. Programs initiated during the mid-1990s co-funded smaller (600 MWe) light-water reactors incorporating passive safety features. Westinghouse's AP-600 received design approval in 1998. The General Electric Simplified Boiling Water Reactor has not been certified, but is being used as a basis for ongoing design research.

The DOE has recently initiated a Generation 4 (Gen4) program to develop innovative and new commercial reactor designs by 2030. This program has both domestic (US) and international components. Progress was made by the international group during 2002 toward identifying six reactor categories to receive research attention through broad consortia of international supporters. Individual Gen4 participant nations are not committed to all of the six designs, thus many including the U.S., might limit their research support within this group. Protocols for the program continue to be developed with significant progress made during Energy Secretary Abraham’s meeting with other energy ministers in Tokyo in September 2002.

The Nuclear Energy Research Advisory Committee (NERAC) was established on October 1, 1998, to provide the Department of Energy (DOE) and Office of Nuclear Energy, Science and Technology (NE) with independent advice to on science and technical issues related to the DOE’s nuclear energy programme. NERAC reviews elements of the NE programme and provides advice and recommendations on long-range plans, priorities, and strategies. NERAC also provides advice on

TABLE 7. STATUS OF NUCLEAR POWER PLANTS (December 31, 2001)

Station	Type	Capacity	Operator[1]	Status	Reactor Supplier[2]	Construction Date	Criticality Date	Grid Date	Commercial Date	Shutdown Date
ARKANSAS ONE-1	PWR	846	ENTERGY	Operational	B&W	01-Oct.-68	06-Aug.-74	17-Aug.-74	19-Dec.-74	
ARKANSAS ONE-2	PWR	936	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	820	FIRSTENERGY	Operational	WEST	01-May-74	04-Aug.-87	17-Aug.-87	17-Nov.-87	
BRAIDWOOD-1	PWR	1140	EXELON	Operational	WEST	01-Aug.-75	29-May-87	12-Jul.-87	29-Jul.-88	
BRAIDWOOD-2	PWR	1142	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	1199	EXELON	Operational	WEST	01-Apr.-75	02-Feb.-85	01-Mar-85	16-Sept.-85	
BYRON-2	PWR	1191	EXELON	Operational	WEST	01-Apr.-75	09-Jan.-87	06-Feb.-87	21-Aug.-87	
CALLAWAY-1	PWR	1143	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	924	AMERGEN	Operational	GE	01-Oct.-75	27-Feb.-87	24-Apr..-87	24-Nov.-87	
COLUMBIA-2	BWR	1108	ENERGYNW	Operational	GE	01-Aug.-72	19-Jan.-84	27-May-84	13-Dec.-84	
COMANCHE PEAK-1	PWR	1084	TXU	Operational	WEST	01-Oct.-74	03-Apr..-90	24-Apr..-90	13-Aug.-90	
COMANCHE PEAK-2	PWR	1124	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	1087	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	787	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	1111	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 2001.

TABLE 7. CONTINUED. STATUS OF NUCLEAR POWER PLANTS (December 31, 2001)

Station	Type	Capacity	Operator[1]	Status	Reactor Supplier[2]	Construction Date	Criticality Date	Grid Date	Commercial Date	Shutdown Date
FARLEY-1	PWR	833	SOUTH	Operational	WEST	01-Oct.-70	09-Aug.-77	18-Aug.-77	01-Dec.-77	
FARLEY-2	PWR	842	SOUTH	Operational	WEST	01-Oct.-70	05-May-81	25-May-81	30-Jul.-81	
FITZPATRICK	BWR	840	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	1210	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	856	SOUTH	Operational	GE	01-Sept.-68	12-Sept.-74	11-Nov.-74	31-Dec.-75	
HATCH-2	BWR	870	SOUTH	Operational	GE	01-Feb.-72	04-Jul.-78	22-Sept.-78	05-Sept.-79	
HOPE CREEK-1	BWR	1049	PSEG	Operational	GE	01-Mar-76	28-Jun.-86	01-Aug.-86	20-Dec.-86	
INDIAN POINT-2	PWR	971	ENTERGY	Operational	WEST	01-Oct.-66	22-May-73	26-Jun.-73	15-Aug.-74	
INDIAN POINT-3	PWR	984	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	1128	EXELON	Operational	GE	01-Sept.-73	21-Jun.-82	04-Sept.-82	01-Jan.-84	
LASALLE-2	BWR	1131	EXELON	Operational	GE	01-Oct.-73	10-Mar-84	20-Apr..-84	19-Oct.-84	
LIMERICK-1	BWR	1143	EXELON	Operational	GE	01-Apr.-70	22-Dec.-84	13-Apr..-85	01-Feb.-86	
LIMERICK-2	BWR	1143	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	869	DOMINION	Operational	CE	01-Nov.-69	17-Oct-75	09-Nov.-75	26-Dec.-75	
MILLSTONE-3	PWR	1136	DOMINION	Operational	WEST	01-May-74	23-Jan.-86	12-Feb.-86	23-Apr.-86	
MONTICELLO	BWR	597	NUCMAN	Operational	GE	01-Jun.-67	10-Dec.-70	05-Mar-71	30-Jun.-71	
NINE MILE POINT-1	BWR	621	CONSTELL	Operational	GE	01-Apr.-65	05-Sept.-69	09-Nov.-69	01-Dec.-69	
NINE MILE POINT-2	BWR	1135	CONSTELL	Operational	GE	01-Aug.-75	23-May-87	08-Aug.-87	11-Mar-88	
NORTH ANNA-1	PWR	925	DOMINION	Operational	WEST	01-Feb.-71	05-Apr.-78	17-Apr.-78	06-Jun.-78	
NORTH ANNA-2	PWR	917	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 2001.

TABLE 7. CONTINUED. STATUS OF NUCLEAR POWER PLANTS (December 31, 2001)

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	1238	FIRSTENERGY	Operational	GE	01-Oct-74	06-Jun.-86	19-Dec.-86	18-Nov.-87	
PILGRIM-1	BWR	667	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	775	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	980	ENTERGY	Operational	GE	01-Mar-77	31-Oct-85	03-Dec.-85	16-Jun.-86	
SALEM-1	PWR	1111	PSEG	Operational	WEST	01-Jan.-68	11-Dec.-76	25-Dec.-76	30-Jun.-77	
SALEM-2	PWR	1110	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	1161	NAES	Operational	WEST	01-Jul.-76	13-Jun.-89	29-May-90	19-Aug.-90	
SEQUOYAH-1	PWR	1124	TVA	Operational	WEST	01-May-70	05-Jul.-80	22-Jul.-80	01-Jul.-81	
SEQUOYAH-2	PWR	1119	TVA	Operational	WEST	01-May-70	05-Nov.-81	23-Dec.-81	01-Jun.-82	
SHEARON HARRIS-1	PWR	900	PROGRESS	Operational	WEST	01-Jan.-74	03-Jan.-87	19-Jan.-87	02-May-87	
SOUTH TEXAS-1	PWR	1264	STP	Operational	WEST	01-Sept.-75	08-Mar-88	30-Mar-88	25-Aug.-88	
SOUTH TEXAS-2	PWR	1265	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	810	DOMINION	Operational	WEST	01-Jun.-68	01-Jul.-72	04-Jul.-72	22-Dec.-72	
SURRY-2	PWR	815	DOMINION	Operational	WEST	01-Jun.-68	07-Mar-73	10-Mar-73	01-May-73	
SUSQUEHANNA-1	BWR	1111	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	796	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 2001.

TABLE 7. CONTINUED. STATUS OF NUCLEAR POWER PLANTS (December 31, 2001)

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	506	VYNPC	Operational	GE	01-Dec.-67	24-Mar-72	20-Sept.-72	30-Nov.-72	
VIRGIL C. SUMMER-1	PWR	966	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	1093	ENTERGY	Operational	CE	01-Nov.-74	04-Mar-85	18-Mar-85	24-Sept.-85	
WATTS BAR-1	PWR	1128	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 2001.

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

national policy and scientific aspects on nuclear energy research as requested by the Secretary of Energy or the Director, NE.

The DOE created its Nuclear Research Initiative (NERI) to address the technical and scientific issues affecting the future use of nuclear energy in the United States. NERI is expected to help preserve the nuclear science and engineering infrastructure within the Nation's universities, laboratories, and industry; to advance the state of nuclear energy technology, and to maintain a competitive position worldwide. DOE funds creative research ideas at science and technology institutions and companies to develop solutions to important nuclear issues and find new potentials for nuclear energy.

In response to advice of the President's Committee of Advisors on Science and Technology (PCAST), DOE established the International Nuclear Energy Research Initiative (I-NERI) to serve as a key mechanism to establish bilateral agreements for international collaboration in developing Generation IV energy systems.

The DOE's Nuclear Energy Plant Optimiser (NEPO) Programme, initiated during fiscal year (FY) 2000, is a programme focused on performance of operating nuclear power plants. The primary areas of focus for the NEPO programme include plant aging and optimisation of electrical production. NEPO is also a public-private R&D partnership with equal or greater matching funds coming from industry.

The Nuclear Engineering Education Research (NEER) Programme sponsors nuclear research at colleges and universities with nuclear engineering programmes, options, or research reactors. The programme seeks 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. The DOE plans to store the radioactive waste in a deep geologic repository at Yucca Mountain Nevada. The proposal was approved by federal agencies, including the Congress during 2002 though challenges by local government agencies remain active. The project's long-term objective is to initiate repository operations during 2010.

4. NUCLEAR POWER INDUSTRY

Most nuclear power plants in the United States are privately owned though nine are owned and operated by government agencies. Operations are subject to safety regulations administered by the federal government including the Nuclear Regulatory Commission. Economic regulations administered by the federal, state, and local governments and institutions apply to the entire electric power supply industry. The following paragraphs discuss other segments of the nuclear power 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

Four companies have supplied nuclear steam supply systems currently operating in the United States. Westinghouse Corporation built the majority of pressurized water reactors (PWR) though 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 while Framatome ANP now owns elements of B&W's nuclear technology. General Electric designed all presently operating boiling water reactors (BWR) in the U.S.

There are now three new reactor designs approved by the NRC for construction in the U.S.; the System 80+ and AP600 of Westinghouse BNFL, and the Advanced Boiling Water Reactor (ABWR) from General Electric. Toshiba and Hitachi are also authorized to sell ABWR designs in the United States. Westinghouse has recently applied for certification of its AP1000 design. Other designs are under pre-application review, including the General Electric ESBWR, the Framatome SWR-1000, the General Atomics GT-MHR, and the Atomic Energy of Canada ACR-700 advanced Candu design. Eskom's Pebble Bed Modular Reactor and Westinghouse's IRIS design have also been discussed with the NRC.

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. Reprocessing is not available in the U.S. Steam generators for PWRs are no longer made in the United States and some high quality steel castings for nuclear reactors have to be imported. This reflects the slow growth of nuclear plant construction and the internationalisation of the nuclear energy business.

To help assure high quality products, the American Society of Mechanical Engineers (ASME) certifies nuclear equipment suppliers. To obtain a nuclear certificate of authorization, a company must comply with quality assurance requirements set forth by the ASME. This programme is open to foreign companies. Presently over 200 foreign and U.S. companies hold ASME nuclear certificates of authorization.

4.2. Operation of Nuclear Power Plants

Plant Operation

The 104 operable nuclear reactors are mostly privately owned and operated though eight are operated by government-owned entities. Twenty-eight companies and agencies now have nuclear power reactor licenses from the NRC.

Training Services

Training services are also available. Approximately 20 private companies provide training for nuclear plant operators. Training facilities also exist at each operating reactor. The Institute of Nuclear Power Plant Operations (INPO) sponsors a widely used training programme. INPO was founded in 1979 as industry's response to the Three Mile Island accident. It promotes 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. A re-examination of reprocessing is included in the National Energy Policy of 2001 though no commitment has been made.

Uranium Production and Conversion

There were six conventional uranium mills and eleven non-conventional plants in the United States at the end of 2001. Four mills and eight non-conventional mills were inactive at yearend. Uranium concentrate was produced at two mills from mine water during that year. Three in-situ leach plants were operated during the year and produced uranium concentrate. During 2001, 2.6 million pounds of uranium concentrate (U_3O_8) were produced in the United States. The nuclear industry in the United States is not expected to grow in the near future due to economic factors including the relatively low market price of uranium. Few companies are therefore actively involved in uranium production and conversion.

Uranium Enrichment

The uranium enrichment business in the United States was transferred in 1993 from DOE to a government-owned company, the U.S. Enrichment Corporation. USEC was created the year before under the Energy Policy Act of 1992, in order to privatise the U.S. enrichment business to make the U.S. more competitive in the global enrichment industry. USEC was subsequently privatised in 1998 via an initial public offering of common stock. USEC operates an enrichment facility (leased from DOE) at Paducah, Kentucky. A second facility at Portsmouth, Ohio stopped operations, but is being maintained in cold standby for future use if needed. The facilities used gaseous diffusion technology that is seen as dated and expensive. Both USEC and a second group, Louisiana Enrichment Services (LES), have indicated intentions to build more modern facilities, gas centrifuge enrichment facilities. USEC is proposing to use gas centrifuge technology developed by DOE. LES is proposing to use Urenco Technology currently in use in Europe.

USEC also signed a five-year contract in 1996 with Russia's Techsnabexport to purchase of low-enriched uranium (LEU) derived from highly enriched uranium (HEU) taken from dismantled Russian nuclear warheads. Uranium derived from Russian HEU might supply 13 million pounds of U.S. commercial requirements by 2004. The DOE has also announced plans to sell or transfer surplus inventories of HEU, LEU, and natural uranium from national defence materials. The scope of penetration of surplus defence materials into the U.S. uranium market is however restricted by legislation and trade policies.

Fuel Fabrication

Three companies currently fabricate uranium fuel in the United States for light-water reactor fuel.

Nuclear Waste Management

Commercial nuclear power reactors currently store most of their spent fuel on-site at the nuclear plant, although a small amount is shipped to off-site facilities. The NRC is reviewing several applications for privately owned independent spent fuel storage away-from-reactor-installations to store spent nuclear fuel. Several private firms 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. In 2000 EIA projected that by 2010, the reactors in the United States will be discharging 2,000 metric tons annually and the spent fuel discharged over the decade could amount to 23 thousand metric tons of uranium. During 2002 the U.S. Congress and the President approved plans to dispose of high-level waste in a geologic repository at Yucca Mountain in Nevada. DOE has indicated that it intends to submit license application for construction authorization to the NRC in late 2004. While objections and court proceedings from the state of Nevada and others continue, there is presently no legal hindrance to this project.

4.4. Research and Development Activities

Both private industry and the Federal Government conduct Research and Development (R&D) related to the nuclear industry. Private companies are actively investigate reactor technology, enrichment technology, 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 for the Nuclear Regulatory Commission and through the national laboratories operated by the U.S. DOE. The DOE operates 26 laboratories and institutes, many of which research 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 overcome the principal technical and scientific obstacles to the future use of nuclear energy in the United States. NERI is also helps 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 this R&D addresses include::

- proliferation-resistant reactors or fuel cycles;
- new reactor designs with higher efficiency, reduced cost, and enhanced safety;
- smaller 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.

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. The occasion for the signing was the Opening Plenary Session of the 22nd Annual Republic of Korea-United States of America Joint Standing Committee on Nuclear Energy Cooperation. Proposals for the program were solicited during July 2002.

The DOE in 2001 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 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 awarded merit-selected research grants in this summer 2002 to joint U.S.-French research teams. The joint research projects will support the recommendation in the Administration's Nuclear Energy Policy to pursue research that will develop next generation nuclear reactor technologies.

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 including Japan, South Korea, and the United States to supply two light water reactors to North Korea. The IAEA will also oversee the dismantling of the existing North Korea nuclear programme under the agreement.

The Nuclear Regulatory Commission's international program activities are wide-ranging. They encompass nuclear policy formulation, international safety cooperation and assistance, international technical information exchange, and cooperative safety research. These activities support NRC's domestic mission, as well as broader U.S. domestic and international interests. Maintaining a program of international cooperation enhances the safe, secure, and environmentally acceptable civilian uses of nuclear materials in both the U.S. and throughout the world. As a regulator of the world's largest civilian nuclear program, the NRC's extensive experience contributes to international programs in areas such as nuclear reactor safety, nuclear safety research, radiation protection, nuclear materials safety and safeguards, waste management, and decommissioning of nuclear facilities. The Nuclear Regulatory Commission helped found the International Nuclear Regulatory Association (INRA) in 1977, an organization of senior regulators from nations operating a substantial majority of the world's commercial nuclear reactors. The NRC also benefits significantly from the regulatory experience and safety research programs of other countries.

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 works with other nations with major nuclear power programmes to further nuclear safety research. These nations include France, Germany, Japan, and the United Kingdom.

The NRC has concluded technical information exchange and general safety cooperation arrangements with the regulatory authorities of 34 countries plus Taiwan. These arrangements serve as communications channels for the prompt and reciprocal notification of safety problems that could affect both U.S. and foreign plants. They also provide the framework for bilateral cooperation in nuclear safety, safeguards, waste management, and environmental protection as well as for NRC's assistance activities to help other countries improve both their regulatory skills and their health and safety practices.

NRC currently participates in cooperative research with other countries, directly through bilateral agreements as well as multilateral agreements with OECD – NEA member States, and the European Union (EU). These programs examine key technical safety issues in regulating the safety of existing and proposed U.S. commercial nuclear facilities and in the use of nuclear materials. At present, NRC manages and coordinates approximately 90 bilateral and multilateral agreements with 25 countries which include, but are not limited to, research activities in the areas of: Thermal-Hydraulic Code Application and Maintenance, Severe Accident Research Program, Probabilistic Risk Assessment Program, Steam Generator Tube Integrity Program (SGTI), Instrumentation and Controls, Human Factors, Nuclear Fuels Research, Advanced Reactor Design, Fire Modelling Research, and Aging Research of Safety Components and Wire Systems. NRC also includes support for the Agency for International Development (USAID)-related work for Russia, assisting the Russian Regulatory organization (GAN) in developing analytical risk assessment methods and evaluation techniques for light water reactors.

The U.S. continues nuclear safety cooperation with the former Soviet Union and countries of central and Eastern Europe. These activities strengthen their regulatory organizations, train foreign inspectors, and work toward operational safety and risk reduction. States receiving assistance include Armenia and Kazakhstan.

The United States played a leading role in resolving implementation issues for the International Convention on Nuclear Safety, which entered into force in October 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.

5. NUCLEAR LAWS AND REGULATIONS

5.1. Regulatory Framework

The Nuclear Regulatory Commission (NRC) is the principal regulator of the nuclear power industry. The NRC's mission is to regulate the Nation's civilian use of by-product, source, and special nuclear materials to ensure adequate protection of public health and safety, to promote the common defence and security, and to protect the environment. Responsibilities include:

- Commercial reactors for generating electric power and nonpower reactors used for research, testing, and training

- Uranium enrichment facilities and nuclear fuel fabrication facilities

- Uses of nuclear materials in medical, industrial, and academic settings and facilities that produce nuclear fuel

- Transportation, storage, and disposal of nuclear materials and waste, and decommissioning of nuclear facilities from service

5.2. Main National Laws and Regulations

The U.S. Congress has enacted several laws, which delineate 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 such activities as well.

Legislation outlined in Table 8 affects the U.S. nuclear industry but also covers the entire electric power industry. The legislation outlined in Table 9 affects the nuclear power industry specifically. These lists are not exhaustive; additional national legislation affecting the nuclear industry also exists. Although the Federal Government has an extensive role in the nuclear industry, there is also a regulatory role for the individual states and some local jurisdictions.

The Energy Policy Act of 1992 (EPACT) specified a new nuclear power plant licensing process. Under the new licensing procedure, an applicant who seeks to build a new reactor, can use off-the shelf reactor designs that have been previously approved and certified by the NRC. After reviewing the application and holding public hearings, the NRC may issue a combined construction and operating license (the previous process separated these licenses and which were issued at different times). When the applicant uses an NRC-certified design, safety issues related to the design will have been already resolved, and the main concern will be the quality of reactor construction.

Before authorizing power operation at a reactor, the NRC performs comprehensive testing and acceptance procedures. The new licensing process is codified in part 52 of Title 10, Code of Federal Regulations and is ready for use after certification of the new designs is completed. The new license procedure seeks a more predictable process and less financial risk to the applicant.

In 2001, NRC completed its rule for the licensing of a geologic disposal facility at Yucca Mountain, Nevada in 10 CFR Part 63. Thus, a comprehensive regulation framework is now in place for use in reviewing a license application for the proposed Yucca Mountain facility.

The revise 10 CFR 70 became effective on October 18, 2000. The revised safety regulations for special nuclear material provides a risk informed and performance-based regulatory approach that includes: (1) the identification of performance requirements for prevention of accidents or mitigation of their consequences; (2) the performance of an Integrated Safety Analysis (ISA) to identify potential accidents at the facility and the items relied on for safety; (3) the implementation of measures to ensure that the items relied on for safety are available and reliable to perform their functions when needed; (4) the maintenance of the safety bases, including the reporting of changes to the NRC; and (5) the allowance for licensees to make certain changes to their safety program and Fabrication Facility and gas centrifuge uranium enrichment facilities will be reviewed for compliance with 10 CFR 70.

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 give the Securities and Exchange Commission authority to break up large and powerful trusts that controlled the Nation's electric and gas distribution networks and to regulate the reorganised industry to prevent the return of new trusts. PUHCA was recently overhauled because many argued that the law's regulations impeded 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 PUHCA. It provides 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 usually a series of intrastate transactions.
The Public Utility Regulatory Policies Act of 1978 (PURPA) (Public Law 95-617)
PURPA sought to promote conservation of electric energy in response to the unstable energy climate of the late 1970's. PURPA created a new class of non-utility generators, small power producers, from which, along with qualified co-generators, utilities were required to buy power.

The Energy Tax Act of 1978 (ETA) (Public Law 95-618)
ETA, like PURPA, was passed in response to the unstable energy climate of the 1970's. ETA encouraged the 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. ETA was later expanded to include other renewable technologies. These incentives were curtailed in the mid-1980's as a result of tax reform legislation.
The Clean Air Act Amendments of 1990 (Public Law 101-549)
These amendments established a new emissions-reduction programme that sought 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 were to responsible for large portions of the sulphur dioxide and nitrogen oxide reductions. The programme employed a unique, market-based approach to sulphur dioxide emission reductions, while relying on more traditional methods for nitrogen oxide reductions. This legislation continues to evolve and specific targets change with national policies.
The Energy Policy Act of 1992 (EPACT) (Public Law 102-486)
EPACT created a new category of electricity producer, the exempt wholesale generator, which circumvented PUHCA's impediments to non-utility electricity generation. EPACT also allowed FERC to open the national electricity transmission system to wholesale suppliers. Seven of EPACT's 30 Titles contain provision related specifically to nuclear power and/or uranium.

Source: Country Information.

Two important issues of national concern are the disposal of spent fuel and decommissioning of retired nuclear plants. The Federal Government collects a fee of one mill (one-tenth of a cent) per kilowatt-hour from companies for nuclear-generated electricity under a general contract with nuclear-generating firms. This money goes into the Nuclear Waste Fund, which pays 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. The DOE annually evaluates the adequacy of the fees collected for nuclear waste disposal. Expenditures of all waste fund monies are subject to Congressional oversight and authorization. While these charges are passed on to consumers in a regulated environment, they are treated as costs under competitive electricity provision.

The NRC has established procedures for site release and minimum funding levels for decommissioning. 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. Required decommissioning funds for individual reactors amount to several hundred million dollars for each unit. Controversies have arisen at specific sites regarding whether funding is sufficient or in excess and whether decommissioning funds are the property of the ratepayers or of the reactor owners. The resolution of these issues has varied from reactor to reactor.

TABLE 9. IMPORTANT LEGISLATION AFFECTING THE NUCLEAR POWER INDUSTRY

Atomic Energy Act of 1954, as amended (Public Law 83-703)
The Atomic Energy Act of 1954 encouraged 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.
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 (LLW). Each state was made responsible for providing, by itself or in co-operation with other states, for the disposal of LLW generated within the state. The Act authorizes the states to form compacts to establish and operate regional LLW disposal facilities, 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 (HLW) and spent nuclear fuel. This Act was amended in 1987 to require the US Department of Energy to begin evaluating the suitability of Yucca Mountain in Nevada as the nation's permanent high-level waste repository. That process was complete and approved by Congress during

2002. Also during 2002 Congress overrode objections to the Yucca Mountain facility by the state of Nevada. Judicial, and possibly, political hurdles to the Yucca Mountain facility may yet remain.

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 among 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 safeguarded 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 other 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). The United States has also entered into trilateral agreements with IAEA and other countries for the safeguards 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 -Implementing Arrangement **G -Cooperation Molybdenum 99 **G	June 25, 1969 October 16, 1997 February 8, 1999	July 25, 1969 October 16, 1997 February 8, 1999	July 24, 1999 October 16, 2002 February 8, 2003	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
China -Research Reactor Fuel **G -Peaceful Uses of Technology **G -Annex 1 **G	July 23, 1985	December 30, 1985 February 23, 1995 June 29, 1998 June 29, 1998	December 29, 2015 (none cited) June 29, 2003 June 29, 2003	TIAS No.12027, —UST—[1]
Colombia	January 9, 1981	December 30, 1985	September 6, 2013	TIAS No. 10722, —UST—
Czech Republic		February 13, 1992	February 12, 2022	
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
France Statement of Intent, Low-Level Waste *B Agreement, Radioactive Waste Mgt. *B Agreement, Radioactive Waste Mgt. *B Implementing Arrangement #1 **G Cooperation Agreement **G	 June 20, 1986 September 20, 1995 October 8, 1995 September 18, 2000 July 9, 2001	 June 20, 1986 September 20, 1995 October 8, 1995 September 18, 2000 July 9, 2001	 (none cited) September 20, 2000 October 8, 2000 September 18, 2005 July 9, 2006	
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

TABLE 10. LIST OF AGREEMENTS FOR PEACEFUL NUCLEAR COOPERATION

Agreement	Date Signed	Effective Date	Termination Date	Citation
IAEA[5]	May 11, 1959	August 7, 1959	-	TIAS No. 4291, 10 UST 1424
-amendment	February 12, 1974	May 31, 1974	August 6, 2014	TIAS No. 7852, 25 UST 1199
-amendment	January 14, 1980	May 6, 1980	-	TIAS No. 9762, 32 UST 1424
Japan	February 26, 1968	July 17, 1988	July 17, 2018	TIAS No. 6517, 19 UST 5214
-amendment	February 24, 1972	April 26, 1972	-	TIAS No. 7306, 23 UST 275
-amendment	March 28, 1973	December 21, 1973	July 9, 2003	TIAS No. 7758, 24 UST 1102
-with Nuclear Fuel Development Corporation of Japan **G		December 3, 1986	December 2, 2001	
-with Japan Atomic Energy Research Institute		July 17, 1988[9]	July 17, 2005	
-with Japanese Research Organizations **G		April 11, 1995 July 17, 1995	April 11, 2005 July 17, 2005	
-with Japan Atomic Energy Research Institute **G		July 17, 1998	July 17, 2000	
--with Power Reactor and Nuclear Fuel Development Corporation *B				
-with Japan Nuclear Cycle Developments Institute *B		August 22, 2000 July 10, 2002	August 22, 2005 July 10, 2005	
--with Nuclear Waste Management Org. *B				
Korea	November 24, 1972	March 19, 1973	March 18, 2014	TIAS No. 7583, 24 UST 775
-amendment	May 15, 1974	June 26, 1974	March 18, 2014	TIAS No. 7842, 25 UST 1102
-Cooperative Laboratory Relationship		June 14, 1996	June 14, 2001	
-Annex 4 **G		June 29, 2000	June 29, 2005	
-Annex 5 **G		May 16, 2001	May 16, 2006	
--Amendment C to Annex III **G		May 16, 2001	June 14, 2001	
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

TABLE 10. LIST OF AGREEMENTS FOR PEACEFUL NUCLEAR COOPERATION

Agreement	Date Signed	Effective Date	Termination Date	Citation
Russian Federation -Disposition of HEU **G -Replacement of Plutonium Reactors **G Agreement Enhancing Safety - Civilian Nuclear Reactor Safety Appendix G, Memo of Understanding *B Appendix H, Memo of Understanding *B Appendix C, Transport Process *B Protocol Extending Agreement *B		 February 18, 1993 March 16, 1994 June 13, 1995 September 16, 1996 May 18, 2000 May 18, 2000 June 2, 2000 June 30, 2000	 (none cited) (none cited) June 13, 2000 September 16, 2001 September 3, 2003 September 3, 2003 September 30, 2003 June 30, 2005	
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 --Agreement, Radioactive Waste Mgt. *B	December 19, 1983 October 23, 1995	April 11, 1984 October 23, 1995	April 10, 2014 October 23, 2000	TIAS No. —, —UST—[7]
Switzerland -amendment Agreement, Radioactive Waste Mgt. *B	December 30, 1965 November 2, 1973 December 23, 1997	August 8, 1966 January 29, 1974 December 23, 1997	August 7, 1996 December 23, 2002	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	
United Kingdom *P	September 17, 2001	September 17, 2001	September 17, 2006	

[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).

[10] United States Nuclear Regulatory Commission, *Information Digest 2001 Edition*, NUREG-1350, Volume 10.

[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).

[12] Energy Information Administration, *Uranium Industry Annual 1998*, DOE/EIA-0478(98).

[13] Bureau of Economic Analysis, U.S. Department of Commerce, *National Accounts Data*, (http://www.bea.doc.gov//bea/dn2/gposhr.htm).

[14] Bureau of Census, U.S. Department of Commerce, *Historical National Population Estimates: 1900-1998*, (http://www.census.gov/population/estimates/nation/popclockest.txt).

[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

OTHER ORGANIZATIONS[1]

Operators/Owners of Nuclear Power Plants

Ameren UE	http://www.ameren.com
American Electric Power (AEP)	http://www.aep.com/
Constellation	http://www.constellation.com/
Detroit Edison	http://www.detroitedison.com/
Dominion Nuclear	http://www.dom.com/about/stations/nuclear/index.jsp
Duke Power	http://www.duke-energy.com/decorp/content/Default.asp
Energy Northwest	http://www.energy-northwest.com/
Entergy Nuclear	http://www.entergy-nuclear.com/
Exelon	http://www.exeloncorp.com/generation/nuclear/pg-nuclear-main.html
First Energy	http://www.firstenergycorp.com/welcome/
FPL Nuclear	http://www.fpl.com/about/nuclear/contents/nuclear_power_serves_you.shtml
Nebraska Public Power District	http://www.nppd.com/index.asp
Nuclear Management Co.	http://www.nmcco.com/
Omaha Public Power District	http://www.oppd.com/
Pacific Gas & Electric	http://www.pge.com/
Pennsylvania Power & Light	http://www.pplweb.com/

[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.

Pinnacle West	http://www.pinnaclewest.com/
Progress Energy	http://www.progressenergy.com/
PSE&G	http://www.pseg.com/
Scana	http://www.scana.com/
South Texas Nuclear Operating Company	http://www.stpnoc.com/
Southern Californian Edison	http://www.sce.com/sc3/default.htm
Southern Nuclear Operations	http://www.southerncompany.com/southernnuclear/home.asp?mnuOpco=soco&mnuType=sub&mnuItem=sn
Tennessee Valley Authority (TVA)	http://www.tva.gov/
TXU	http://txu.com/us/default.asp
Wolf Creek Nuclear Operating Corporation	http://www.wcnoc.com/start.cfm

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

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/
General Atomics	http://www.gat.com/
NAC International	http://www.nacintl.com/
New York Nuclear and Washington Nuclear	http://www.nynco.com/
The Uranium Exchange Company	http://www.uxc.com/
Westinghouse	http://www.westinghouse.com/
BNFL Inc. (U.S. subsidiary of British Nuclear Fuels plc)	http://www.bnfl.com/website.nsf/
Compagnie Générale des Matières Nucléaires (COGEMA)	http://www.cogema-inc.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/
Nuclear Energy Institute	WWW.NEI.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/
Indiana University Cyclotron Facility	http://www.iucf.indiana.edu/
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/
Stanford University	http://www.stanford.edu/
Department of Nuclear Engineering University of California, Berkeley	http://www.nuc.berkeley.edu/
University of California, Davis	http://www.ucdavis.edu/
University of California, San Diego (UCSD)	http://infopath.ucsd.edu/
University of Maryland Nuclear Physics Group	http://www.physics.umd.edu/enp/
University of Washington Nuclear Physics Laboratory	http://www.npl.washington.edu/
University of Wisconsin	http://wiscinfo.wisc.edu/
University of Wisconsin Reactor Laboratory	http://reactor.engr.wisc.edu/