UNITED STATES OF AMERICA

UNITED STATES OFAMERICA

1. ENERGY, ECONOMIC AND ELECTRICITY INFORMATION

The United States of America's (U.S.) nuclear power industry is large and generally comprehensive. The industry includes most phases of the fuel cycle, from uranium exploration and mining to nuclear waste disposal, but does not include reprocessing. In addition to domestic contributions, many services and supplies to the nuclear power industry are also available and sourced as imports. Most of the U.S. nuclear power industry is privately owned and managed and is 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 industry. Federal government and regional agencies own and manage nine operable power reactors.

1.1. General Overview

The United States 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. Economic statistics for the United States are regularly published by the U.S. Department of Commerce's Bureau of Economic Statistics.Table 2 shows the historical Gross Domestic Product (GPD) statistics. The energy situation in the United States is provided in the Energy Information Administration's (EIA) regularly updated Country Analysis Brief for the United States. Table 3 shows the US energy reserves and Table 4 the historical energy statistics.

TABLE 1. POPULATION INFORMATION

	1970	1980	1990	2000	2001	2002	Growth rate (%/yr) 1990 To 2002
Population (millions)	210.1	230.4	254.1	285.0	288.0	291.0	1.1
Population density (inhabitants/km²)	22.4	24.6	27.1	30.4	30.7	31.1	

Predicted population growth rate (%) 2002 to 2010	6.4
Area (1000 km²)	9373.0
Urban population in 2002 as percent of total	77.7

Source: IAEA Energy and Economic Database.

TABLE 2. GROSS DOMESTIC PRODUCT (GDP)

	1980	1990	2000	2001	2002	Growth rate (%/yr) 1990 To 2002
GDP (millions of current US$)	2,771,500	5,750,800	9,810,200	10,405,447	11,025,034	5.6
GDP (millions of constant 1990 US$)	4,208,610	5,750,800	7,926,059	8,264,449	8,613,100	3
GDP per capita (current US$/capita)	12,029	22,634	34,421	36,127	37,882	4.4

Source: IAEA Energy and Economic Database.

TABLE 3. ESTIMATED ENERGY RESERVES

	Estimated energy reserves in (Exajoule)					
	Solid	Liquid	Gas	Uranium (1)	Hydro (2)	Total
Total amount in place	5796.68	158.86	181.40	190.55	432.35	6759.84

(1) This total represents essentially recoverable reserves.

(2) For comparison purposes a rough attempt is made to convert hydro capacity to energy by multiplying the gross theoretical annual capability (World Energy Council - 2002) by a factor of 10.

Source: IAEA Energy and Economic Database.

TABLE 4. ENERGY STATISTICS

	1970	1980	1990	2000	2001	2002	Average annual growth rate (%) 1970 To 1990	Average annual growth rate (%) 1990 To 2002
Energy consumption								
- Total (1)	67.51	75.57	79.67	98.97	99.59	100.55	0.83	1.96
- Solids (2)	13.40	17.84	20.67	28.36	28.00	27.26	2.19	2.33
- Liquids	28.21	31.97	31.19	34.87	34.98	35.01	0.50	0.97
- Gases	23.24	20.35	19.27	25.35	26.22	27.80	-0.93	3.10
- Primary electricity (3)	2.65	5.41	8.52	10.39	10.39	10.48	6.01	1.74
Energy production								
- Total	63.45	65.07	68.33	74.36	74.10	74.60	0.37	0.73
- Solids	15.55	20.51	23.74	28.39	28.48	28.80	2.14	1.62
- Liquids	22.41	20.10	17.81	15.15	14.90	14.99	-1.14	-1.43
- Gases	22.86	19.31	18.25	20.67	20.56	20.56	-1.12	1.00
- Primary electricity (3)	2.63	5.15	8.52	10.15	10.16	10.24	6.05	1.55
Net import (Import - Export)								
- Total	5.61	12.23	13.77	24.43	25.93	26.43	4.59	5.58
- Solids	-1.83	-2.17	-2.37	-1.16	-0.98	-0.79	1.30	-8.79
- Liquids	6.63	13.38	14.56	21.76	22.85	22.87	4.02	3.83
- Gases	0.82	1.02	1.57	3.82	4.06	4.35	3.33	8.84

(1) Energy consumption = Primary energy consumption + Net import (Import - Export) of secondary energy.

(2) Solid fuels include coal, lignite and commercial wood.

(3) Primary electricity = Hydro + Geothermal + Nuclear + Wind.

(*) Energy values are in Exajoule except where indicated.

Source: IAEA Energy and Economic Database.

1.2. Energy Policy

The United States has a market-driven economy. Decisions affecting resources, prices, technology development, and other matters pertaining to energy are made by the private sector within the context of government regulations and laws. However, through funding of research and development, tax allowances, service charges, regulations, and other mechanisms, federal and local governments encourage the development and use of selected energy resources. Favoured resources can vary by jurisdiction. Additional features of federal policy are contained in the Energy Policy Act of 1992 which covers a wide variety of issues, including energy efficiency standards, alternate fuels development, and renewable energy.

Energy statistics and projections for the United States are regularly published by the Energy Information Administration. An EIA publications list is available through www.eia.doe.gov/bookshelf.html. These publications include regular energy, electricity, and nuclear statistics and short and long term energy projections.

1.3 The Electricity System

1.3.1. Structure of the Electric Power Sector

The U.S. electric power industry is a combination of traditional commercial electric utilities and less traditional electricity-producing and marketing entities. Utilities include investor-owned, publicly owned, Federal, and co-operative firms. Historically, the larger companies were vertically integrated though structures have changed in many regions from regulated service 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 several thousand. Their activities are primarily 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 though the distinction between such utilities and independent producers sometimes hare to identify. 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.

The EIA publishes data related to the electric power industry and to the energy industry in general. The EIA's Country Analysis Brief for the United States publishes data and assessments of the United States in particular. Forecasts and projections to 2025 for the United States are published in the Annual Energy Outlook. Historical data are provided in the Annual Energy Review. Current publication information is also available.

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 and 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 utilities 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.

1.3.2. 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. Within the U.S., California originated the concept 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, though not all, States. In many States these regulate the prices for electricity that privately owned utilities might charge to retail customers though market or market-like mechanism have also been involved also involved since 1999 as utilities 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 consistent. Several other States have taken a more deliberative approach toward deregulation, especially following unanticipated price spikes in California and elsewhere, and others have withdrawn from initial ambitious targets. Nonetheless, an overall trend remains toward increased market deregulation though through quite varied routes.

1.3.3. Main Indicators

Electricity data (Table 5) and energy related ratios (Table 6) follow.

TABLE 5. ELECTRICITY PRODUCTION AND INSTALLED CAPACITY

							Average annual growth rate (%)	
	1970	**1980**	**1990**	**2000**	**2001**	**2002**	**1970 To 1990**	**1990 To 2002**
Electricity production (TW.h)								
- Total (1)	1639.77	2354.38	3196.69	4128.02	4161.68	4189.98	3.39	2.28
- Thermal	1366.75	1820.28	2312.64	3075.23	3107.95	3127.22	2.66	2.55
- Hydro	250.70	277.92	288.96	275.14	261.13	258.89	0.71	-0.91
- Nuclear	21.80	251.12	576.78	753.90	768.83	780.10	17.80	2.55
- Geothermal	0.53	5.07	16.01	18.14	18.14	18.14	18.64	1.05
Capacity of electrical plants (GWe)								
- Total	360.33	630.11	733.33	798.09	800.08	806.04	3.62	0.79
- Thermal	298.00	495.97	535.51	593.93	595.55	600.08	2.97	0.95
- Hydro	55.75	76.65	92.36	98.13	98.25	98.76	2.56	0.56
- Nuclear	6.49	56.49	101.05	98.23	98.23	98.23	14.71	-0.24
- Geothermal	0.08	1.01	2.65	5.44	5.54	6.22	18.82	7.38
- Wind			1.77	2.37	2.51	2.76		3.79

(1) Electricity losses are not deducted.

Source: IAEA Energy and Economic Database.

TABLE 6. ENERGY RELATED RATIOS

	1970	**1980**	**1990**	**2000**	**2001**	**2002**
Energy consumption per capita (GJ/capita)	321	328	314	347	346	345
Electricity per capita (kW.h/capita)	7,815	10,334	11,852	13,845	13,221	13,277
Electricity production/Energy production (%)	25	35	45	54	54	54
Nuclear/Total electricity (%)	1	11	18	18	18	19
Ratio of external dependency (%) (1)	8	16	17	25	26	26
Load factor of electricity plants						
- Total (%)	52	43	50	59	59	59
- Thermal	52	42	49	59	60	59
- Hydro	51	41	36	32	30	30
- Nuclear	38	51	65	88	89	91

(1) Net import / Total energy consumption.

Source: IAEA Energy and Economic Database.

2. NUCLEAR POWER SITUATION

2.1. Historical Development and current nuclear power organizational structure

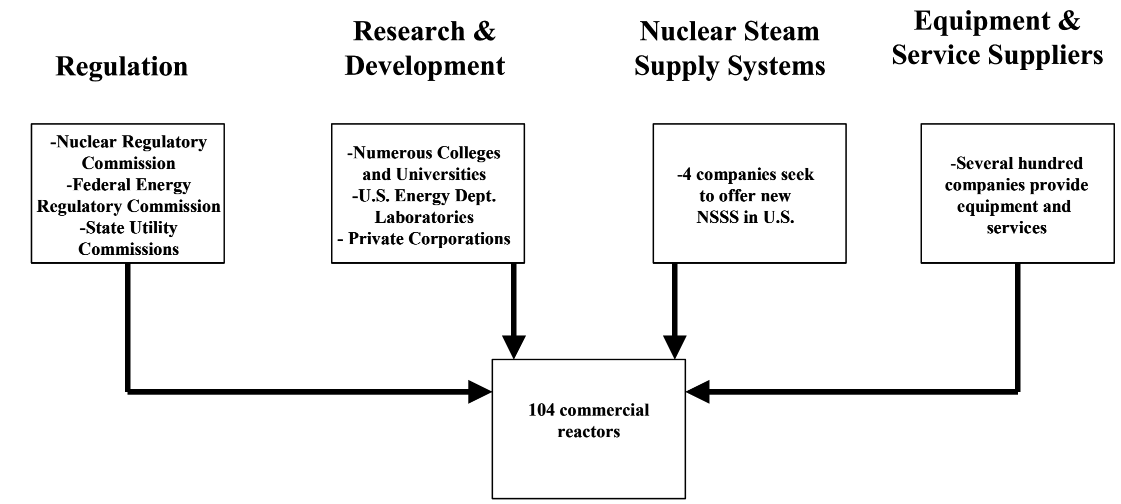
2.1.1. Overview

The early growth of the U.S. commercial nuclear power followed President Eisenhower's Atoms for Peace programme that encouraged civilian nuclear power applications while retaining a strong nuclear weapons technology. The Atomic Energy Act of 1954 made possible several demonstration and development reactor 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. The process of placing orders had however actually begun to decline prior to Three Mile Island as many projects were cancelled or deferred as anticipated electricity demand growth slowed and nuclear construction costs grew. Many previously initiated construction projects continued after 1979 though sometimes schedules were deliberately drawn out. The last new reactor in the United States, Watts Bar 1, was completed in 1996. No additional plants have been 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. Plans to dismantle WNP 1 imply that the license there might be abandoned.

2.1.2. Current Organizational Chart

Supporting the operation of nuclear power plants in the U.S. is a an extensive industrial base, including reactor manufactures, numerous companies supplying major system components, both mechanical and electrical, and companies supplying equipment and services to plants.



Nuclear Fuel Cycle

Uranium Production	Uranium Conversion	Uranium Enrichment	Fuel Fabrication	Waste Management
- 2 major companies	-1 Uranium hexafluoride facility	-enrichment company -additional proposed	- 3 companies	-Most stored at reactor site -Yucca Mountain approved

2.2. Nuclear Power Plants: Status and Operations

2.2.1. Status of Nuclear Power Plants

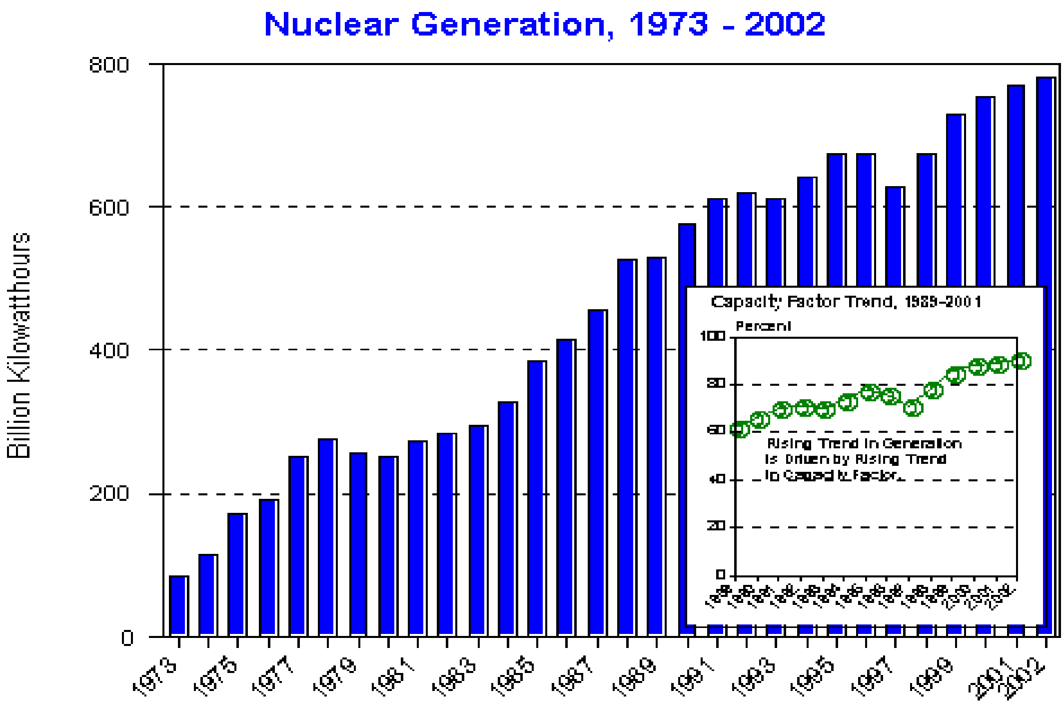
The nuclear power industry grew to its present size following construction programmes initiated during the 1960's and 1970's when nuclear power was anticipated to be a low cost source of electricity. Increases in nuclear generating capacity during 1969-1996 made nuclear power the second largest source of electricity generation in the U.S., following coal. 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 during the 1990's. Several nuclear reactors were permanently closed during the 1990s though many were small or prototype units. The last units closed were during 1998.

Annual nuclear electricity generation has more than tripled since 1980 to 780 billion kW·h in 2002. Nuclear power now accounts for over 20 percent of total electricity generation in the United States. The positive nuclear power record has been influenced by growth in reactor productivity as measured by an increase in capacity factors from 56% in 1980 to 66% in 1990 and over 90% in 2002. 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 though the plant's owner/operator, the Tennessee Valley Authority, intends to restart the reactor by 2007. Reactors are located at 65 sites (plants) throughout the United States with most located in the eastern half of the country. Reactors had a total net summer capacity of 98.7 MW(e) by the end of 2002. Table 7 shows the current status of nuclear power plants.

Over 40 years of operational experience and steadily improving licensee performance have changed the way that the U.S. regulates nuclear power. This has taken the form of a more risk-informed and performance-based 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 also continue to revise regulations to focus requirements on plant programs and activities that are most risk significant.

2.2.2. Performance of Nuclear Power Plants

An increasing need for additional power in the U.S. along with improved economic and safety performance have led many licensees to renew their operating licenses for an additional 20 years beyond the their initial 40-year limits. Twenty-three reactors have extended their operating licenses since 2000. Applications to extend the licenses of at least 35 additional reactors are anticipated through 2006. Expectations are that essentially all operating reactors in the U.S. will eventually apply for operating license renewals. The NRC publishes the updated status of such applications on its website. A review of this list indicates that some of the oldest units in the U.S. have yet to apply.



2.2.3. Plant Uprating

Licensees have also implemented power uprates throughout their history as a means to increase the output of their reactors. This process has grown considerably in recent years. Power uprates are classified by the Nuclear Regulatory Commission (NRC) in three groups: (1) measurement uncertainty recapture uprates of less than 2 percent implement enhanced techniques for calculating reactor power, (2) stretch power uprates are typically less than 7 percent and do not usually involve major plant modification, and (3) extended power uprates, larger than stretch power uprates, require significant modification to major balance-of-plant equipment. Extended uprates have been approved for increases as much as 20 percent, though these might take place over several stages of plant modification. As of April 2003, the NRC has approved 92 power uprates adding about 4022 MW(e) to the generating capacity in the United States. This is equivalent to more than 4 average sized nuclear power plants. The NRC no longer publishes data on anticipated uprates but a survey by the Energy Information Administration in indicates that 1743 MWe will be added through uprates between 2003 and 2007 or the equivalent of slightly less than two average sized U.S. reactors.

2.2.4. Nuclear Power Development Plans

The Administration's 2001 National Energy Policy identified nuclear energy as a key part of the Nation's targeted energy mix. During 2002, the U.S. Department of Energy initiated its Nuclear Power 2010 (NP2010) program. Initially the program set a 2010 target for the completion of two new nuclear power plants under its Nuclear Power 2010 program though this schedule is now less precise. Any construction would exclude presently certified reactor designs but could involve reactors that are presently in the design certification process. Three utilities, Dominion Resources, Exelon, and Entergy have applied during 2004 early site permits (ESP) which will allow them to initiate nuclear power site clearances prior to commitments to build. Several other firms have indicated that they might be interested in the ESP process. The U.S. Department of Energy also hopes to make arrangements for the joint funding of combined operating licenses (COL) at two sites by the end of 2004. A COL is the last federal licensing requirement before construction is permitted to begin, though the COL is valid for at least ten years prior to actual construction. Plant vendors assert that construction costs of new designs could match the costs of building new coal-fired units. These cost claims for as yet unbuilt designs have not been verified by actual experience, so the difference in view is unresolved.

The future of nuclear power will depend on several factors including successfully dealing with nuclear waste issues, the reduction of nuclear capital costs, and favourable government policies. Progress has been made on each including the 2002 federal approval of a long-term high level 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 streamlined its licensing process for future nuclear power reactors, an area in which it has lacked recent experience. The goal of each of these changes is to shorten construction lead-times and to improve the economics of new reactor technology. The U.S. government goal is that these and similar actions might restart the construction of nuclear power plants by the end of the decade.

The Energy Information Administration of the U.S. Department of Energy maintains material related to the status of U.S. nuclear power plants including links to additional information.

TABLE 7. STATUS OF NUCLEAR POWER PLANTS (December 31, 2002)

Station	Type	Capacity MWe	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	984	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	831	FIRSTENERGY	Operational	WEST	01-May-74	04-Aug.-87	17-Aug.-87	17-Nov.-87	
BRAIDWOOD-1	PWR	1185	EXELON	Operational	WEST	01-Aug.-75	29-May-87	12-Jul.-87	29-Jul.-88	
BRAIDWOOD-2	PWR	1177	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	1113	TVA	Operational	GE	01-May-67	20-Jul.-74	28-Aug.-74	01-Mar-75	
BROWNS FERRY-3	BWR	1113	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	1194	EXELON	Operational	WEST	01-Apr.-75	02-Feb.-85	01-Mar-85	16-Sept.-85	
BYRON-2	PWR	1162	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	845	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	1017	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	842	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	850	EXELON	Operational	GE	01-Jan.-66	07-Jan.-70	13-Apr..-70	09-Jun.-70	
DRESDEN-3	BWR	850	EXELON	Operational	GE	01-Oct.-66	31-Jan.-71	22-Jul.-71	16-Nov.-71	
DUANE ARNOLD-1	BWR	566	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 2002.

TABLE 7. CONTINUED. STATUS OF NUCLEAR POWER PLANTS (December 31, 2002)

Station	Type	Capacity MWe	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	1231	ENTERGY	Operational	GE	01-May-74	18-Aug.-82	20-Oct.-84	01-Jul.-85	
H.B. ROBINSON-2	PWR	710	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	1130	EXELON	Operational	GE	01-Sept.-73	21-Jun.-82	04-Sept.-82	01-Jan.-84	
LASALLE-2	BWR	1130	EXELON	Operational	GE	01-Oct.-73	10-Mar-84	20-Apr..-84	19-Oct.-84	
LIMERICK-1	BWR	1134	EXELON	Operational	GE	01-Apr.-70	22-Dec.-84	13-Apr..-85	01-Feb.-86	
LIMERICK-2	BWR	1134	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	605	AMER	Operational	GE	01-Jan.-64	03-May-69	23-Sept.-69	01-Dec.-69	
PALISADES	PWR	767	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 2002.

TABLE 7. CONTINUED. STATUS OF NUCLEAR POWER PLANTS (December 31, 2002)

Station	Type	Capacity MWe	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	855	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	FPL	Operational	WEST	01-Jul.-76	13-Jun.-89	29-May-90	19-Aug.-90	
SEQUOYAH-1	PWR	1126	TVA	Operational	WEST	01-May-70	05-Jul.-80	22-Jul.-80	01-Jul.-81	
SEQUOYAH-2	PWR	1125	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	1105	PP&L	Operational	GE	01-Nov.-73	10-Sept.-82	16-Nov.-82	08-Jun.-83	
SUSQUEHANNA-2	BWR	1111	PP&L	Operational	GE	01-Nov.-73	08-May-84	03-Jul.-84	12-Feb.-85	
THREE MILE ISLAND-1	PWR	816	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 2002.

TABLE 7. CONTINUED. STATUS OF NUCLEAR POWER PLANTS (December 31, 2002)

Station	Type	Capacity MWe	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	ENTERGY	Operational	GE	01-Dec.-67	24-Mar-72	20-Sept.-72	30-Nov.-72	
VIRGIL C. SUMMER-1	PWR	986	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	1091	ENTERGY	Operational	CE	01-Nov.-74	04-Mar-85	18-Mar-85	24-Sept.-85	
WATTS BAR-1	PWR	1138	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 2002.

TABLE 7b. TABLE OF OPERATORS

Code	Operator Name
AMERUE	AMEREN (UNION ELECTRIC)
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

2.3. Supply of NPPs

2.3.1. Nuclear Steam Supply Systems (NSSS)

Four companies supplied nuclear steam supply systems currently operating in the United States. Westinghouse Corporation built the majority of pressurized water reactors (PWR) though Combustion Engineering (CE) and Babcock & Wilcox (B&W) also built 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. The American Nuclear Society's *Buyer's Guide 2003* for the nuclear industry lists eleven NSSS suppliers for the United States. The list includes several suppliers of designs not certified in the United States and excludes several suppliers that provide certified reactor designs or that have reactor designs in pre-certification with the NRC.

There are now three new reactor designs approved by the NRC for construction in the United States; 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. There are now seven reactor designs that are either undergoing certification or pre-certification procedures with the NRC. Other designs might be anticipated to join the process. Westinghouse has recently applied for certification of its AP1000 design. Pre-certified designs include the General Electric ESBWR, the Framatome SWR-1000, the General Atomics GT-MHR, and the Atomic Energy of Canada ACR-700 advanced Candu design.

2.3.2. Equipment and Service Suppliers

A large number of firms 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 and some high quality steel castings are no longer made in the United States for nuclear reactors. Domestic suppliers in the U.S. must often compete with imports. This has resulted in the slow growth of nuclear plant construction and the internationalisation of the nuclear energy business. The American Nuclear Society's annual *Buyer's Guide*, published in their journal *Nuclear News* provides a partial list of equipment and service providers to the nuclear industry.

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.

2.4. Operation of NPPs

2.4.1. Plant Operation

The 104 operable nuclear reactors are mostly privately owned and operated though nine are operated by government-owned entities. If several announced mergers are completed, twenty-five companies and agencies will have commercial reactor operating licenses from the NRC.

2.4.2. Training Services

Several 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.

2.5. Fuel Cycle and Waste Management

All activities of the commercial nuclear fuel cycle are conducted in the United States, with the exception of spent fuel reprocessing which U.S. fuel cycle policy prohibits. A re-examination of reprocessing is included in the National Energy Policy of 2001 though no commitment has been made. Each fuel cycle stage is subject to competition and supply from international sources which in many cases dominate the stage. At present the U.S. nuclear fuel supply is highly dependent on imports for mined uranium concentrates (80%), uranium conversion (48%), and enrichment (86%). Virtually all fuel fabrication requirements are met by domestic sources. The Energy Information Administration publishes data on the nuclear fuel cycle.

2.5.1. Uranium Production and Conversion

There were four operating conventional uranium mills and six non-conventional plants in the United States at the end of 2002. These numbers reflect a decline in the industry that continues. Additional conventional and non-conventional mills were inactive at yearend 2002. 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 2002, 2.3 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 due to the relatively low market price of uranium and the comparatively poor quality of domestic ores. Canada is the major source of concentrate imports though supplies have also come from Australia, Russia, Kazakhstan, Uzbekistan, Namibia, and a few additional locations.

The United States has one uranium conversion plant located at Metropolis, Illinois. Major sources of conversion service imports include Canada and Russia.

Data on uranium is published in the Uranium Industry Annual.

2.5.2. Uranium Enrichment

The uranium enrichment business in the United States was transferred in 1993 from DOE to a government-owned company, the United States Enrichment Corporation (USEC). USEC was created in 1992 under the Energy Policy Act of 1992 to make the U.S. more competitive in the global enrichment industry. USEC was 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 has stopped operations. 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. The LES facility would be located in New Mexico while the USEC site has not yet been announced.

USEC also signed a five-year contract (Megatons to Megawats) in 1996 with Russia's Techsnabexport to purchase of low-enriched uranium (LEU) derived from highly enriched uranium (HEU) 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 material stockpiles. The scope of penetration of surplus defence materials into the uranium market is however restricted by legislation and trade policies.

Enrichment services have also been imported from facilities in the United Kingdom, France, Germany, the Netherlands, and Russia.

2.5.3. Fuel Fabrication

Three companies (Framatome ANP, Global Nuclear Fuels, and Westinghouse) fabricate uranium fuel in the United States for light-water reactor fuel. Plants are located in Columbia, South Carolina; Wilmington, North Carolina; Richland, Washington; and Lynchburg, Virginia. Some product is exported to Japan

2.5.4. Nuclear Waste Management

Commercial nuclear power reactors currently store most of their spent fuel on-site at the nuclear plant, although a small amount has been shipped to off-site facilities. The spent fuel inventory in the United States was 42.7 thousand metric tons of uranium as of December 2000. In 2000 EIA projected that by 2010, the reactors in the United States will be discharging ~2,000 metric tons annually and the spent nuclear fuel (SNF) discharged over the decade would amount to approximately 23 thousand metric tons of uranium. By 2035, when the last of 118 commercial power reactors will have completed its initial 40-year license period, SNF containing a total of about 83,800 MTHM will have been generated dur8ing their initial planned. (Most commercial reactors will operate beyond forty years.) This projected inventory includes SNF resulting from burning approximately 33 MTHM of surplus weapons-usable plutonium in the form of mixed-oxide fuel in commercial nuclear reactors.

During 2002 Congress and the President approved plans to dispose of high-level waste (HLW) in a geologic repository at Yucca Mountain in Nevada. DOE intends to submit license application for construction authorization for this repository to the NRC in late 2004. While objections and court proceedings from the state of Nevada and others continue, there is presently no legal barrier to the completion of this project. The Nuclear Waste Policy Act (NWPA) of 1982 provides that the NRC may approve the emplacement in the first repository of a quantity of spent fuel containing no more than 70,000 MTHM or a quantity of solidified HLW resulting from the reprocessing of such quantity of spent fuel.

The Office of Civilian Radioactive Waste Management (OCRWM) manages nuclear wastes for the U.S. Department of Energy. OCRWM programs include:

- Program management activities are administered from Washington, DC. Responsibilities include oversight of quality assurance, program planning and administration, program management and integration, external interactions, human resources, and the OCRWM budget.

- The Yucca Mountain site is located in Nye County, Nevada, approximately 100 miles northwest of Las Vegas. For two decades, the OCRWM conducted scientific and engineering investigations at Yucca Mountain to determine its suitability as a nuclear waste repository.

- Development of waste acceptance, storage and transportation systems. Activities also include interactions with other waste owners, generators and international waste management programs

2.6. Research and Development

Both private industry and the Federal Government conduct research and development (R&D) for the nuclear industry. Private companies actively investigating reactor technology, enrichment technology, and nuclear fuel design. One of the main institutions for private research funding is through 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 national laboratories operated by private agencies licensed by the U.S. DOE. DOE includes 26 laboratories and institutes, many of which are involved with 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.

2.7. International Co-operation and Initiatives

During 2003 the director of the US Department of Energy's Office of Nuclear Energy, Science, and Technology was elected Chairman of the Steering Committee of the Nuclear Energy Agency. The United States Secretary of Energy also signed an agreement with the Republic of Korea's Minister of Science and Technology to conduct joint research on advanced proliferation resistant fuel cycle technologies. The United States also signed International Nuclear Energy Research Initiative (I-NERI) agreements with Canada and Brazil to foster collaborative research and development (R&D) on advanced nuclear technologies.

The preceding activities represent a portion of the Department of Energy's Office of Nuclear Energy, Science, and Technology is involved in several international nuclear programs. I-NERI agreements, for example, were initiated by the Department of Energy to foster international collaborative research and development on next-generation nuclear reactor and fuel cycle technology. The United States intends to sign such agreements with all members of the Generation IV International Forum (GIF) which is developing advanced, next-generation reactor designs that offer advantages in terms of economics, safety, proliferation-resistance, and waste minimization. GIF has targeted the implementation of five selected advanced designs by 2030 with some designs targeted for earlier implementation.

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 energy arrangements 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.

2.8. Human Resources Development

The United States shares the global trend of declining enrollments in nuclear engineering schools. The work force in the nuclear power industry is aging and it is feared that many professional skills might vanish as the staff at nuclear power and research facilities retire. Without any active program of construction in the nuclear power industry, it is not clear what level of trained personnel will be required by the industry in the future. The long term trend toward a decline in the number of university programs offering nuclear engineering degrees ended in 2002 when to schools added new programs.

The U. S. DOE's Office of Nuclear Energy, Science and Technology has an active program to encourage the development of academic programs related to nuclear power. The American Nuclear Society, a professional organization, also promotes the improvement of academic work related to nuclear power at higher education institutions.

3. NATIONAL LAWS AND REGULATIONS

3.1. Safety Authority and the Licensing Process

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

3.2. Main National Laws and Regulations in Nuclear Power

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.

During 2003 the United States Congress considered an Energy Policy bill the encompassed a broad area of energy reforms. The bill failed to pass in the Senate during 2003 and was deferred until at least 2004 for further consideration. If the bill is passed in both legislative houses and signed by the President it could have major effects on US policy toward nuclear power and energy in general. There is no certainty regarding passage or content prior to those events.

4. CURRENT ISSUES AND DEVELOPMENTS ON NUCLEAR POWER

4.1. Energy Policy

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 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 Energy 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.

4.2. Privatisation and deregulation

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. 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."

4.3. Role of the government in the nuclear R& D

The United States government's involvement in nuclear research and development includes both programs supported by the Department of Energy's Office of Nuclear Energy, Science, and Technology and in activities conducted at an array of national laboratories. Financial support is also provided to research at several private and state government funded universities scattered throughout the nation. Research covers a variety of topics ranging from commercial nuclear power to the fuel cycle to weapons technology to basic nuclear physics.

4.4. Nuclear Energy and Climate Change

The relationship between nuclear energy and climate change is an active area of government and private sector interest in the United States. The U.S. Department of Energy's Energy Information Administration publishes many documents on climate change issues. The Environmental Protection Agency coordinates most U.S. activities related to global warming. There are many nongovernmental agencies that also discuss the interactions of nuclear energy and climate change. The Nuclear Energy Institute (NEI) which represents U. S. nuclear energy industry interests discusses industry views on nuclear power and climate change The lead agency in the U.S. hydrogen policy is the Department of Energy's Office of Energy Efficiency and Renewable Energy.

4.5. Safety and waste management issues

The Nuclear Regulatory Commission (NRC) is the primary agency involved in nuclear safety regulation. This regulatory responsibility includes safety evaluations and rules related to waste management. The actual management of nuclear waste is the responsibility of the U.S. Department of Energy which handles waste through its Office of Civilian Radioactive Waste Management (OCRWM). The primary intended ultimate destination for long-lived, high level waste (HLW) civilian radioactive waste will be the Yucca Mountain Project in Nevada. A smaller HLW facility already exists in Carlsbad, New Mexico. The selection of the Yucca Mountain Project site remains a controversial issue with state and local authorities in Nevada taking the lead role in judicial and legislative challenges to the site's selection.

4.6. Other issues

The Department of Energy's Office of Nuclear Energy, Science, and Technology's Nuclear Power 2010 (NP2010) intends to complete the construction of the next commercial nuclear power plant in the United States within the next ten years or less. In the NP2010 process the Department of Energy intends to provide financial assistance in key licensing/regulatory areas including combined operating licenses and reactor design certification. Government sites might also be made available for nuclear power investments. The Department of Energy also is a key player in the Generation IV International Forum (GIF) which is intended to contribute to the commercial development of next generation reactor designs by 2030. Congressional websites (Senate and House of Representatives) can often be accessed for transcripts and broadcasts of committee hearings on nuclear power.

The decline of the domestic uranium mining industry in the United States has been a matter of concern to some authorities. At present most uranium used in the United States is imported and services processing and enriching uranium fuels are also imported. At present the United States does not reprocess spent fuels though the topic is now subject to review under the present Administration's Energy Policy guidelines. Other items and goals subject to investigation include research into spent fuel waste transmutation and the advancement of advanced commercial reactor designs.

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Appendix 1

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.

The site https://ostiweb.osti.gov/iaem/ includes both bilateral and multilateral agreements.

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

International agreements related to the U.S. Department of Energy are handled by the Office of Policy and International Agreements.

Appendix 2

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/

[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.

Pennsylvania Power & Light http://www.pplweb.com/

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 BNFL 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/