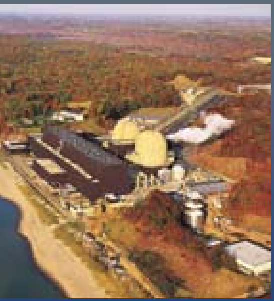
U.S.NRC

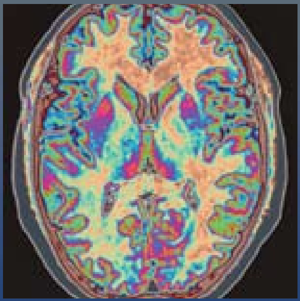
United States Nuclear Regulatory Commission

Protecting People and the Environment

2007-2008

Information Digest



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Protecting People and the Environment

ABSTRACT

The "U.S. Nuclear Regulatory Commission (NRC) 2007–2008 Information Digest" (the digest) provides a summary of information about the NRC, including the agency's regulatory responsibilities and licensing activities, and general information on domestic and worldwide nuclear energy.

Published annually, the digest is a compilation of nuclear- and NRC-related data designed to serve as a quick reference to major facts about the agency and the industry it regulates. In general, the data include activities through 2006 or the data available at manuscript completion. Information on the generating capacity and average capacity factor for operating U.S. commercial nuclear power reactors is obtained from the NRC, as well as from various industry sources. Industry source information is reviewed by the NRC for consistency only, and no independent validation and/or verification is performed.

Comments and/or suggestions on the data presented are welcomed and should be directed to Richard Rough, Director, Resource Management Support Staff, Office of the Chief Financial Officer, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001. For detailed and complete information about tables and figures, refer to the source publications.

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The National Capitol, Washington, DC

NRC AS A REGULATORY AGENCY

MISSION, GOALS, AND STATUTORY AUTHORITY

Mission

The mission of the U.S. Nuclear Regulatory Commission (NRC) is to license and regulate the Nation's civilian use of byproduct, source, and special nuclear materials to ensure adequate protection of public health and safety, promote the common defense and security, and protect the environment. The NRC's scope of responsibility includes regulation of commercial nuclear power plants; research, test, and training reactors; nuclear fuel cycle facilities (also called fuel cycle facilities); medical, academic, and industrial uses of radioactive materials; and the transport, storage, and disposal of radioactive materials and wastes. The NRC's regulations are designed to protect the public and occupational workers from radiation hazards in those industries using radioactive materials.

Goals

The NRC's FY 2004 – FY 2009 Strategic Plan focuses on five goals:

Safety – Ensure protection of public health and safety and the environment.

Security – Ensure the secure use and management of radioactive materials.

Openness – Ensure openness in our regulatory process.

Effectiveness – Ensure that NRC actions are effective, efficient, realistic, and timely.

Management – Ensure excellence in agency management to carry out the NRC's strategic objective.

These goals support our ability to maintain the public health, safety, and trust. Under each goal, strategic outcomes provide a general barometer of whether the goals are being achieved. The NRC's Strategic Plan is available at **http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1614/v3/index.html.**

Statutory Authority

The NRC was established by the Energy Reorganization Act of 1974 and began operations on January 19, 1975. The Energy Reorganization Act of 1974 separated the Atomic Energy Commission's regulatory functions from its military and promotional functions and assigned the regulatory functions to the NRC. The NRC thus inherited part of the Atomic Energy Commission's mission under the Atomic Energy Act of 1954 – to regulate the civilian commercial, industrial, academic, and medical uses of nuclear materials, in order to protect the public health and safety, and promote the common defense and security. In so doing, Congress defined the NRC's mission to enable the Nation to use radioactive materials for beneficial civilian purposes while ensuring that public health and safety, common defense and security, and the environment are protected. The NRC's regulations are issued under the *U.S. Code of Federal Regulations* (CFR), Title 10, Chapter 1.

The following principal statutory authorities govern the NRC's work:

- Atomic Energy Act of 1954, as Amended (P.L. 83-703)
- Energy Reorganization Act of 1974, as Amended (P.L. 93-438)
- Uranium Mill Tailings Radiation Control Act of 1978, as Amended (P.L. 95-604)
- Nuclear Non-Proliferation Act of 1978 (P.L. 95-242)
- West Valley Demonstration Project Act of 1980 (P.L. 96-368)
- Nuclear Waste Policy Act of 1982, as Amended (P.L. 97-425)
- Low-Level Radioactive Waste Policy Act amendments of 1985 (P.L. 99-240)
- Diplomatic Security and Anti-Terrorism Act of 1986 (P.L. 107-56)
- Solar, Wind, Waste, and Geothermal Power Production Incentives Act of 1990
- Energy Policy Act of 1992 Provisions
- Energy Policy Act of 2005

The NRC, the Agreement States, and those who hold licenses to use radioactive materials share a common responsibility to protect public health and safety and the environment. Federal regulations and the NRC regulatory program are important elements in the protection of the public. Because licensees are the ones using radioactive material, they have the ultimate responsibility to handle the use of materials.

NRC voted the Best Place to work in the Federal Government (2007).

Chairman
Dale E. Klein

Commissioner
Edward McGaffigan, Jr.

MAJOR ACTIVITIES

The NRC fulfills its responsibilities through a system of the following licensing and regulatory activities:

- Licensing the design, construction, operation, and decommissioning of nuclear plants and other nuclear facilities, such as nuclear fuel facilities, uranium enrichment facilities, and research and test reactors.
- Licensing the possession, use, processing, handling, and exporting of nuclear materials.
- Licensing the siting, design, construction, operation, and closure of low-level radioactive waste disposal sites under NRC jurisdiction and the construction, operation and closure of a geologic repository for high-level radioactive waste.
- Licensing the operators of civilian nuclear reactors.
- Inspecting licensed and certified facilities and activities.
- Certifying privatized uranium enrichment facilities.
- Conducting research on light-water reactor safety to gain independent expertise and information for making timely regulatory judgments and for anticipating problems of potential safety significance.
- Developing and implementing rules and regulations that govern licensed nuclear activities.
- Investigating nuclear incidents and allegations concerning any matter regulated by the NRC.
- Enforcing NRC regulations and the conditions of NRC licenses.
- Conducting public hearings on matters of nuclear and radiological safety, environmental concern, and common defense and security.
- Developing effective working relationships with the States regarding reactor operations and the regulation of nuclear material.
- Developing policy and providing direction on issues involving security at nuclear facilities; and interfacing with other Federal agencies, including the Department of Homeland Security, on

Commissioner
Gregory B. Jaczko

Commissioner
Peter B. Lyons

safety and security issues; and developing and directing the NRC program for response to incidents.

- Conducting a program of emergency preparedness and response for licensed nuclear facilities.
- Collecting, analyzing, and disseminating information about the operational safety of commercial nuclear power reactors and certain non-reactor activities.

ORGANIZATIONS AND FUNCTIONS

The NRC's Commission is composed of five members, with one member designated by the President to serve as Chairman. Each member is appointed by the President, with the consent of the U.S. Senate, to serve a 5-year term. The members' terms are normally staggered so that one Commissioner's term expires on June 30th every year. No more than three members of the Commission can be from the same political party. The members of the Commission (as of July 2007) are shown above.

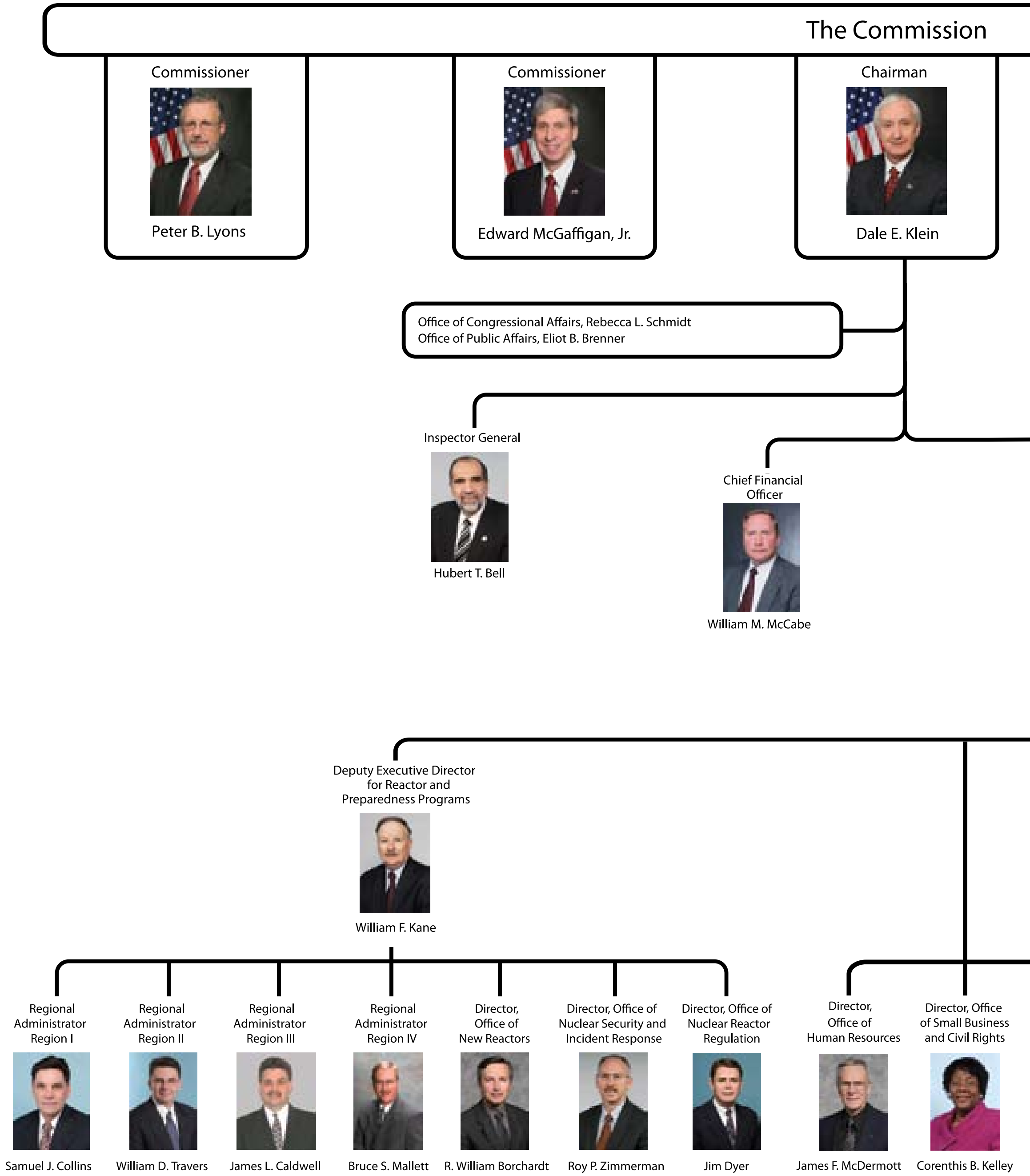
The Chairman serves as the principal executive officer and official spokesman of the Commission. The Executive Director for Operations carries out the program policies and decisions made by the Commission.

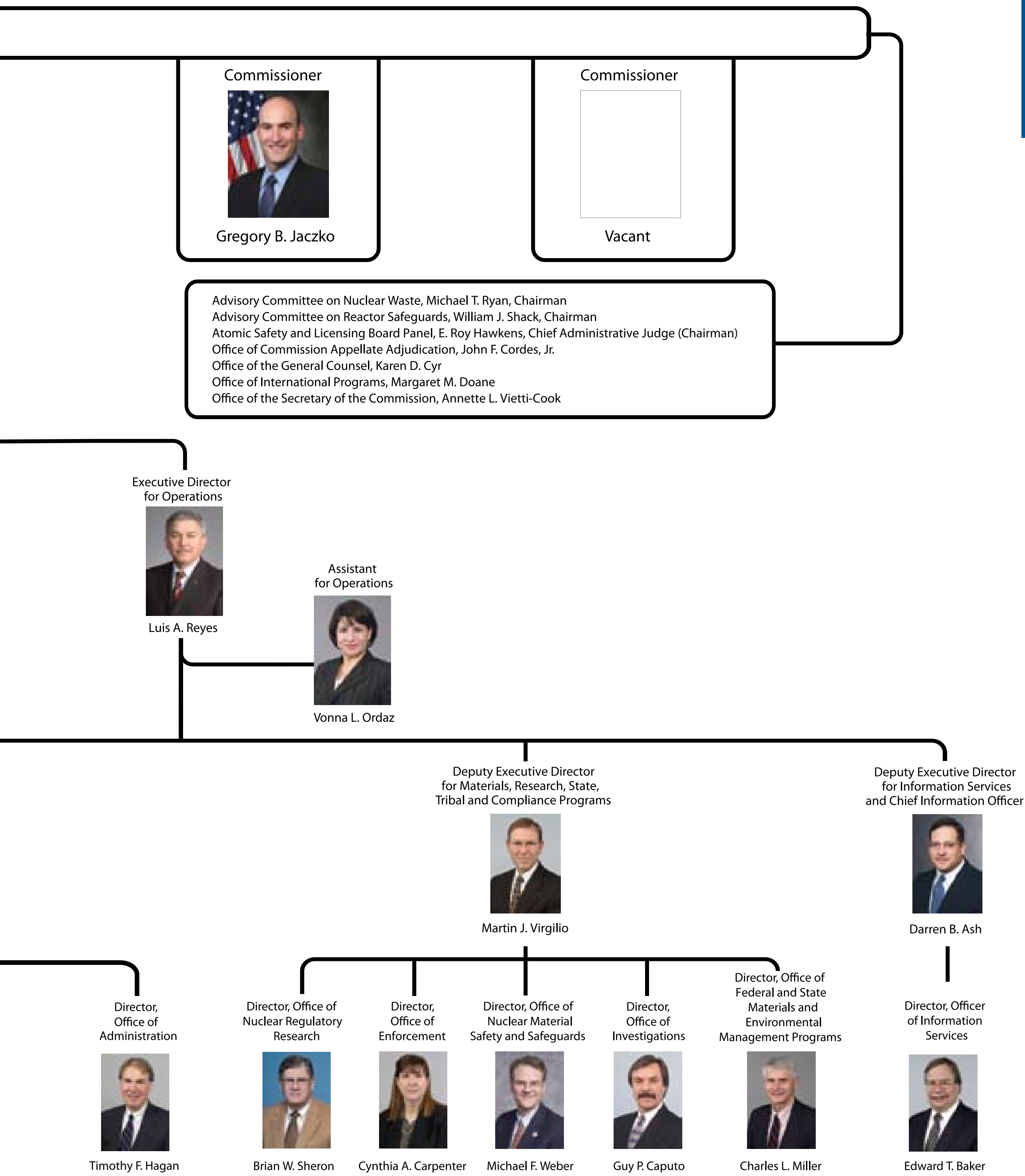
Figure 1 is an organizational chart of the NRC. Figure 2 is a map of the NRC headquarters, regions, and Technical Training Center.

Commissioner Expiration of Term (as of 2007)

Commissioner	Expiration of Term
Dale E. Klein, Chairman	June 30, 2011
Edward McGaffigan, Jr.	June 30, 2010
Gregory B. Jaczko	June 30, 2008
Peter B. Lyons	June 30, 2009

Figure 1. **U.S. Nuclear Regulatory Commission Organization Chart**





Commissioner
Gregory B. Jaczko
Commissioner
Vacant
Advisory Committee on Nuclear Waste, Michael T. Ryan, Chairman
Advisory Committee on Reactor Safeguards, William J. Shack, Chairman
Atomic Safety and Licensing Board Panel, E. Roy Hawkens, Chief Administrative Judge (Chairman)
Office of Commission Appellate Adjudication, John F. Cordes, Jr.
Office of the General Counsel, Karen D. Cyr
Office of International Programs, Margaret M. Doane
Office of the Secretary of the Commission, Annette L. Vietti-Cook
Executive Director for Operations
Luis A. Reyes
Assistant for Operations
Vonna L. Ordaz
Deputy Executive Director for Materials, Research, State, Tribal and Compliance Programs
Martin J. Virgilio
Deputy Executive Director for Information Services and Chief Information Officer
Darren B. Ash
Director, Office of Administration
Timothy F. Hagan
Director, Office of Nuclear Regulatory Research
Brian W. Sheron
Director, Office of Enforcement
Cynthia A. Carpenter
Director, Office of Nuclear Material Safety and Safeguards
Michael F. Weber
Director, Office of Investigations
Guy P. Caputo
Director, Office of Federal and State Materials and Environmental Management Programs
Charles L. Miller
Director, Officer of Information Services
Edward T. Baker

The NRC's major offices follow:

Office of Nuclear Reactor Regulation

Responsible for all licensing and inspection activities associated with the operation of nuclear power reactors and research and test reactors.

Office of New Reactors

Responsible for the design, siting, licensing, and construction oversight for new commercial nuclear power reactors.

Office of Nuclear Material Safety and Safeguards

Responsible for regulating activities which provide for the safe and secure production of nuclear fuel used in commercial nuclear reactors; the safe storage, transportation, and disposal of high-level radioactive waste and spent nuclear fuel; and the transportation of radioactive materials regulated under the Atomic Energy Act.

Office of Federal and State Materials and Environmental Management Programs

Responsible for development, implementation, and oversight of regulatory framework for industrial, commercial and medical uses of radioactive materials, uranium recovery activities, and the decommissioning of previously operating nuclear facilities and power plants.

Office of Nuclear Regulatory Research

Responsible for providing independent expertise and information for making timely regulatory judgments, anticipating problems of potential safety significance, and resolving safety issues; providing support for developing technical regulations and standards; and collecting, analyzing, and disseminating information about the operational safety of commercial nuclear power plants and certain nuclear materials activities.

Office of Nuclear Security and Incident Response

Responsible for overall agency policy and activities involving security at nuclear facilities. Provides safeguards and security interface with other Federal agencies and maintains the agency emergency preparedness and response program.

Regional Offices

Conduct inspection, enforcement, investigation, licensing, and emergency response programs for nuclear reactors, fuel facilities, and materials licensees.

Office of Information Services

Responsible for the strategic use of information technology as a management tool across a spectrum of agency activities and for an agencywide approach to information management, capital planning and performance-based management of information technology, and information management service functions.

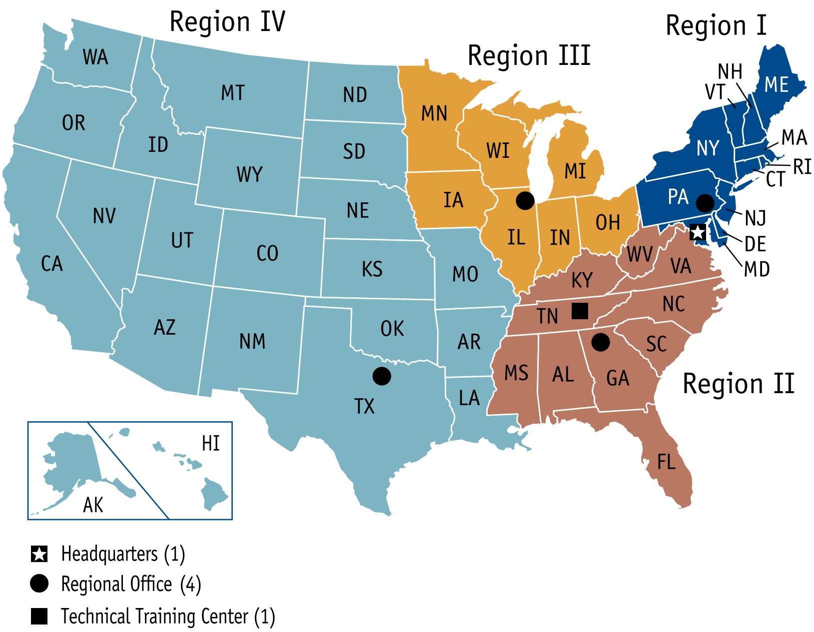
Office of the Chief Financial Officer

Responsible for NRC's Planning, Budgeting, Performance Management process, financial services and for all financial management activities.

Office of the Inspector General

Provides the Commission with an independent review and appraisal of NRC programs and operations to ensure their effectiveness, efficiency, and integrity.

Figure 2. NRC Regions



Headquarters:
Rockville, Maryland
301-415-7000
1-800-368-5642

Operations Center:
Rockville, Maryland
301-816-5100

The NRC maintains an Operations Center that is a focal point for NRC communications with its licensees, State agencies, and other Federal agencies concerning operating events in the commercial nuclear sector. The Operations Center is staffed 24 hours a day by NRC operations officers.

Regional Offices:
The NRC has four regional offices located throughout the United States.

Region I:
King of Prussia, Pennsylvania
610-337-5000

Region III:
Lisle, Illinois
630-829-9500

Region II:
Atlanta, Georgia
404-562-4400

Region IV:
Arlington, Texas
817-860-8100

Resident Sites:
At least two NRC resident inspectors who report to the appropriate regional office are located at each nuclear power reactor site. (Refer to Figure 16 for a map of the U.S. operating commercial nuclear power reactors.)

Technical Training Center:
Chattanooga, Tennessee
423-855-6500

Source: U.S. Nuclear Regulatory Commission

NRC BUDGET

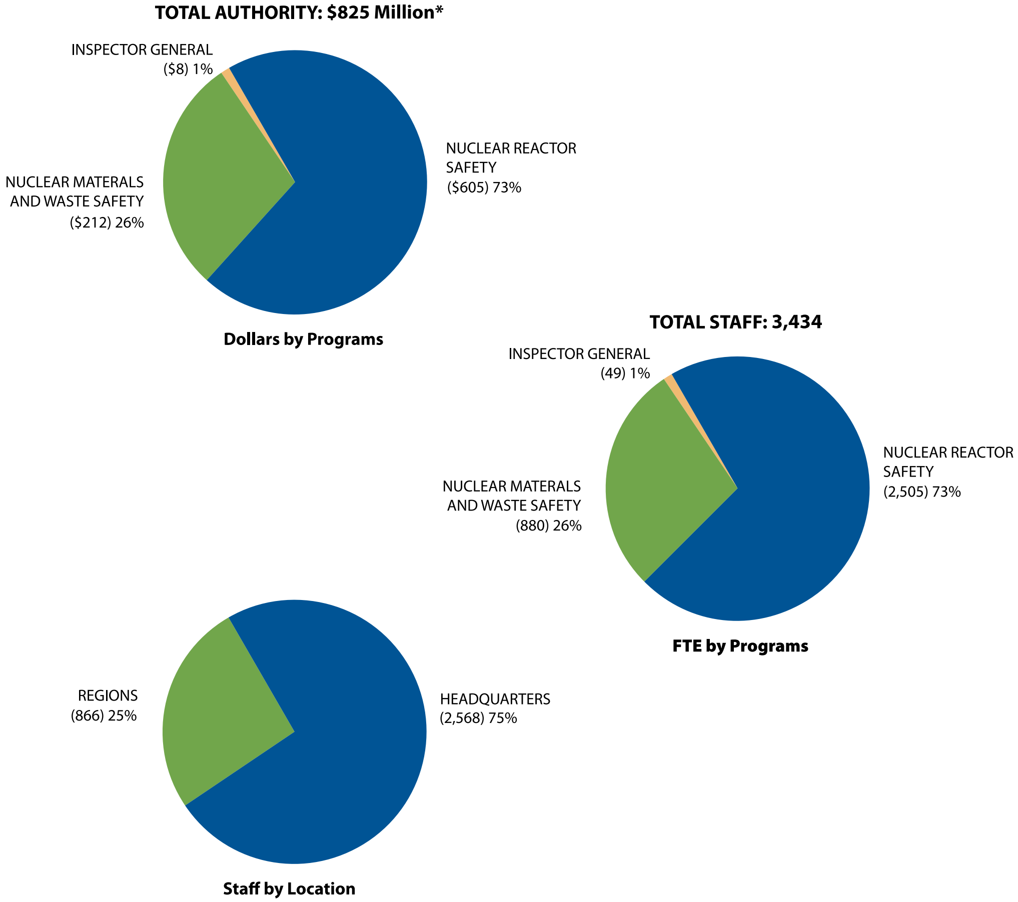
The NRC allocates funds and staff to the following programs (see Figure 3):

- Nuclear Reactor Safety
- Nuclear Materials and Waste Safety

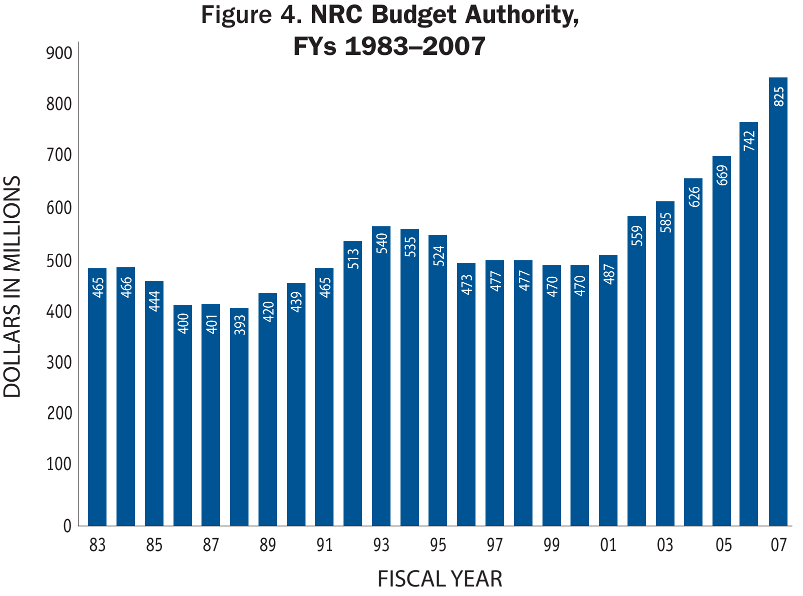
The Office of the Inspector General (OIG) receives its own appropriation, the amount of which is included in the NRC budget.

For FY 2007, Congress appropriated $825 million for the NRC. The NRC's FY 2007 personnel ceiling is 3,434 full-time equivalent (FTE) staff (see Figures 4-6).

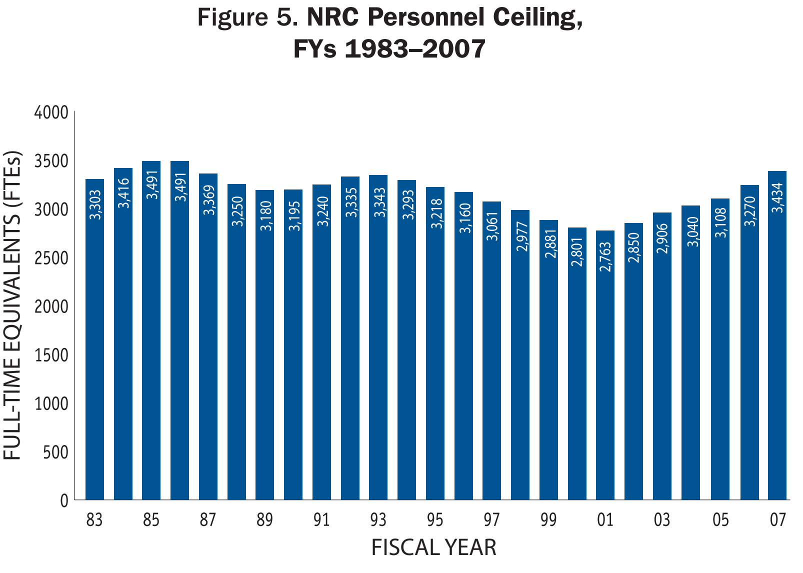
Figure 3. Distribution of NRC FY 2007 Budget Authority and Staff (Dollars in Millions)



*Budget authority includes pay raise supplement.
Note: Dollars and percentages are rounded to the nearest whole number. Program dollars are full costed.
Source: U.S. Nuclear Regulatory Commission



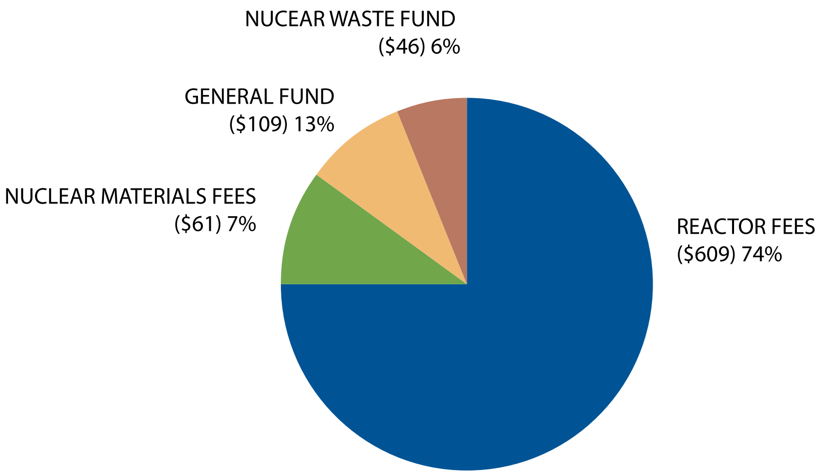
Note: Dollars are rounded to the nearest million.
Source: U.S. Nuclear Regulatory Commission



Source: U.S. Nuclear Regulatory Commission

Figure 6. **Recovery of NRC Budget Authority, FY 2007***

TOTAL AUTHORITY: $825 Million



Dollars in Millions

The Omnibus Budget Reconciliation Act of 1990 (OBRA-90), as amended, requires the NRC to recover 90 percent of its budget authority, less appropriations from the Nuclear Waste Fund, and for Waste Incidental to Reprocessing activities and generic homeland security activities, for FY 2007 by assessing fees to its licensees. The NRC budget authority to be recovered from fees in FY 2007 is $670.5 million. The annual fees assessed to the major classes of NRC licensees in FY 2007 follow:

Class of Licensee	**Range of Annual Fees**
Operating Power Reactor	$4,043,000**
Fuel Facility	$341,000 to $4,096,000
Uranium Recovery Facility	$18,700
Materials User	$750 to $29,000

*Based on the final FY 2007 fee rule.
**Includes spent fuel storage/reactor decommissioning FY 2007 annual fee of $159,000.
Note: Percentages are rounded to the nearest whole number.
Source: U.S. Nuclear Regulatory Commission

Dresden Nuclear Power Plant, Warrenville, Illinois.

U.S. AND WORLDWIDE ENERGY

U.S. ELECTRICITY

Capacity, Capability, and Net Generation

U.S. electric generating capability totaled approximately 978 gigawatts in 2005. Nuclear energy accounted for approximately 10 percent of this capability (see Figure 7).

U.S. net electric generation totaled approximately 4,053 billion kilowatthours in 2006. Nuclear energy accounted for approximately 19 percent of this generation (see Figure 8).

In 2005, 104 nuclear reactors licensed to operate in 31 States generated approximately one-fifth of the Nation's electricity (see Table 1 and Figure 9).

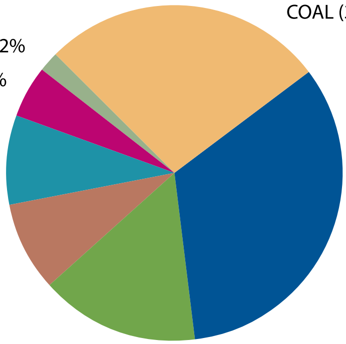
- Three States (New Jersey, South Carolina, and Vermont) relied on nuclear power for more than 50 percent of their electricity (see Table 1).
- Thirteen additional States relied on nuclear power for 25 to 50 percent of their electricity (see Table 1).

Since 1995, nuclear electric generation has increased by 17 percent and coal-fired generation has increased by 16 percent (see Figure 10 and Table 2). All other electricity generating sources have increased by a total of 22 percent.

In 2005, electricity from coal and nuclear sources accounted for 43 percent of the U.S. generating-capability (see Figure 11 and Table 3).

Figure 7. **U.S. Electric Capacity and Capability by Energy Source, 2005**

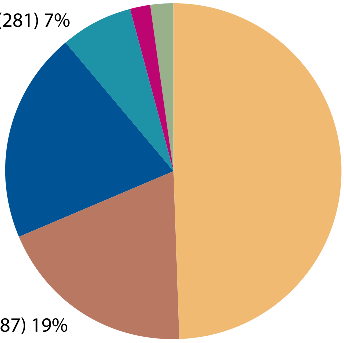
TOTAL CAPABILITY: 978 gigawatts



*Renewable energy includes geothermal, wood and wood waste, refuse, wind, solar energy and nonwood waste.
**Dual-fired units can burn oil or gas.
Note: Net summer capability. Percentages are rounded to the nearest whole number. Numbers rounded to the nearest thousand.
Source: DOE/EIA/Electric Power Annual 2005. Existing Capacity by Energy Source, Table 2.2, http://www.eia.doe.gov

Figure 8. **U.S. Electric Net Generation by Energy Source, 2006**

TOTAL GENERATION: 4,053 billion kilowatthours



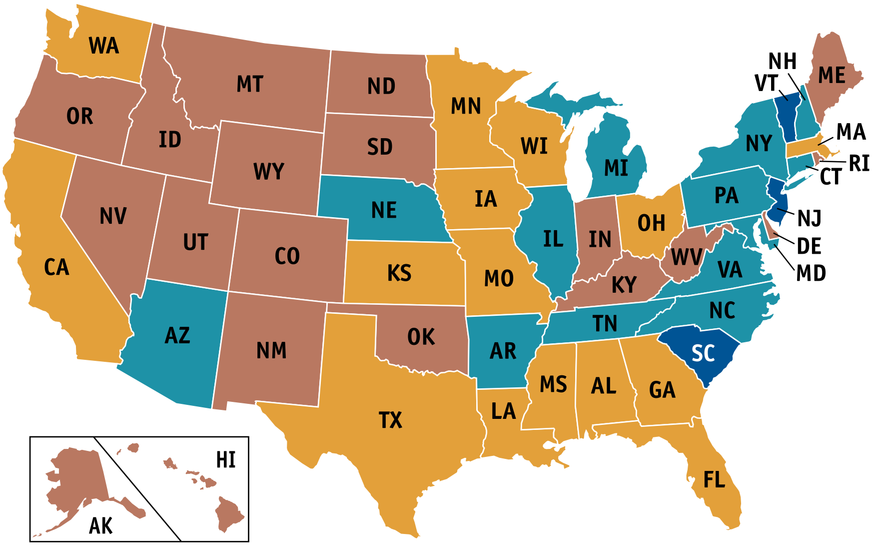
*Renewable energy includes geothermal, wood and nonwood waste, wind, and solar energy.
Renewable conventional hydroelectric power is included in hydroelectric power.
Note: Net summer capability. Percentages are rounded to the nearest whole number. Numbers rounded to the nearest thousand.
Source: DOE/EIA Monthly Energy Review, March 2007, Table 7.2a, http://www.eia.doe.gov

Table 1. **Electric Generating Capability and Electric Generation in Each State by Nuclear Power, 2005**

Percent Net Nuclear			Percent Net Nuclear		
State	**Capability**	**Generation**	**State**	**Capability**	**Generation**
Alabama	16	23	Missouri	6	9
Arizona	16	25	Nebraska	18	28
Arkansas	13	29	New Hampshire	28	40
California	7	18	New Jersey	23	52
Connecticut	26	46	New York	13	29
Florida	7	13	North Carolina	18	31
Georgia	11	23	Ohio	6	9
Illinois	27	48	Pennsylvania	21	35
Iowa	5	10	South Carolina	29	52
Kansas	11	19	Tennessee	16	29
Louisiana	8	17	Texas	5	10
Maryland	14	28	Vermont	51	71
Massachusetts	5	12	Virginia	15	35
Michigan	13	27	Washington	4	8
Minnesota	13	24	Wisconsin	10	17
Mississippi	8	22	USA	10	19
			Others*	0	0

* The District of Columbia and 19 States have no nuclear generating capability.
Notes: Net summer capability is the percent of electricity the State is capable of producing with nuclear energy.
Percentages are rounded to the nearest whole number.
Source: DOE/EIA Electric Power Annual 2005, http://www.eia.doe.gov

Figure 9. **Net Electricity Generated in Each State by Nuclear Power, 2005**



1% to 24% (15)

- Alabama
- California
- Florida
- Georgia
- Iowa
- Kansas
- Louisiana
- Massachusetts
- Minnesota
- Mississippi
- Missouri
- Ohio
- Texas
- Washington
- Wisconsin

25% to 50% (13)

- Arizona
- Arkansas
- Connecticut
- Illinois
- Maryland
- Michigan
- Nebraska
- New Hampshire
- New York
- North Carolina
- Pennsylvania
- Tennessee
- Virginia

More than 50% (3)

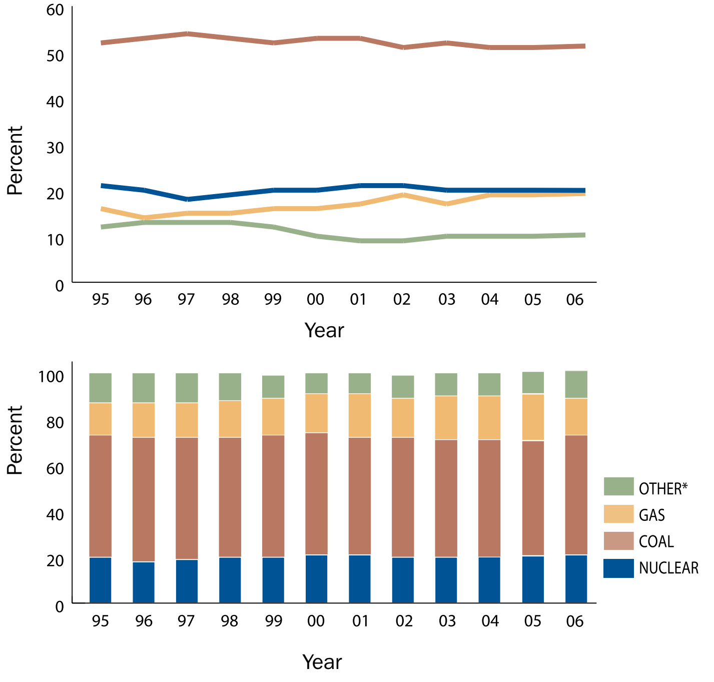
- New Jersey
- South Carolina
- Vermont

None (19)

- Alaska
- Colorado
- Delaware
- Hawaii
- Idaho
- Indiana
- Kentucky
- Maine
- Montana
- Nevada
- North Dakota
- New Mexico
- Oklahoma
- Oregon
- Rhode Island
- South Dakota
- Utah
- West Virginia
- Wyoming

Note: Percentages are rounded to the nearest whole number.
Source: DOE/EIA Electric Power Annual 2005, http://www.eia.doe.gov

Figure 10. U.S. Net Electric Generation by Energy Source, 1995–2006



* Other includes petroleum and hydroelectric.

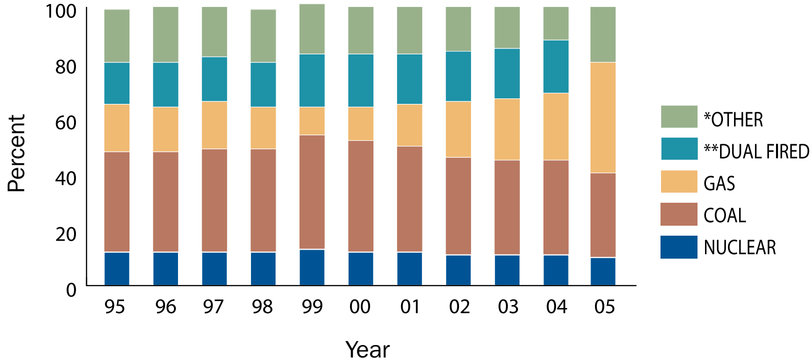
Source: DOE/EIA Monthly Energy Review (March 2007), Table 7.2a, http://www.eia.doe.gov

Table 2. U.S. Net Electric Generation by Energy Source, 1995–2006 (Billion Kilowatthours)

Year	Coal	Petroleum	Gas	Hydroelectric	Nuclear
1995	1,710	75	512	308	673
1996	1,796	82	470	344	675
1997	1,844	93	497	355	629
1998	1,873	127	549	319	674
1999	1,884	124	570	313	728
2000	1,965	109	611	269	754
2001	1,943	128	640	211	767
2002	1,936	96	705	256	772
2003	1,963	118	643	267	766
2004	1,976	117	715	262	789
2005	2,013	122	767	264	780
2006	1,987	63	824	281	787

Source: DOE/EIA Monthly Energy Review (March 2007), Table 7.2a, http://www.eia.doe.gov

Figure 11. U.S. Electric Generating Capability by Energy Source, 1995–2005



* Other includes petroleum and hydroelectric. **Dual-Fired numbers discontinued after 2004. Note: Percentages are rounded to the nearest whole number. Source: DOE/EIA Electric Power Annual 2005, http://www.eia.doe.gov

Table 3. U.S. Electric Generating Capability by Energy Source, 1995–2005 (Billion Kilowatts)

Year	Coal	Petroleum	Gas	*Dual-Fired	Hydroelectric	Nuclear
1995	301	64	142	122	97	100
1996	302	70	135	129	94	101
1997	303	70	137	129	76	100
1998	300	63	125	130	94	97
1999	315	36	75	146	99	97
2000	315	36	98	150	98	88
2001	314	40	127	153	99	98
2002	315	38	174	162	100	99
2003	313	36	208	171	99	99
2004	313	34	227	172	98	100
2005	313	59	385	—	99	100

Source: DOE/EIA Electric Power Annual 2005, http://www.eia.doe.gov
*Dual-Fired numbers discontinued after 2004.

Average Production Expenses

The production expense data presented herein include all nuclear, fossil, and coal-fired utility-owned steam electric plants (see Table 4 and Figure 12).

In 2005, production expenses averaged $18.16 per megawatthour for nuclear reactors and $27.70 per megawatthour for fossil fuel plants.

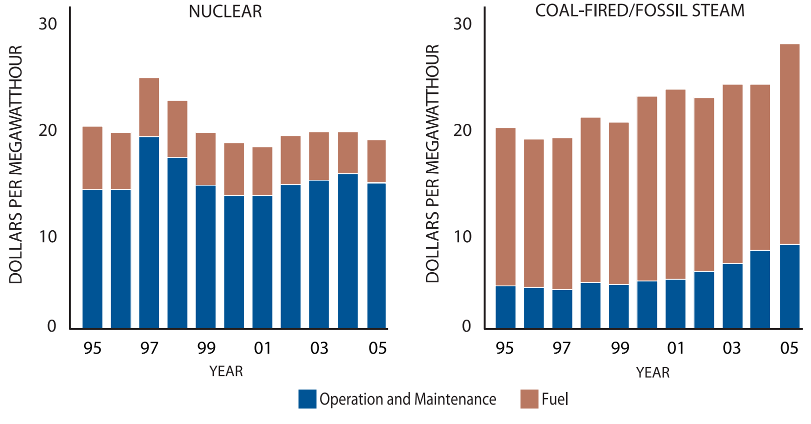
U.S. ELECTRICITY GENERATED BY COMMERCIAL NUCLEAR POWER

In 2006, net nuclear-based electric generation in the United States produced a total of 787 billion kilowatthours (see Table 5 and Figure 13).

In 2005, the average U.S. net capacity factor was 89 percent. It increased to 90 percent in 2006. Since 1995, the average capacity factor has increased approximately 14 percent (see Table 5).

- Capacity factor is the ratio of electricity generated to the amount of energy that could have been generated (see Glossary).
- Ninety-seven percent of U.S. commercial nuclear reactors operated above a capacity factor of 70 percent in 2006 (see Table 6).
- In 2006, Babcock & Wilcox reactors had the highest average capacity factors compared to those of the other three vendors. The seven Babcock & Wilcox reactors had an average capacity factor of 93 percent. The average capacity factors for the other three vendors were the following: 48 Westinghouse Electric reactors – 92 percent, 35 General Electric reactors – 91 percent, and 14 Combustion Engineering reactors – 82 percent (see Table 6).

Figure 12. U.S. Average Nuclear Reactor and Coal-Fired and Fossil Steam Plant Production Expenses, 1995–2005



Source: Federal Energy Regulatory Commission, FERC Form 1, "Annual Report of Major Electric Utilities, Licensees and Others," DOE/EIA – Electric Power Annual 2005.

Table 4. U.S. Average Nuclear Reactor, Coal-Fired and Fossil Steam Plant Production Expenses, 1995-2005 (Dollars per Megawatthour)

Year	Operation and Maintenance	Fuel	Total Production Expenses
Nuclear			
1995	13.49	5.74	19.23
1996	13.76	5.49	19.25
1997*	18.90	5.89	24.79
1998	16.19	5.42	21.61
1999	14.06	5.17	19.23
2000	13.34	4.95	18.29
2001	13.31	4.67	17.98
2002	13.58	4.60	18.18
2003	14.09	4.58	18.67
2004	13.68	4.58	18.26
2005	13.62	4.54	18.16
Coal-Fired			
1995	4.24	14.51	18.75
1996	4.03	14.20	18.23
1997*	3.96	14.03	17.99
Fossil-Steam**			
1998	4.59	16.01	20.60
1999	4.59	15.62	20.21
2000	4.76	17.69	22.45
2001	5.01	18.13	23.14
2002	5.22	16.11	21.33
2003	5.23	17.35	22.58
2004	5.64	18.21	23.85
2005	5.93	21.77	27.70

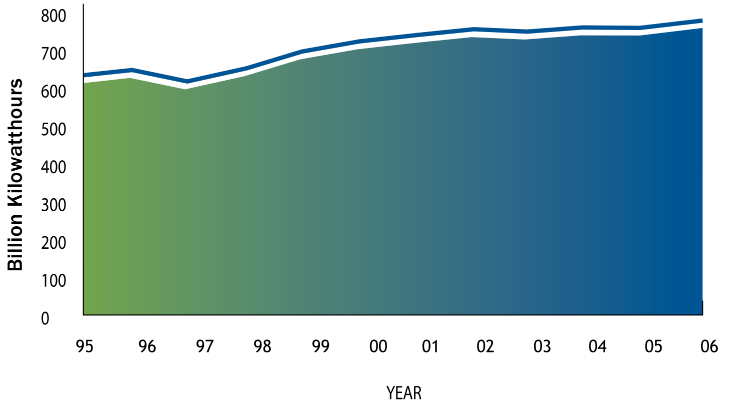
*Data for 1997 and prior years were obtained from Utility Data Institute, Inc.
**Includes coal and fossil fuel. Plant production expenses are no longer available exclusively for coal-fired fuel.
Source: Federal Energy Regulatory Commission, FERC Form 1, "Annual Report of Major Electric Utilities, Licensees and Others," DOE/EIA – Electric Power Annual 2005.

Table 5. **U.S. Nuclear Power Reactor Average Net Capacity Factor and Net Generation, 1995–2006**

Year	Number of Operating Reactors	Average Annual Capacity Factor (Percent)	Net Generation of Electricity	
			Billions of Kilowatthours	Percent of Total U.S. Capacity
1995	109	79	673	20.1
1996	110	77	675	19.6
1997	104	74	629	18.0
1998	104	78	674	18.6
1999	104	86	728	19.6
2000	104	88	754	19.8
2001	104	90	767	20.0
2002	104	91	772	20.0
2003	104	91	766	19.9
2004	104	91	789	19.6
2005	104	89	782	19.3
2006	104	90	787	19.4

Note: Average annual capacity factor is based on net maximum dependable capacity.
See Glossary for definition.
Source: 1995 – 2006 net electricity based on March 2007 DOE/EIA – Monthly Energy Review Table 7.2a, and licensee data as compiled by the U.S. Nuclear Regulatory Commission.

Figure 13. **Net Generation of U.S. Nuclear Electricity, 1995–2006**



Note: Average annual capacity factor is based on net maximum dependable capacity.
See Glossary for definition.
Source: 1995 – 2006 net electricity based on March 2007 DOE/EIA – Monthly Energy Review Table 7.2a, and licensee data as compiled by the U.S. Nuclear Regulatory Commission.

Table 6. **U.S. Commercial Nuclear Power Reactor Average Capacity Factor by Vendor and Reactor Type, 2004–2006**

	Licensed to Operate			Average Capacity Factor (Percent)			Percent of Net Nuclear Generated		
Capacity Factor	2004	2005	2006	2004	2005	2006	2004	2005	2006
Above 70 Percent	102	99	101	N/A	N/A	N/A	99	99	99
50 to 70 Percent	1	4	1	N/A	N/A	N/A	1	1	1
Below 50 Percent	1	1	2	N/A	N/A	N/A	>1	>1	>1
Vendor:									
Babcock & Wilcox	7	7	7	89	90	93	6	6	6
Combustion Engineering	14	14	14	91	87	82	13	13	12
General Electric	35	35	35	89	88	91	33	33	34
Westinghouse Electric	48	48	48	90	91	92	48	48	48
Total	104	104	104	N/A	N/A	N/A	100	100	100
Reactor Type:									
Boiling Water Reactor	35	35	35	89	89	91	33	33	34
Pressurized Water Reactor	69	69	69	92	92	90	67	67	66
Total	104	104	104	N/A	N/A	N/A	100	100	100

Note: Average capacity factor is based on net maximum dependable capacity. See Glossary for definition. Refer to Appendix A for the 2001–2006 average capacity factors for each reactor. Percentages are rounded to the nearest whole number.
Source: Licensee data as compiled by the U.S. Nuclear Regulatory Commission

WORLDWIDE ELECTRICITY GENERATED BY COMMERCIAL NUCLEAR POWER

In 2006, 439 operating reactors in 31 countries had a maximum dependable capacity of 370,163 megawatts electric (net MWe) (see Figure 14).

- Refer to Appendix J for a world list of the number of nuclear power reactors and Appendix K for nuclear power units by reactor type, worldwide. Major producers of nuclear electricity during 2006 were the United States and France.
- Approximately 30 percent of the world's net nuclear-generated electricity was produced in the United States (see Figure 15).
- France produced approximately 16 percent of the world's net nuclear-generated electricity in 2005. In 2004, the nuclear portion of its total domestic electricity generation was approximately 79 percent (see Figure 15). Of the countries cited here, reactors in South Korea (93 percent), United States (90 percent), Germany (89 percent), and Sweden (82 percent) had the highest average gross capacity factor in 2006 (see Table 8). Reactors in the United States had the greatest gross nuclear generation at 823 billion kilowatthours. France was the next highest producer at 450 billion killowatthours (see Table 7).
- Refer to Appendix L for a list of the top 50 units by gross capacity factor, worldwide, and Appendix M for a list of the top 50 units by gross generation, worldwide.

Over the past 10 years, the average annual gross capacity factor has increased 18 percentage points in the United States, increased 6 percentage points in Germany, increased 7 percentage points in Sweden, and decreased 12 percentage points in Japan (see Table 8).

Table 7. Commercial Nuclear Power Reactor Average Gross Capacity Factor and Gross Generation by Selected Country, 2006

Country	Number of Operating Reactors	Average Gross Capacity Factor (in percent)	Total Gross Nuclear Generation (in billions of kWh)	Number of Operating Reactors in Top 50 by Capacity Factor	Number of Operating Reactors in Top 50 by Generation
Canada	21	71	98	4	0
France	59	77	450	0	11
Germany	17	89	167	2	11
Japan	55	70	303	5	3
Russia	31	70	155	0	0
South Korea	20	93	149	6	0
Sweden	10	82	68	0	2
Ukraine	15	74	90	0	0
United States	104	88	823	26	21

Note: The United States (U.S.) gross capacity factor and generation includes estimates based on net mWh for 9 U.S. units.
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Table 8. Commercial Nuclear Power Reactor Average Gross Capacity Factor by Selected Country, 1997–2006

Annual Gross Average Capacity Factor (Percent)

Country	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Canada	61	50	52	50	53	53	54	64	66	71
France	72	73	71	72	73	75	75	77	78	77
Germany	83	79	88	87	87	83	84	87	86	89
Japan	82	83	79	79	79	77	59	70	69	70
Russia	—	—	61	67	67	67	70	68	66	70
South Korea	—	—	88	90	93	93	94	92	95	93
Sweden	75	78	78	66	84	75	77	89	87	82
Ukraine	—	—	65	69	74	75	78	76	72	74
United States	70	76	85	87	88	89	87	90	87	88
	{73	78	86	88	90	91	89	91	89	90}*

*For comparison, the U.S. average net capacity factor is used. The 2006 U.S. average net capacity factor is 90 percent. Brackets { } denote average net capacity factor. See Glossary for definition.
Note: Percentages are rounded to the nearest whole number.
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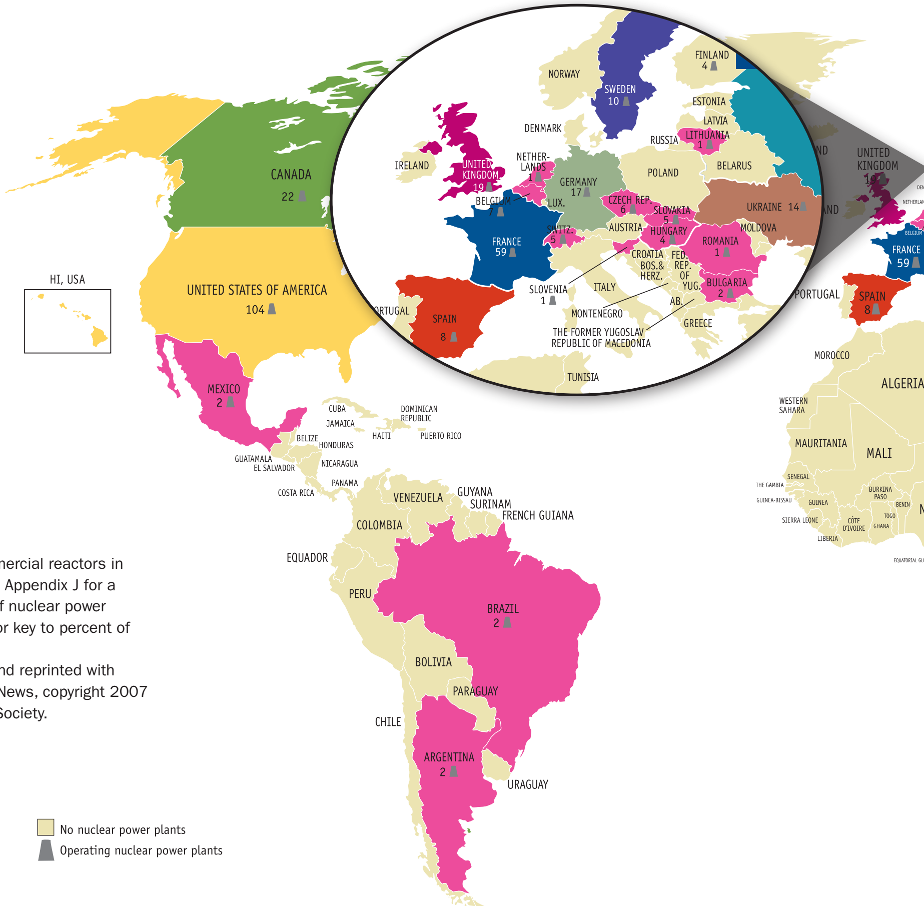
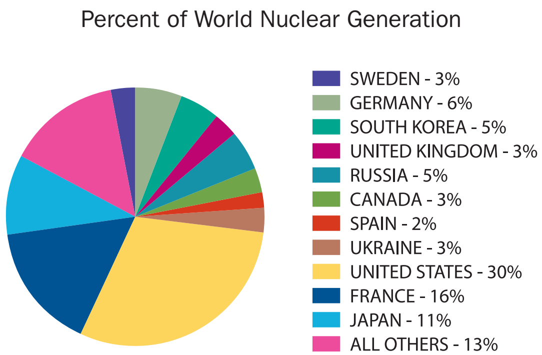
Figure 14. Operating Nuclear



Notes: There are no commercial reactors in Alaska or Hawaii. Refer to Appendix J for a world list of the number of nuclear power reactors. See Figure 15 for key to percent of world nuclear generation.
Source: Data excerpted and reprinted with permission from Nuclear News, copyright 2007 by the American Nuclear Society.

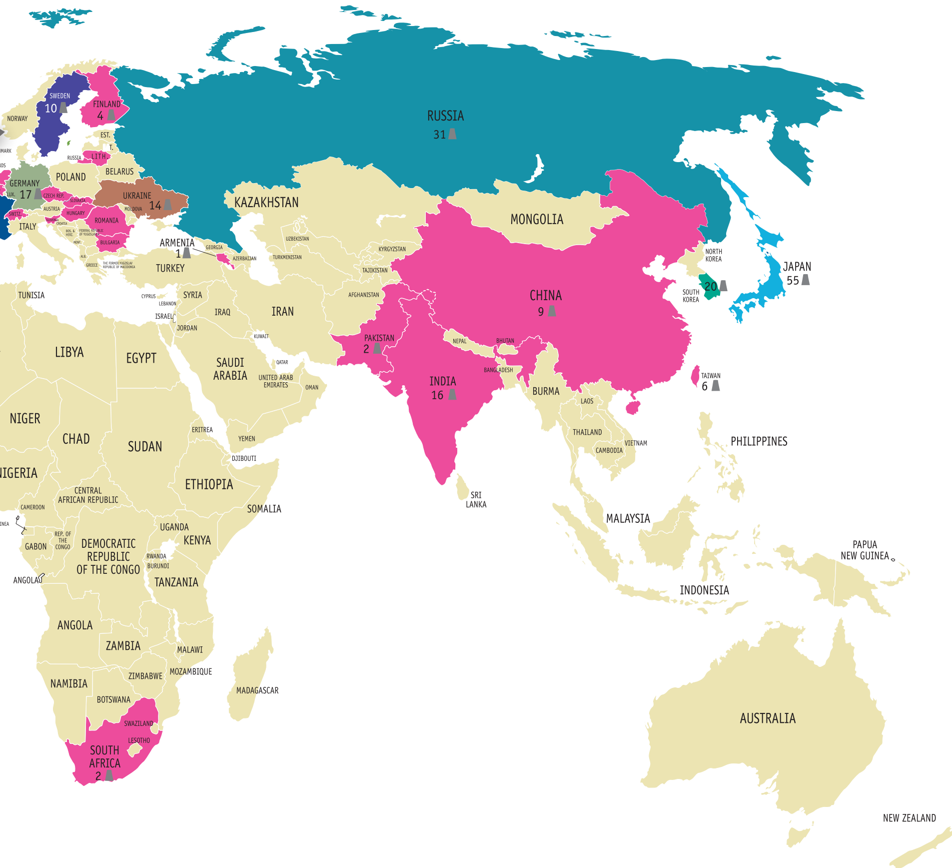
Figure 15. Net Nuclear Electric Power as a Percent of World Nuclear Generation, 2005



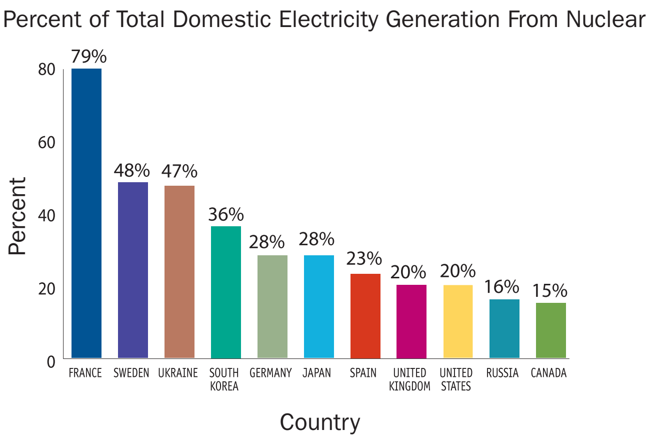
Total World Net Nuclear Electricity Generation: 2,625.57 billion kilowatthours

Source: DOE/EIA International Energy Information, http://www.eia.doe.gov

Power Plants Worldwide, 2005



Total Domestic Net Nuclear Electricity Generation, 2004



INTERNATIONAL ACTIVITIES

The NRC's legislatively mandated international responsibilities are to license the export and import of nuclear materials and equipment and to participate in activities that support U.S. Government compliance with international treaties and agreement obligations. The NRC also has programs of bilateral nuclear safety cooperation and assistance activities with 35 countries (see Table 9); it actively participates in multinational efforts such as the International Atomic Energy Agency (IAEA) and the Nuclear Energy Agency (NEA) and has a robust international cooperative research program.

The NRC licenses the exports and imports of nuclear facilities, equipment, and materials. NRC has implemented enhanced controls on the export and import of risk-significant radioactive sources in order to reduce the likelihood that these sources will be used in a "dirty bomb."

The NRC assists in implementing the U.S. Government's international policy and priorities through the development of legal instruments in the nuclear field to address vital issues such as nuclear nonproliferation, safety, safeguards, physical protection, security, radiation protection, spent fuel and waste management, nuclear safety research, and liability. Among the international treaties and agreement obligations that the NRC assists the U.S. Government in implementing are the Nuclear Non-Proliferation Treaty; U.S. bilateral agreements for Peaceful Nuclear Cooperation pursuant to Section 123 of the U.S. Atomic Energy Act of 1954, as amended; and such conventions as those on Nuclear Safety, the Safety of Spent Fuel Management, the Safety of Radioactive Waste Management, and the Physical

(Left to Right) NRC Chairman Dale E. Klein with NRC Executive Director for Operations Luis A. Reyes and NRC Commissioner Peter B. Lyons at the International Atomic Energy Agency

Table 9. **Regulatory Authorities Providing for Bilateral Information Exchange and Cooperation on Nuclear Safety, Safeguards, Waste Management, and Radiological Protection**

Country	Agreement Renewal Date	Country	Agreement Renewal Date
Argentina	2007	Japan	2008
Armenia	2012	Kazakhstan	2009
Australia	2008	Republic of Korea	2010
Belgium	2010	Lithuania	2010
Brazil	2009	Mexico	2007
Bulgaria	2011	The Netherlands	2008
Canada	2007	Peru	Open-Ended
China	2009	Philippines	Open-Ended
Czech Republic	2010	Romania	2010
Egypt	1991	Slovak Republic	2010
Finland	2011	Slovenia	2010
France	2008	South Africa	2010
Germany	2012	Spain	2010
Greece	2008	Sweden	2011
Hungary	2012	Switzerland	2007
Indonesia	2008	Ukraine	2011
Israel	2010	United Kingdom	2007
Italy	2010		

Note: The NRC also provides support to the American Institute in Taiwan.

Protection of Nuclear Material. The NRC also ensures compliance by its licensees under the U.S. voluntary safeguards agreement with the IAEA.

The NRC also participates in a wide range of mutually beneficial programs to exchange information with counterparts in the international community and to enhance the safety and security of peaceful nuclear activities worldwide. This low-cost, high-impact program provides safety and security information through its participation in joint cooperative activities and assistance to other countries to develop and improve regulatory organizations and overall nuclear safety and security. These activities include the following:

- Ensuring prompt notification to foreign partners of U.S. safety problems that warrant action or investigation and notification to the NRC program offices about safety problems identified at foreign facilities.
- Assisting other countries (e.g., Russia, Ukraine, Armenia, Kazakhstan, Georgia, Azerbaijan, Iraq, India, and Pakistan) to develop and improve regulatory programs. These assistance efforts are carried out through training, workshops, peer review of regulatory documents, working group meetings, and technical information and specialist exchanges.

The NRC participates in the multinational programs of the IAEA and the NEA concerned with safety research and regulatory matters, radiation protection, risk assessment, emergency preparedness, waste management, transportation, safeguards, physical protection, security, standards development, training and technical assistance.

The NRC engages in joint cooperative research programs through approximately 100 multilateral agreements in over 22 countries to leverage access to foreign test facilities not otherwise available in the United States. Access to foreign test facilities expands the NRC's knowledge base and contributes to the efficient and effective use of the NRC's resources in conducting research on high-priority safety issues.

Calvert Cliffs Nuclear Power Plant, Lusby, Maryland.

OPERATING NUCLEAR REACTORS

U.S. COMMERCIAL NUCLEAR POWER REACTORS

As of June 2005, 104 commercial nuclear power reactors[1] are licensed to operate in 31 States (see Figure 16):

- 4 reactor vendors
- 26 operating companies
- 80 different designs
- 65 sites

Diversity

Although there are many similarities, each reactor design can be considered unique. A typical pressurized water reactor is shown in Figure 17 and a typical boiling water reactor is shown in Figure 18.

Experience

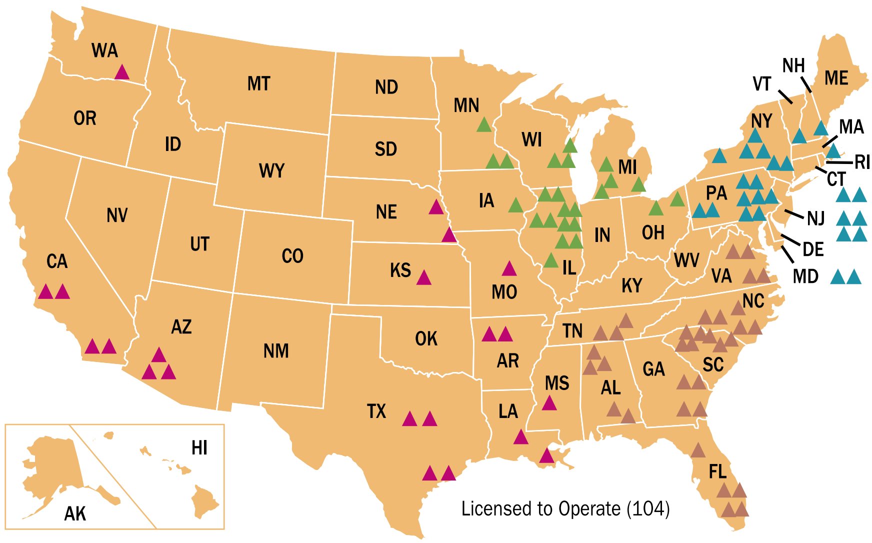
The 104 reactors licensed to operate during 2006 have accumulated approximately 2,560 reactor-years of experience (see Figure 19 and Table 10). An additional 385 reactor-years of experience have been accumulated by permanently shutdown reactors.

Principal Licensing and Inspection Activities

- The NRC uses performance indicators and reactor and facility inspections as the basis for its independent determination of licensee compliance with NRC regulations.
- Approximately 15 separate license changes are requested per power reactor each year:
  - More than 1,650 separate reviews were completed by the NRC in FY 2005.
- Approximately 4,500 reactor/senior operators are licensed by the NRC:
  - Each operator must requalify every 2 years and apply for license renewal every 6 years.
- Approximately 3,000 source documents concerning events are reviewed by the NRC annually.
- The NRC oversees the decommissioning of nuclear power reactors. Refer to Appendix F for their decommissioning status.
- On average, approximately 6,140 hours of inspection effort were expended at each operating reactor site during 2006 (see Figure 21).

1 Refer to Appendices A–F for a listing of currently operating, formerly operating, research, and test reactors and canceled U.S. commercial nuclear power reactors.

Figure 16. U.S. Operating Commercial Nuclear Power Reactors



REGION I

CONNECTICUT
- Millstone 2 and 3

MARYLAND
- Calvert Cliffs 1 and 2

MASSACHUSETTS
- Pilgrim 1

NEW HAMPSHIRE
- Seabrook 1

NEW JERSEY
- Hope Creek 1
- Oyster Creek
- Salem 1 and 2

NEW YORK
- James A. FitzPatrick
- Ginna
- Indian Point 2 and 3
- Nine Mile Point 1 and 2

PENNSYLVANIA
- Beaver Valley 1 and 2
- Limerick 1 and 2
- Peach Bottom 2 and 3
- Susquehanna 1 and 2
- Three Mile Island 1

VERMONT
- Vermont Yankee

REGION II

ALABAMA
- Browns Ferry 1, 2, and 3
- Joseph M. Farley 1 and 2

FLORIDA
- Crystal River 3
- St. Lucie 1 and 2
- Turkey Point 3 and 4

GEORGIA
- Edwin I. Hatch 1 and 2
- Vogtle 1 and 2

NORTH CAROLINA
- Brunswick 1 and 2
- McGuire 1 and 2
- Shearon Harris 1

SOUTH CAROLINA
- Catawba 1 and 2
- Oconee 1, 2, and 3
- H.B. Robinson 2
- Summer

TENNESSEE
- Sequoyah 1 and 2
- Watts Bar 1

VIRGINIA
- North Anna 1 and 2
- Surry 1 and 2

REGION III

ILLINOIS
- Braidwood 1 and 2
- Byron 1 and 2
- Clinton
- Dresden 2 and 3
- La Salle County 1 and 2
- Quad Cities 1 and 2

IOWA
- Duane Arnold

MICHIGAN
- D.C. Cook 1 and 2
- Fermi 2
- Palisades

MINNESOTA
- Monticello
- Prairie Island 1 and 2

OHIO
- Davis-Besse
- Perry 1

WISCONSIN
- Kewaunee
- Point Beach 1 and 2

REGION IV

ARKANSAS
- Arkansas Nuclear 1 and 2

ARIZONA
- Palo Verde 1, 2, and 3

CALIFORNIA
- Diablo Canyon 1 and 2
- San Onofre 2 and 3

KANSAS
- Wolf Creek 1

LOUISIANA
- River Bend 1
- Waterford 3

MISSISSIPPI
- Grand Gulf

MISSOURI
- Callaway

NEBRASKA
- Cooper
- Fort Calhoun

TEXAS
- Comanche Peak 1 and 2
- South Texas Project 1 and 2

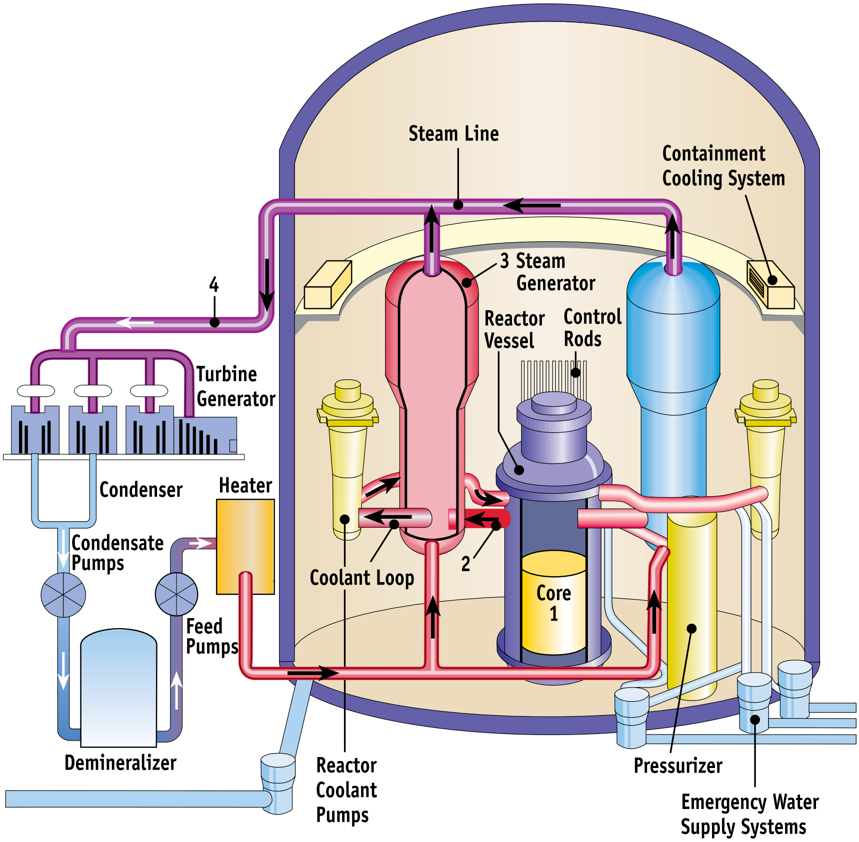
WASHINGTON
- Columbia Generating Station

Source: U.S. Nuclear Regulatory Commission

Figure 17. **Typical Pressurized Water Reactor**

HOW NUCLEAR REACTORS WORK

In a typical commercial pressurized light-water reactor (1) the reactor core creates heat, (2) pressurized water in the primary coolant loop carries the heat to the steam generator, (3) inside the steam generator heat from the primary coolant loop vaporizes the water in a secondary loop producing steam, (4) the steam line directs the steam to the main turbine causing it to turn the turbine generator, which produces electricity. The unused steam is exhausted to the condenser where it is condensed into water. The resulting water is pumped out of the condenser with a series of pumps, reheated, and pumped back to the steam generator. The reactor's core contains fuel assemblies (see Figure 33) which are cooled by water, which is force-circulated by electrically powered pumps. Emergency cooling water is supplied by other pumps, which can be powered by onsite diesel generators. Other safety systems, such as the containment cooling system, also need electric power and can be powered by onsite diesel generators. Pressurized-water reactors contain between 150–200 fuel assemblies. For more information on nuclear reactor fuel, see Figures 26–28.

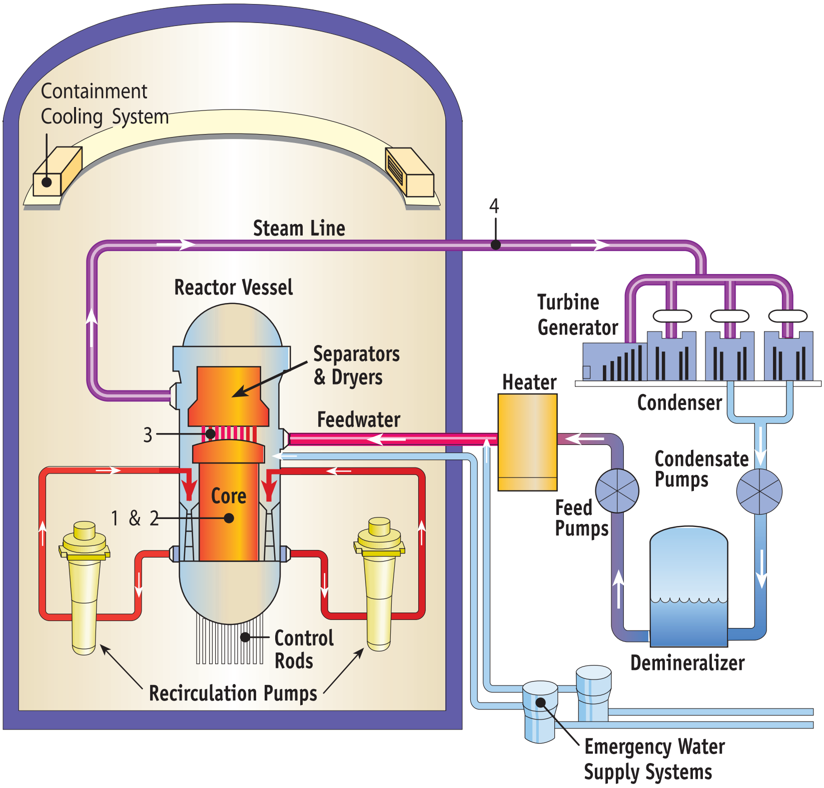


Source: U.S. Nuclear Regulatory Commission

Figure 18. **Typical Boiling Water Reactor**

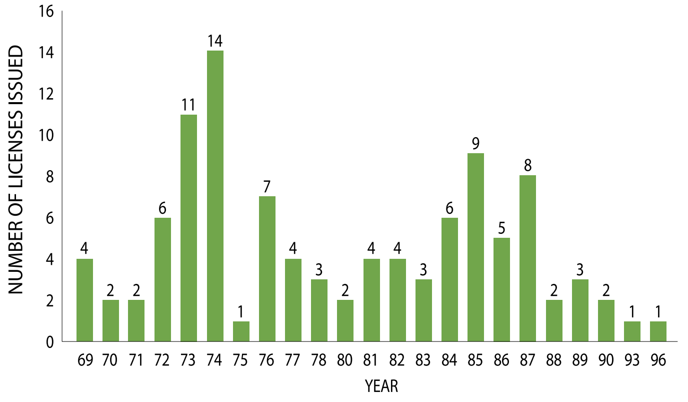
HOW NUCLEAR REACTORS WORK

In a typical commercial boiling water reactor (1) the reactor core creates heat, (2) a steam-water mixture is produced when very pure water (reactor coolant) moves upward through the core absorbing heat, (3) the steam-water mixture leaves the top of the core and enters the two stages of moisture separation where water droplets are removed before the steam is allowed to enter the steam line, (4) the steam line directs the steam to the main turbine causing it to turn the turbine generator, which produces electricity. The unused steam is exhausted to the condenser where it is condensed into water. The resulting water is pumped out of the condenser with a series of pumps, reheated, and pumped back to the reactor vessel. The reactor's core contains fuel assemblies (see Figure 33) which are cooled by water, which is force-circulated by electrically powered pumps. Emergency cooling water is supplied by other pumps, which can be powered by onsite diesel generators. Other safety systems, such as the containment cooling system, also need electric power and can be powered by onsite diesel generators. Boiling water reactors contain between 370–800 fuel assemblies. For more information on nuclear reactor fuel, see Figures 26–28.



Source: U.S. Nuclear Regulatory Commission

Figure 19. U.S. Commercial Nuclear Power Reactor Operating Licenses Issued by Year



Note: No licenses issued after 1996.

Table 10. U.S. Commercial Nuclear Power Reactor Operating Licenses Issued by Year

1969	Dresden 2
	Ginna
	Nine Mile Point 1
	Oyster Creek
1970	H.B. Robinson 2
	Point Beach 1
1971	Dresden 3
	Monticello
1972	Palisades
	Pilgrim 1
	Quad Cities 1
	Quad Cities 2
	Surry 1
	Turkey Point 3
1973	Browns Ferry 1
	Fort Calhoun
	Indian Point 2
	Kewaunee
	Oconee 1
	Oconee 2
	Peach Bottom 2
	Point Beach 2
	Surry 2
	Turkey Point 4
	Vermont Yankee
1974	Arkansas Nuclear 1
	Browns Ferry 2
	Brunswick 2
	Calvert Cliffs 1
	Cooper
	D.C. Cook 1
	Duane Arnold
	Edwin I. Hatch 1
	James A. FitzPatrick
	Oconee 3
	Peach Bottom 3
	Prairie Island 1
	Prairie Island 2
	Three Mile Island 1
1975	Millstone 2
1976	Beaver Valley 1
	Browns Ferry 3
	Brunswick 1
	Calvert Cliffs 2
	Indian Point 3
	Salem 1
	St. Lucie 1
1977	Crystal River 3
	Davis-Besse
	D.C. Cook 2
	Joseph M. Farley 1
1978	Arkansas Nuclear 2
	Edwin I. Hatch 2
	North Anna 1
1980	North Anna 2
	Sequoyah 1
1981	Joseph M. Farley 2
	McGuire 1
	Salem 2
	Sequoyah 2
1982	La Salle County 1
	San Onofre 2
	Summer
	Susquehanna 1
1983	McGuire 2
	San Onofre 3
	St. Lucie 2
1984	Callaway
	Diablo Canyon 1
	Grand Gulf 1
	La Salle County 2
	Susquehanna 2
	Washington Nuclear Project 2
1985	Byron 1
	Catawba 1
	Diablo Canyon 2
	Fermi 2
	Limerick 1
	Palo Verde 1
	River Bend 1
	Waterford 3
	Wolf Creek 1
1986	Catawba 2
	Hope Creek 1
	Millstone 3
	Palo Verde 2
	Perry 1
1987	Beaver Valley 2
	Braidwood 1
	Byron 2
	Clinton
	Nine Mile Point 2
	Palo Verde 3
	Shearon Harris 1
	Vogtle 1
1988	Braidwood 2
	South Texas Project 1
1989	Limerick 2
	South Texas Project 2
	Vogtle 2
1990	Comanche Peak 1
	Seabrook
1993	Comanche Peak 2
1996	Watts Bar 1

Source: Data as compiled by the U.S. Nuclear Regulatory Commission
Note: Limited to reactors licensed to operate. Year is based on the date the initial full-power operating license was issued.

OVERSIGHT OF U.S. COMMERCIAL NUCLEAR POWER REACTORS

Reactor Oversight Process

The NRC does not operate nuclear power plants. Rather, it regulates the operation of the Nation's 104 nuclear power plants by establishing regulatory requirements for the design, construction and operation of such plants. To ensure that the plants are operated safely within these requirements, the NRC licenses the plants to operate, licenses the plant operators, and establishes technical specifications for the operation of each plant.

The NRC provides continuous oversight of plants through its Reactor Oversight Process (ROP) to verify that they are being operated in accordance with NRC rules and regulations. The NRC has full authority to take whatever action is necessary to protect public health and safety and may demand immediate licensee actions, up to and including a plant shutdown.

The ROP is described on the NRC's Web site and in NUREG-1649, Revision 4, "Reactor Oversight Process." In general terms, the ROP uses both inspection findings and performance indicators (PIs) to assess the performance of each plant within a regulatory framework of seven cornerstones of safety. The ROP recognizes that issues of very low safety significance inevitably occur, and plants are expected to effectively address these issues. The NRC performs a baseline level of inspection at each plant. The NRC may perform supplemental inspections and take additional actions to ensure that significant performance issues are addressed. A summary of the NRC's inspection effort for 2006 is shown in Figure 21. The latest plant-specific inspection findings and PI information can be found on the NRC's Web site.

The ROP takes into account improvements in the performance of the nuclear industry over the past 25 years and improved approaches to inspecting and evaluating the safety performance of NRC-licensed plants. The improvements in plant performance can be attributed both to efforts within the nuclear industry and to successful regulatory oversight.

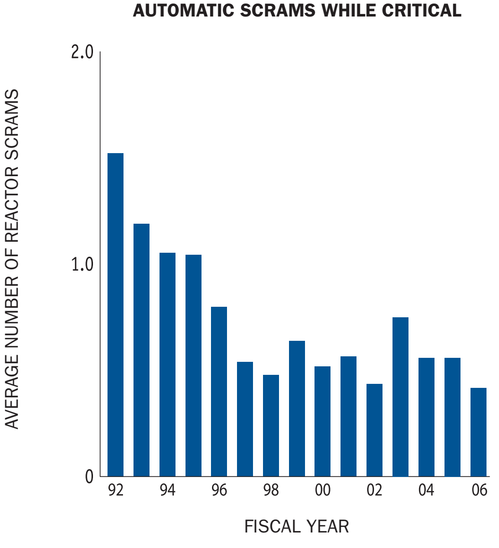
Industry Performance Indicators

In addition to evaluating the performance of each individual plant, the NRC compiles data on overall reactor industry performance using various industry-level performance indicators, as shown in Figure 20 on the following page and Appendix G. The industry performance indicators can provide additional data for assessing trends in overall industry performance.

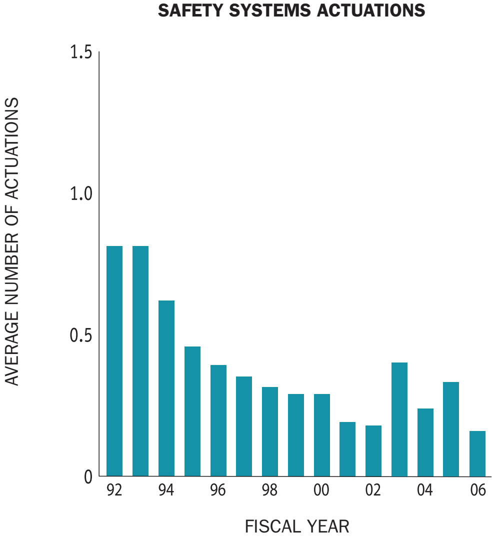
FUTURE U.S. COMMERCIAL NUCLEAR POWER REACTOR LICENSING

The NRC expects and is preparing to perform new reactor licensing work in response to the Energy Policy Act of 2005 and associated Administration initiatives.

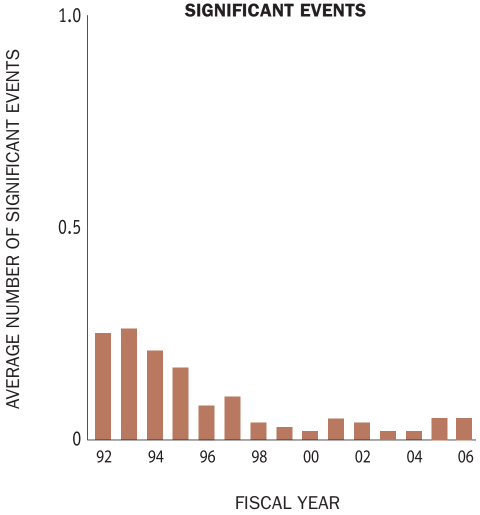
Figure 20. **Industry Performance Indicators: Annual Industry Averages, FYs 1992–2006**



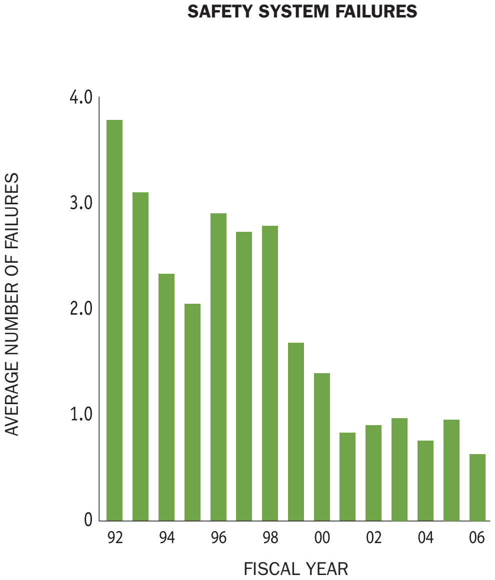
A reactor is said to be "critical" when it achieves a self-sustaining nuclear chain reaction, as when the reactor is operating. The sudden shutting down of a nuclear reactor by rapid insertion of control rods, either automatically or manually by the reactor operator is referred to as a "scram." This indicator measures the number of unplanned automatic scrams that occur while the reactor is critical.



Safety system actuations are certain manual or automatic actuations of the logic or equipment of the Emergency Core Cooling Systems (ECCS) or emergency power systems. These systems are specifically designed to either remove heat from the reactor fuel rods if the normal core cooling system fails or provide emergency electrical power if the normal electrical systems fail.



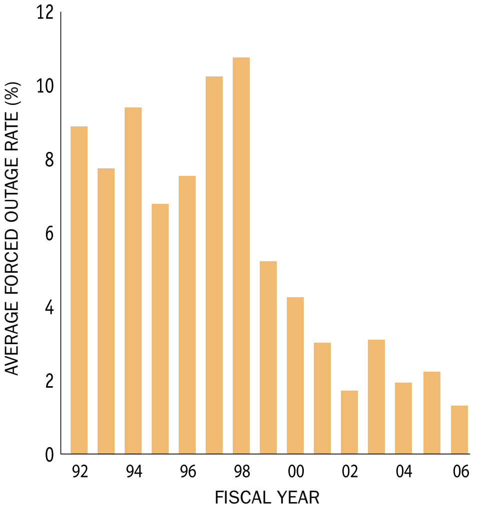
Significant Events are events that meet specific NRC criteria, including degradation of safety equipment, a reactor scram with complications, an unexpected response to a transient, or degradation of a fuel or pressure boundary. Significant events are identified by NRC staff through detailed screening and evaluation of operating experience.



Safety system failures are any actual failures, events or conditions that could prevent a system from performing its required safety function.

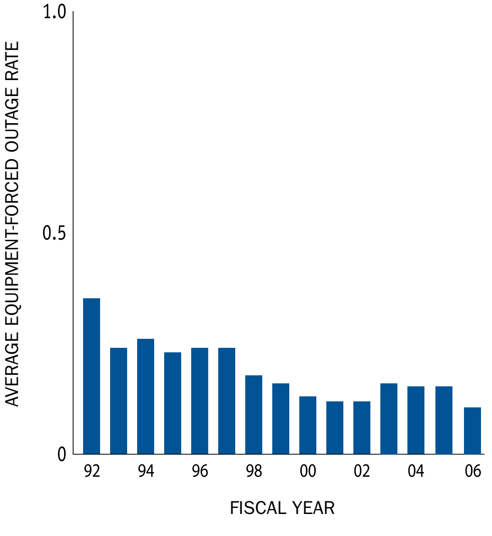
Figure 20. **Industry Performance Indicators: Annual Industry Averages, FYs 1992–2006: Continued**

FORCED OUTAGE RATE



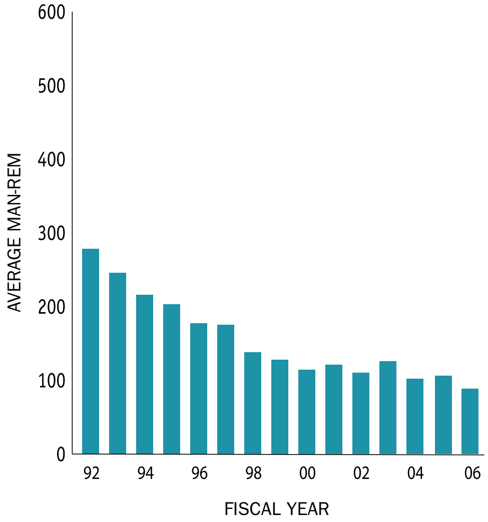
The forced outage rate is the number of hours that the plant is unable to operate (forced outage hours) divided by the sum of the hours that the plant is generating and transmitting electricity (unit service hours) and the hours that the plant is unable to operate (forced outage hours).

EQUIPMENT-FORCED OUTAGES PER 1000 CRITICAL HOURS



This indicator is the number of times the plant is forced to shutdown because of equipment failures for every 1000 hours that the plant is in operation and transmitting electricity.

COLLECTIVE RADIATION EXPOSURE

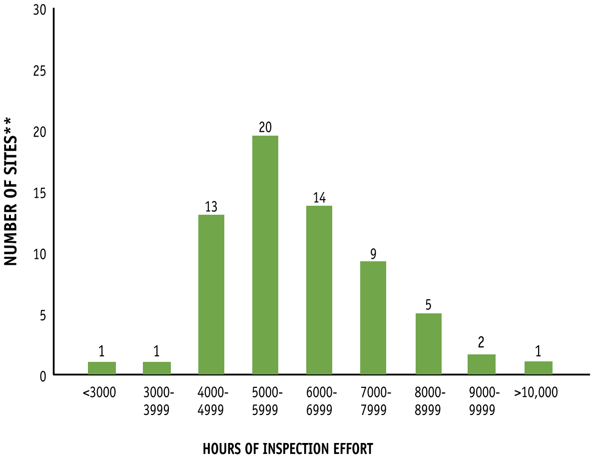


This indicator monitors the total radiation dose accumulated by plant personnel.

Note: Data represents annual industry averages, with plants in extended shutdown excluded. Data are rounded for display purposes. These data may differ slightly from previously published data as a result of refinements in data quality.

Source: Licensee data as compiled by the U.S. Nuclear Regulatory Commission.

Figure 21. NRC Inspection Effort at Operating Reactors, CY 2006*



*Data include regular and non-regular hours for all activities related to baseline, plant-specific, generic safety issues, and allegation inspections (does not include effort for performance assessment.)

**66 total sites (Indian Point 2, and Indian Point 3, Hope Creek, and Salem are treated as separate sites for inspection effort.)

Source: U.S. Nuclear Regulatory Commission.

The Act, whose overall goal is to promote "secure, affordable, and reliable energy," recognizes that the country's aging electric power supply system must expand and be replaced with clean energy sources.

The NRC staff is engaged in numerous ongoing interactions with vendors and utilities regarding prospective new reactor applications and licensing activities. Based on these interactions, the staff expects to receive a significant number of new reactor combined license (COL) applications over the next several years and is currently developing the infrastructure necessary to support the application reviews. Staffing levels are being increased based on anticipated receipt of up to 19 COLs for a total of 28 new nuclear units over the next few years.

The NRC has and continues to perform activities to ensure that it is prepared to review new applications. These activities include developing a COL application regulatory guide (Regulatory Guide 1.206), developing strategies for optimizing the review of the applications to be received, and a construction inspection program framework and subsequent inspection program for new construction activities, while also continuing our activities in the pre-application and design certification review processes. In addition, the NRC is updating NUREG-0800, "Standard Review Plan," and associated regulatory guides, and has performed rulemaking activities to revise the 10 CFR Part 52 licensing process. The staff is preparing to receive the first COL application in fall 2007.

The NRC is performing design certification preapplication reviews for AREVA's Evolutionary Power Reactor (EPR) and Mitsubishi's US Advanced Pressurized Water Reactor. The NRC is currently performing the design certification review of General Electric's (GE) Economic Simplified Boiling Water Reactor (ESBWR) design. In the past, the NRC has issued design certifications for four reactor designs that can be referenced in an application for a nuclear power plant. These designs include the following:

- GE Nuclear Energy's Advanced Boiling Water Reactor design;
- Westinghouse's System 80+ design;
- Westinghouse's AP600 design; and
- Westinghouse's AP1000 design.

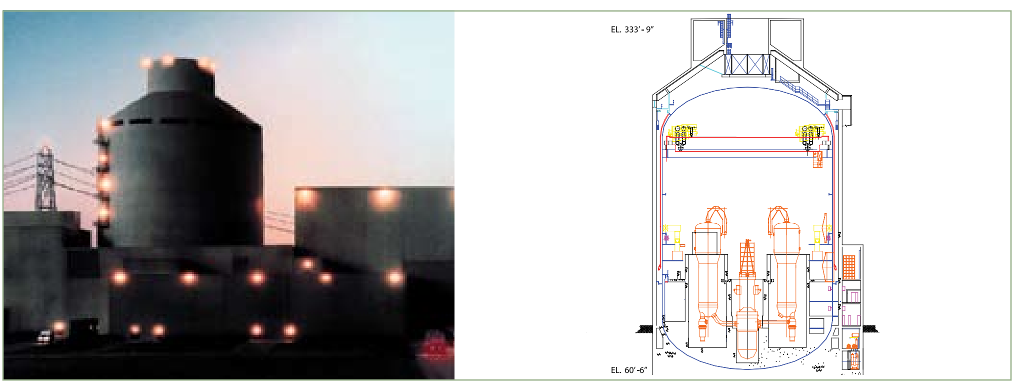
The NRC has issued two early site permits (ESPs) to System Energy Resources, Inc., for the Grand Gulf site in Mississippi and Exelon Generation Company, LLC, for the Clinton site in Illinois. The NRC is currently reviewing two applications submitted by Dominion Nuclear North Anna, LLC, for the North Anna site in Virginia and Southern Nuclear Operating Company for the Vogtle site in Georgia. An ESP provides for early resolution of site safety, environmental protection, and emergency preparedness issues, independent of a specific nuclear plant review. Mandatory adjudicatory hearings associated with the ESPs are conducted after the completion of the NRC staff's technical review.

Additional information on the NRC's new reactor licensing activities is available on the NRC's Web site at **http://www.nrc.gov/reactors/new-reactor-licensing.html**.

REACTOR LICENSE RENEWAL

Based on the Atomic Energy Act, the NRC issues licenses for commercial power reactors to operate for 40 years and allows these licenses to be renewed for up to an additional 20 years.

Westinghouse AP1000 Certified January 2006



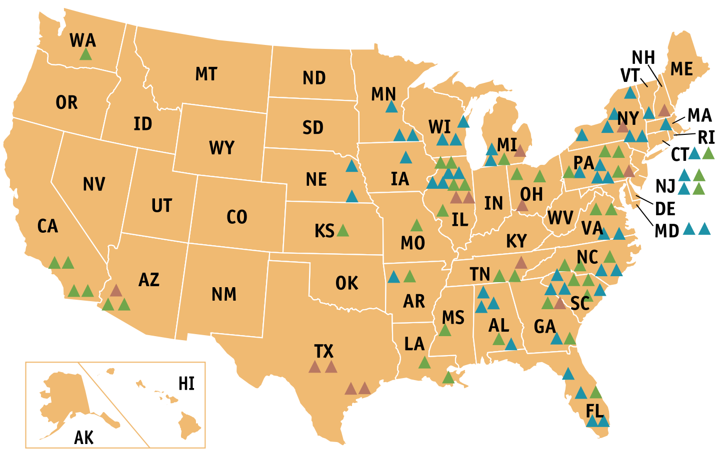
The original 40-year term for reactor licenses was based on economic and antitrust considerations, not on limitations of nuclear technology. Due to this selected time period, however, some structures and components may have been engineered on the basis of an expected 40-year service life.

As of May 2007, over one-half of the licensed plants have either received or are under review for license renewal. The age of operating reactors is illustrated in Figure 22. Figure 23 and Table 11 list the expiration dates of operating commercial nuclear licenses.

The decision whether to seek license renewal rests entirely with nuclear power plant owners and typically is based on the plant's economic situation and whether it can meet NRC requirements. Extending reactor operating licenses beyond their current 40-year terms will provide a viable approach for electric utilities to ensure the adequacy of future electricity-generating capacity that offers significant economic benefits when compared to the construction of new reactors.

License renewal rests on the determination that current operating plants continue to maintain an adequate level of safety.

Figure 22. **U.S. COMMERCIAL NUCLEAR POWER REACTORS— YEARS OF OPERATION**



YEARS OF COMMERCIAL OPERATION	NUMBER OF REACTORS
△ 0-9	0
▲ 10-19	13
▲ 20-29	41
▲ 30-39	50

Source: U.S. Nuclear Regulatory Commission

Over the plant's life, this level of safety has been enhanced through maintenance of the licensing basis, with appropriate adjustments to address new information from industry operating experience. Additionally, the NRC's regulatory activities have provided ongoing assurance that the current licensing basis will continue to provide an acceptable level of safety. The license renewal review process was developed to provide continued assurance that this level of safety will be maintained for the period of extended operation if a renewed license is issued.

The NRC has issued regulations establishing clear requirements for license renewal to assure safe plant operation for extended plant life (codified in 10 CFR Parts 51 and 54). The review of a renewal application proceeds along two paths – one for the review of safety issues and the other for environmental issues. An applicant must provide the NRC with an evaluation that addresses the technical aspects of plant aging and describes the ways those effects will be managed. The applicant must also prepare an evaluation of the potential impact on the environment if the plant operates for up to an additional 20 years. The NRC reviews the application and verifies the safety evaluations through inspections.

Public participation is an important part of the license renewal process. There are several opportunities for members of the public to question how aging will be managed during the period of extended operation. Information provided by the applicant is made available to the public. A number of public meetings are held, and all NRC technical and environmental review results are fully documented and made publicly available. Concerns may be litigated in an adjudicatory hearing if any party that would be adversely affected requests a hearing.

The NRC Web site (**http://www.nrc.gov**) provides information on the plants that have received renewed licenses and the renewal applications that are under review. The Web site also provides information on the license renewal regulations and process.

U.S. NUCLEAR RESEARCH AND TEST REACTORS

Nuclear research and test reactors are designed and utilized for research, testing, and educational purposes:

- In the performance of research and testing in the areas of physics, chemistry, biology, medicine, materials sciences, and related fields.
- In educating people for nuclear-related careers in the power industry, national defense, health service industry, research, and education.
- There are 50 licensed research and test reactors:
  - 33 reactors operating in 22 States (see Figure 24); and
  - 17 reactors permanently shut down under decommissioning.

Figure 23. U.S. Commercial Nuclear Power Reactor Operating Licenses — Expiration Date by Year Assuming Construction Recapture

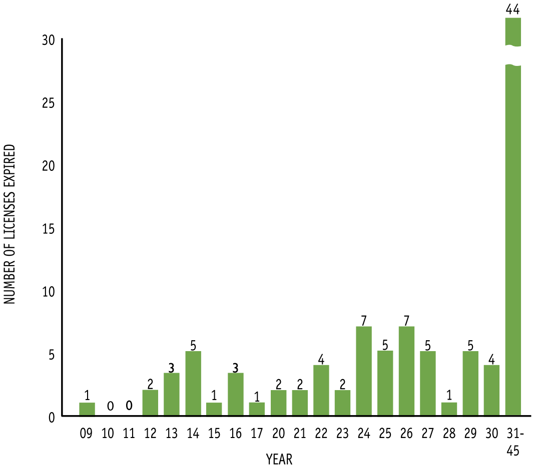


Table 11. U.S. Commercial Nuclear Power Reactor Operating Licenses — Expiration Date by Year, 2009–2046

2009	Oyster Creek
2012	Pilgrim 1 Vermont Yankee
2013	Indian Point 2 Kewaunee Prairie Island 1
2014	Cooper Duane Arnold James A. FitzPatrick Prairie Island 2 Three Mile Island 1
2015	Indian Point 3
2016	Beaver Valley 1 Crystal River 3 Salem 1
2017	Davis-Besse
2020	Salem 2 Sequoyah 1
2021	Diablo Canyon 1 Sequoyah 2
2022	La Salle County 1 San Onofre 2 San Onofre 3 Susquehanna 1
2023	La Salle County 2 Columbia Generating St.
2024	Byron 1 Callaway Grand Gulf 1 Limerick 1 Palo Verde 1 Susquehanna 2 Waterford 3
2025	Diablo Canyon 2 Fermi 2 Palo Verde 2 River Bend 1 Wolf Creek 1
2026	Braidwood 1 Byron 2 Clinton Hope Creek 1 Perry 1 Seabrook 1 Shearon Harris 1
2027	Beaver Valley 2 Braidwood 2 Palo Verde 3 South Texas Project 1 Vogtle 1
2028	South Texas Project 2
2029	Limerick 2 Dresden 2 Ginna Vogtle 2 Nine Mile Point 1
2030	Comanche Peak 1 Robinson 2 Point Beach1 Monticello
2031	Dresden 3 Palisades
2032	Turkey Point 3 Surry 1 Quad Cities 1 Quad Cities 2
2033	Browns Ferry 1 Comanche Peak 2 Fort Calhoun Oconee 1 Oconee 2 Peach Bottom 2 Point Beach 2 Turkey Point 4 Surry 2
2034	Arkansas Nuclear 1 Browns Ferry 2 Brunswick 2 Calvert Cliffs 1 D.C. Cook 1 Edwin Hatch 1 Oconee 3 Peach Bottom 3
2035	Watts Bar Millstone 2
2036	Browns Ferry 3 Brunswick 1 Calvert Cliffs 2 St. Lucie 1
2037	Joseph m. Farley 1 D.C. Cook 2
2038	Arkansas Nuclear 2 Edwin Hatch 2 North Anna 2
2040	North Anna 2
2041	Joseph M Farley 2 McGuire 1
2042	Summer
2043	Catawba 1 Catawba 2 McGuire 2 St. Lucie 2
2045	Millstone 3
2046	Nine Mile Point 2

Year assumes that the maximum number of years for construction recapture has been added to the current expiration date. This column is limited to reactors eligible for construction recapture. See Glossary for definition.
Note: Limited to reactors licensed to operate.
Source: Data as compiled by the U.S. Nuclear Regulatory Commission. Data as of December 2006.

- Since 1958, 76 licensed research and test reactors have been decommissioned.
- Refer to Appendix E for listing of operating research and test reactors regulated by the NRC.
- Refer to Appendix F for listing of decommissioning research and test reactors regulated by the NRC.

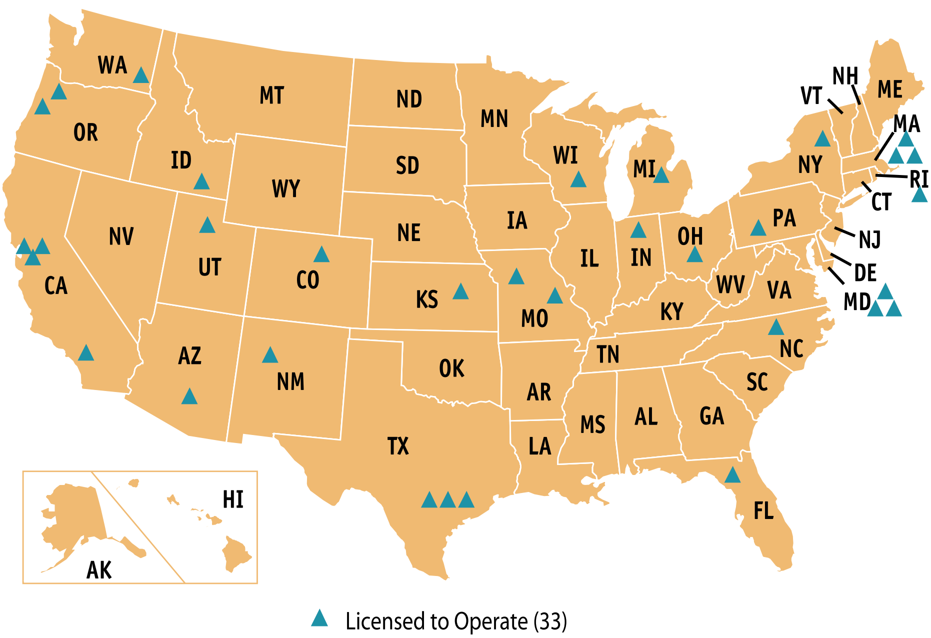
Principal Licensing and Inspection Activities

- The NRC licenses approximately 300 research and test reactor operators. Each operator is requalified before renewal of a 6-year license.
- The NRC conducts approximately 45 research and test reactor inspections each year.

NUCLEAR REGULATORY RESEARCH

The NRC's research program, conducted by the Office of Nuclear Regulatory Research (RES), furthers the regulatory mission of the NRC by providing technical advice, technical tools, and information for identifying and resolving safety issues, making regulatory decisions, and promulgating regulations and guidance. In addition, RES conducts confirmatory experiments and analyses, develops technical bases for supporting realistic

Figure 24. **U.S. Nuclear Research and Test Reactors**



Source: U.S. Nuclear Regulatory Commission

safety decisions by the NRC, and prepares the NRC for the future by evaluating the safety aspects of current and new reactor designs and technologies.

The challenges that face RES include changes in practices and performance of the regulated industry, the emergence of new safety issues as the industry continues to mature, the availability of new technologies, development of new reactor design, knowledge management, and public awareness of and involvement in the regulatory process. Accordingly, the NRC must have highly skilled, experienced experts with access to facilities to formulate sound technical solutions and to support timely and realistic regulatory decisions.

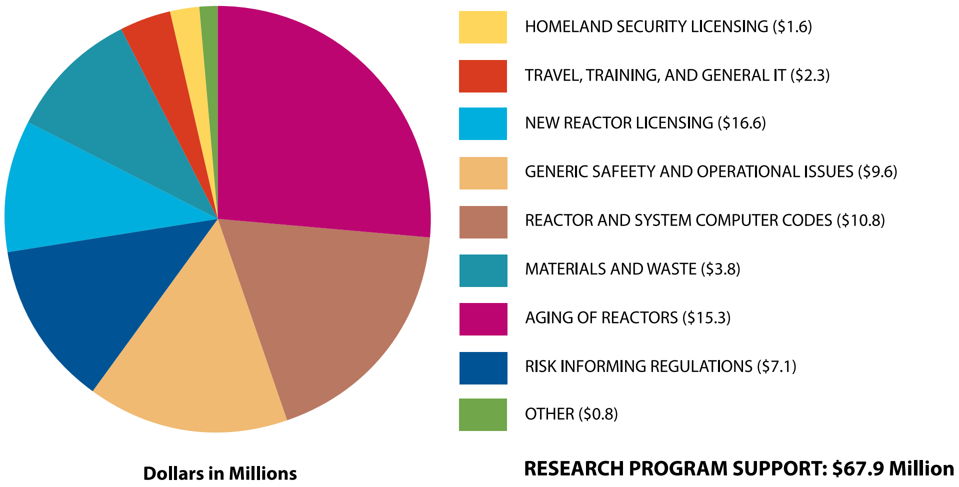
The NRC's current research program focuses on supporting the NRC strategic performance goals: safety, security, openness, effectiveness, and management. To ensure protection of public health and safety and the environment, RES's programs include research into material degradation issues (e.g., stress-corrosion cracking and boric acid corrosion), new and evolving technologies (e.g., new reactor technology, mixed oxide fuel performance), operating experience, and probabilistic risk assessment (PRA) technologies. RES also develops and maintains computer codes for use in analyzing severe accidents, environmental effects, nuclear criticality, fire conditions, thermal hydraulic performance of reactors, fuel performance, and PRA. These computer codes continue to evolve as computational abilities expand and additional operational data allows for more realistic modeling. To ensure the secure use and management of radioactive materials, RES is investigating potential vulnerabilities to malicious attack and compensatory actions of nuclear facilities. To ensure openness in the regulatory process, RES conducts public meetings and participates with the Office of Nuclear Reactor Regulation in the annual Regulatory Information Conference to bring together diverse groups of stakeholders and discuss the latest trends in cutting-edge research. To ensure that the NRC's actions are effective, efficient, realistic, and timely, RES participates in information exchanges and cooperative research, both domestic and international, to share positions on technical and policy issues, enhance the effective and efficient use of agency resources, avoid duplication of effort, and share facilities wherever possible. To enhance management excellence, RES manages human capital by using innovative recruitment, development, and retention strategies. Additionally, RES encourages knowledge management initiatives to support staff development and networking. This achieves a high-quality, diverse work force, which supports providing high-quality research products.

The NRC provides RES with funding to manage cooperative agreements with universities and nonprofit organizations for research in specific areas of interest to the agency (see Figure 25). These cooperative agreements include Ohio State University for work on risk importance of digital systems, the Electric Power Research Institute for work on irradiationassisted stress corrosion cracking, and the University of Maryland for work on PRA techniques in risk-informed and performance-based regulations.

The NRC also provides RES with funding to manage grants with universities and non-profit organizations for research in specific areas of interest to the agency. These grants include the National Council on Radiation Protection and the International Council on Radiation Protection for work on radiation protection issues and Pennsylvania State University for work on fuel cladding behavior.

Additionally, the NRC provides RES with funding to manage agreements with foreign governments for international cooperative research in specific areas of interest to the agency. These research agreements include the Halden Reactor Project in Norway for research and development of fuel, reactor internals, plant control and monitoring, and human factors; the Cabri Water Loop Project in France for fuels research; and the Studsvik Cladding Integrity Project in Sweden for fuels research.

Figure 25. **NRC Research Funding, FY 2007**



Source: U.S. Nuclear Regulatory Commission

Magnetic Resonance Imaging (MRI).

NUCLEAR MATERIALS

URANIUM MILLING

A uranium mill is a chemical plant designed to extract uranium from mined ore. The mined ore is brought by truck to the milling facility where the ore is crushed and leached. In most cases, sulfuric acid is used as the leaching agent, but alkaline leaching can also be used. The leaching agent extracts not only uranium from the ore but also several other constituents like molybdenum, vanadium, selenium, iron, lead, and arsenic. The product produced from the mill is referred to as "yellow cake" (U_3O_8) because of its yellowish color.

As defined in the NRC regulations of 10 CFR Part 40, uranium milling is any activity that results in the production of byproduct material as defined in this part. The regulations in 10 CFR Part 40 define byproduct material the same as Section 11e.(2) of the Atomic Energy Act as, "the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content," but adds "including discrete surface wastes resulting from uranium solution extraction processes."

Uranium is extracted from ore at uranium mills and at in situ leach (ISL) facilities (the NRC-licensed heap leach and ion exchange facilities no longer operate). In both cases, an extraction process concentrates the uranium into yellow cake, and the process waste is byproduct material. The yellow cake is sent to a conversion facility for processing in the next step in the manufacture of nuclear fuel. The uranium milling and disposal of byproduct material by NRC licensees is regulated under 10 CFR Part 40, Appendix A.

Conventional mills crush the pieces of ore and extract 90 to 95 percent of the uranium from the ore. Mills are typically located in areas of low population density, and they process ores from mines within about 50 kilometers (30 miles) of the mill. Most mills in the United States are in decommissioning.

ISL facilities are another means of extracting uranium from underground. ISL facilities recover from low grade ores the uranium that may not be economically recoverable by other methods. In this process, a leaching agent such as oxygen with sodium carbonate is injected through wells into the ore body to dissolve the uranium. The leach solution is pumped from the formation, and ion exchange is used to separate the uranium from the solution. About 12 such ISL facilities exist in the United States. Of these, four are licensed by the NRC, and the rest are licensed by Texas, an Agreement State.

U.S. FUEL CYCLE FACILITIES

The NRC licenses and inspects all commercial nuclear fuel facilities involved in the enriching, processing, and fabrication of uranium ore into reactor fuel.

There are seven major fuel fabrication and production facilities and two gaseous

Table 12. Locations of Uranium Milling Facilities

LICENSEE	SITE NAME/LOCATION
In Situ Leach Facilities	
Cogema Mining, Inc.	Irigaray/ChR, Wyoming
Crow Butte Resources, Inc.	Crow Butte, Nebraska
Hydro Resources, Inc.	Crown Point, New Mexico
Power Resources, Inc.	Smith Ranch, Highlands, Ruth, Reynolds Ranch and North Butte, Wyoming
Conventional Uranium Milling Facilities	
Umetco Minerals Corp.	Gas Hills, Wyoming
Western Nuclear, Inc.	Split Rock, Wyoming
Pathfinder Mines Corp.	Lucky Mc, Wyoming
American Nuclear Corp.	Gas Hills, Wyoming
Pathfinder Mines Corp.	Shirley Basin, Wyoming
Exxon Mobil Corp.	Highlands, Wyoming
Bear Creek Uranium Co.	Bear Creek, Wyoming
Kennecott Uranium Corp.	Sweetwater, Wyoming
Homestake Mining Co.	Grants, New Mexico
Rio Algom Mining, LLC	Ambrosia Lake, New Mexico
UNC Mining and Milling	Churchrock, New Mexico

Note: The facilities listed are under the authority of the NRC to produce byproduct material.

Table 13. **Major U.S. Fuel Cycle Facility Sites**

Uranium Hexafluoride Production Facilities (see Figure 26)	
Honeywell International, Inc.	Metropolis, Illinois
Uranium Fuel Fabrication Facilities (see Figure 28)	
Global Nuclear Fuels-Americas, LLC	Wilmington, North Carolina
Westinghouse Electric Company, LLC Columbia Fuel Fabrication Facility	Columbia, South Carolina
Nuclear Fuel Services, Inc.	Erwin, Tennessee
AREVA NP, Inc. Mt. Athos Road Facility	Lynchburg, Virginia
BWX Technologies Nuclear Products Division	Lynchburg, Virginia
AREVA NP, Inc.	Richland, Washington
Gaseous Diffusion Uranium Enrichment Facilities (see Figure 27)	
U.S. Enrichment Corporation	Paducah, Kentucky
U.S. Enrichment Corporation	Piketon, Ohio*
Proposed Gas Centrifuge Uranium Enrichment Facilities (see Figure 27)	
USEC Inc.	Piketon, Ohio
Louisana Energy Services	Eunice, New Mexico
Proposed Mixed Oxide Fuel Fabrication Facilities (see Figure 28)	
Shaw AREVA Mox Services, LLC	Aiken, South Carolina

Note: The NRC regulates 9 other facilities that possess significant quantities of special nuclear material (other than reactors) or process source material (other than uranium recovery facilities).
*Currently in cold shutdown and not used for enrichment.

diffusion uranium enrichment facilities licensed to operate in eight States. In addition, the NRC has granted licenses for two gas centrifuge uranium enrichment facilities, one to Louisana Energy Services in – 2006, and one to USEC Inc. in April 2007. Both facilities are currently under construction. Also, there is one proposed mixed oxide fuel fabrication facility that has been approved for construction but has not yet been constructed and is undergoing a licensing review (see Table 13).

USEC Inc. submitted an application for a Lead Cascade Facility in February 2003, and a license for the facility was issued in February 2004. The Lead Cascade is a test facility intended to provide operational information on the machines and auxiliary systems as they would be used in commercial production of enriched uranium. The Lead Cascade Facility is located at the Portsmouth Gaseous Diffusion Plant site in Piketon, Ohio, and began operation in late 2006.

USEC Inc. submitted a license application for the American Centrifuge Plant (ACP) in August 2004. The ACP would be an expansion of the Lead Cascade Facility for commercial production of enriched uranium. The NRC issued the final Environmental Impact Statement in April 2006. The Safety Evaluation Report (SER) was issued in September 2006. The NRC issued the license in April 2007.

The U.S. Department of Energy (DOE) announced plans to construct a mixed oxide fuel fabrication facility through a contract with the consortium Shaw AREVA MOX Services, of The Shaw Group Inc. and COGEMA Inc., an affiliate of AREVA. The facility is intended to convert surplus U.S. weapons-grade plutonium, supplied by DOE, into fuel for use in commercial nuclear reactors. Such use would render the plutonium essentially inaccessible and unattractive for weapons use.

In March 2005, the NRC issued a construction authorization and safety evaluation report for a mixed oxide fuel fabrication facility to be located at DOE's Savannah River Site. Shaw AREVA MOX Services must obtain a separate NRC approval before it may possess special nuclear material and operate the facility. In September 2006, the applicant submitted a license application for the mixed oxide fuel fabrication facility, which the NRC is reviewing.

DOE's proposed Global Nuclear Energy Partnership (GNEP) is a comprehensive strategy to enable the expansion of emissions-free nuclear energy worldwide by demonstrating and deploying proliferation-resistant technologies to recycle spent nuclear fuel. As part of the GNEP project, the NRC would have the regulatory authority to conduct license reviews of any proposed commercial spent fuel recycling facilities and advanced recycling reactors.

The NRC's domestic safeguards program is aimed at ensuring that special nuclear material within the United States is not stolen or otherwise diverted from civilian

Figure 26. **Typical Uranium Enrichment Facility**

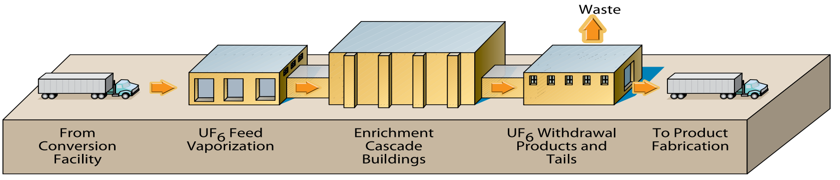
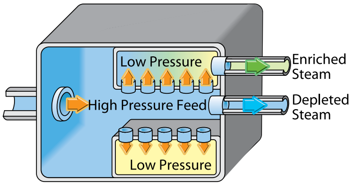


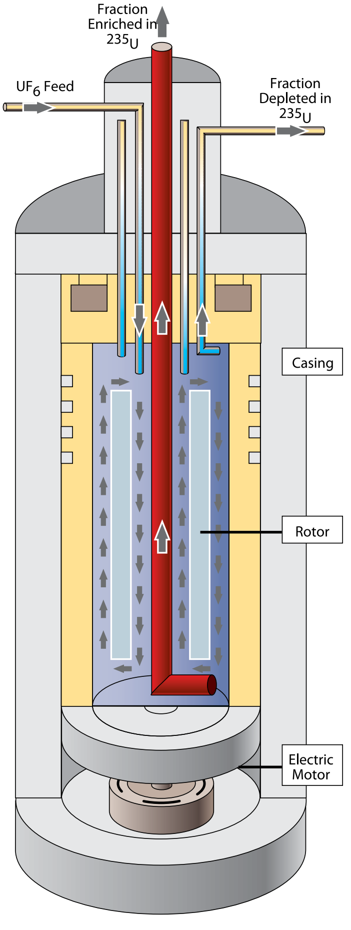
Figure 27. **Two Enrichment Processes**

A. Gas Diffusion Process



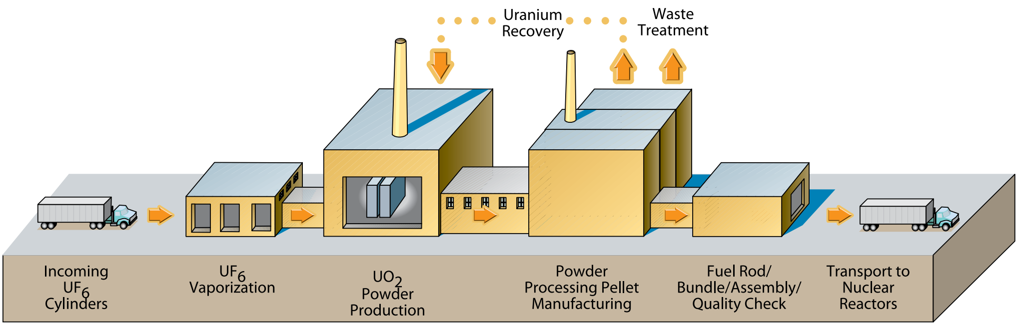
The gaseous diffusion method uses molecular diffusion to effect separation. The isotopic separation is accomplished by diffusing uranium, which has been combined with fluorine to form UF_6 gas, through a porous membrane (barrier) and utilizing the different molecular velocities of the two isotopes to achieve separation.

B. Gas Centrifuge Process



The gas centrifuge process uses a large number of rotating cylinders in series and parallel configurations. Gas is introduced and rotated at a high speed, concentrating the component of higher molecular weight towards the outer wall of the cylinder and the lower molecular weight component towards the axis. The enriched and the depleted gas are removed by scoops.

Figure 28. **Typical Fuel Fabrication Plant**



Fabrication is the final step in the process used to produce uranium fuel. It begins with the conversion of enriched uranium hexafluoride (UF_6) gas to a uranium dioxide solid. Nuclear fuel must maintain both its chemical and physical properties under the extreme conditions of heat and radiation present inside an operating reactor vessel. Fabrication of commercial light-water reactor fuel consists of three basic steps:

1. chemical conversion of UF_6 to uranium dioxide (UO_2) powder;
2. ceramic process that converts uranium oxide powder to small pellets; and
3. mechanical process that loads the fuel pellets into rods and constructs finished fuel assemblies.

After the UF_6 is chemically converted to UO_2, the powder is blended, milled, and pressed into ceramic fuel pellets about the size of a fingertip. The pellets are stacked into long tubes made of material called "cladding" (such as zirconium alloys). After careful inspection, the resulting fuel rods are bundled into fuel assemblies for use in reactors. The cladding material provides one of multiple barriers to contain the radioactive fission products produced during the nuclear chain reaction.

Following final assembly operations, the completed fuel assembly (about 12-feet long) is washed, inspected, and finally stored in a special rack until it is ready for shipment to a nuclear power plant site.

Fuel fabrication facilities mechanically and chemically process the enriched uranium into nuclear reactor fuel.

facilities for possible use in clandestine fissile explosives and does not pose an unreasonable risk to the public from radiological sabotage. The NRC verifies through licensing and inspection activities that licensees apply safeguards to protect against sabotage, theft, and diversion. Additionally, the NRC and DOE developed and continue to implement the Nuclear Material Management and Safeguards System (NMMSS) to track transfers and inventories of special nuclear material, source material from abroad, and other material. Approximately 180 NRC-licensed facilities are authorized to possess plutonium and enriched uranium in quantities ranging from a single kilogram to multiple tons. These licensees verify and document their inventories in the NMMSS database. There are also several hundred additional sites licensed by the NRC or State governments that possess plutonium and enriched uranium in smaller quantities typically ranging from one gram to tens of grams. The NRC is currently working with these licensees to confirm the accuracy of inventories to provide increased confidence in the location and quantity of plutonium and enriched uranium held by NRC and Agreement State licensees.

Principal Licensing and Inspection Activities

- The NRC issues approximately 80 new licenses, license renewals, license amendments, and safety and safeguards reviews for fuel cycle facilities annually.
- The NRC routinely conducts safety, safeguards, and environmental protection inspections of approximately fuel cycle facilities or sites.

Louisiana Energy Services submitted a license application in December 2003 for a gas centrifuge uranium enrichment plant, known as the National Enrichment Facility, to be located in Eunice, New Mexico. The NRC issued the final Environmental Impact Statement and Safety Evaluation Report in June 2005. The NRC issued the license in June 2006.

U.S. MATERIALS LICENSES

Approximately 22,000 licenses are issued for medical, academic, industrial, and general uses of nuclear materials (see Table 14).

- Approximately 4,400 licenses are administered by the NRC.
- Approximately 17,600 licenses are administered by the 34 States that participate in the Agreement States Program. An Agreement State has signed an agreement with the NRC that authorizes the State to regulate materials within that State (see Table 14).

Reactor-produced radionuclides are used extensively throughout the United States for civilian and military industrial applications, basic and applied research, manufacture of consumer products, academic studies, and medical diagnosis, treatment, and research. The NRC and Agreement State regulatory programs are designed

Table 14. **U.S. Materials Licenses by State**

State	Number of Licenses: NRC	Number of Licenses: Agreement States
Alabama	18	437
Alaska	56	0
Arizona	11	330
Arkansas	7	248
California	47	2,029
Colorado	20	353
Connecticut	193	0
Delaware	60	0
District of Columbia	41	0
Florida	15	1,606
Georgia	16	526
Hawaii	59	0
Idaho	82	0
Illinois	37	742
Indiana	278	0
Iowa	2	177
Kansas	12	301
Kentucky	9	435
Louisiana	10	551
Maine	2	129
Maryland	61	610
Massachusetts	27	513
Michigan	535	0
Minnesota	12	200
Mississippi	5	320
Missouri	296	0
Montana	77	0
Nebraska	3	149
Nevada	3	275
New Hampshire	4	79
New Jersey	512	0
New Mexico	14	193
New York	38	1,505
North Carolina	18	673
North Dakota	10	64
Ohio	50	817
Oklahoma	26	245
Oregon	4	484
Pennsylvania	696	0
Rhode Island	1	59
South Carolina	15	369
South Dakota	41	0
Tennessee	23	601
Texas	43	1,630
Utah	11	183
Vermont	38	0
Virginia	385	0
Washington	19	429
West Virginia	183	0
Wisconsin	29	342
Wyoming	78	0
Others*	143	0
Total	4,375	17,604

Agreement State (shaded rows)

*Others includes U.S. territories such as Puerto Rico, Virgin Islands, and Guam.
Note: Agreement States data are latest available as of April 6, 2006. NRC data as of May 2, 2007.
For updates, please refer to Federal and State Materials and Environmental Management (FSME) Web site, http://hsrd.ornl.gov/nrc/Materials/licensesbyregion040606.pdf.

to ensure that licensees safely use these materials and do not endanger public health and safety or cause damage to the environment.

Medical and Academic

The NRC and Agreement States issue licenses to hospitals and physicians for the use of certain radioactive materials in treating patients. In nuclear medicine, diagnostic procedures include in vitro tests (the addition of radioactive materials to lab samples taken from patients) and in vivo tests (direct administration of radioactive drugs to patients). Therapeutic treatments include the use of radioactive drugs to treat certain medical conditions such as hyperthyroidism, treat certain forms of cancer, and relieve bone pain associated with cancer.

The NRC issues licenses to academic institutions for educational and research purposes. Licensed activities include classroom demonstrations by qualified instructors, laboratory research, and the use of certain neutron sources and source material in subcritical assemblies.

The facilities, personnel, program controls and equipment in each application are reviewed to ensure the safety of the public, patients, and occupationally exposed workers.

Industrial

Radionuclides are used in a number of industrial and commercial applications, including industrial radiography, gauging devices, gas chromatography, well logging, and manufacturing. The radiography process uses radiation sources to determine structural defects in metallic castings and welds. Portable and fixed gauges use radiation sources to measure density and thickness of an object. Such measurements determine the thickness of paper products, fluid levels of oil and chemical tanks, and the moisture and density of soils and material at construction sites. Gas chromatography uses low-energy sources for identifying the constituent elements of substances. It is used to determine the components of complex mixtures such as petroleum products, smog and cigarette smoke, and in biological and medical research to identify the components of complex proteins and enzymes. Well-logging devices use a radioactive source to trace the position of materials previously placed in a well. This process is used extensively for oil, gas, coal, and mineral exploration.

General Licenses

A general licensee is a person or organization that acquires, uses, or possesses a generally licensed device and has received the device through an authorized transfer by the device manufacturer/distributor, or by change of company ownership where the device remains in use at a particular location.

A generally licensed device is a device containing radioactive material that is typically used to detect, measure, gauge, or control the thickness, density, level, or chemical composition of various items. Examples of such devices are gas chromatographs (detector cells), density gauges, fill-level gauges, and static-elimination devices. The NRC registers and tracks generally licensed devices to increase control and accountability of the devices and to prevent them from becoming orphan sources.

Principal Licensing and Inspection Activities

- The NRC issues approximately 3,400 new licenses, renewals, or license amendments for materials licenses annually.
- The NRC conducts approximately 1,500 health and safety inspections of its nuclear materials licensees annually.

MEDICAL APPLICATIONS

Diagnostic

For most diagnostic nuclear medicine procedures, a small amount of radioactive material, known as a radiopharmaceutical, is administered, either by injection, inhalation, or orally. The radiopharmaceutical collects in the organ being evaluated. The radioactive material emits photons that are detected externally by a device known as a gamma camera to produce images that provide information about the organ function and composition.

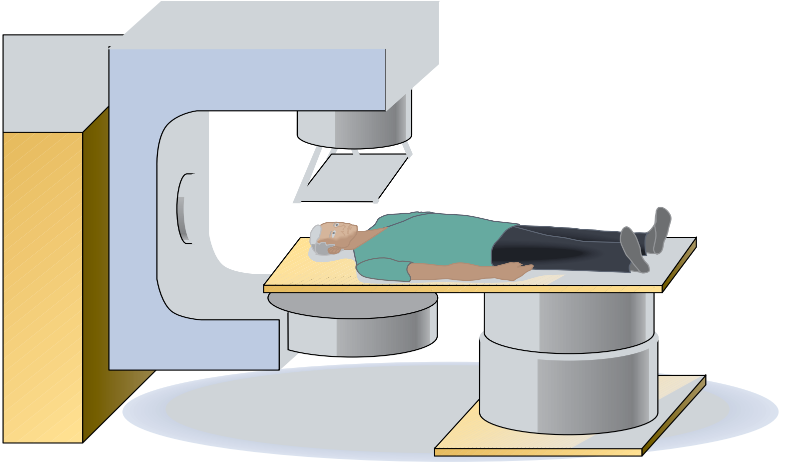
Radiation Therapy

The primary objective of radiation therapy is to deliver an accurately prescribed dose of radiation to the target site while minimizing the radiation dose to surrounding healthy tissue. Radiation therapy can be used to eradicate cancer or the threat of disease or relieve systems associated with the disease. Treatments often involve multiple exposures (also called fractions) spaced over a period of time for maximum therapeutic effect. When used to treat malignant disease, radiation therapy is often delivered in combination with surgery or chemotherapy.

There are three main categories of radiation therapy:

1. External beam therapy (also called teletherapy) involves a beam of radiation from outside the body that is directed to the target tissue (see Figure 29). There are several different categories of external beam therapy units. The type of treatment machine that is regulated by the NRC contains a high-activity radioactive source (usually Cobalt-60) that emits photons to treat the target site.
2. In brachytherapy treatments, sealed radioactive sources are permanently or temporarily placed near to or on a body surface, in a body cavity, directly to a surface within a cavity, or directly to the tissue. The radiation dose is delivered at a distance of up to a few centimeters from the source or sources.

Figure 29. **Cobalt-60 Teletherapy Unit**



Source: U.S. Nuclear Regulatory Commission

3. Therapeutic radiopharmaceuticals are large amounts of unsealed radioactive materials that localize in a specific region or organ system to deliver a large radiation dose. Therapeutic doses of radiopharmaceuticals are administered to control a specific disease or treat tumors or to relieve symptoms of cancer-induced bone pain.

NUCLEAR GAUGES

Fixed Gauges

Fixed gauges consist of a radioactive source that is contained in a source holder. When the source holder's shutter is opened manually or by activating a remote electrical button, a beam of radiation is directed at the material or product being processed or controlled. A detector mounted opposite to the source measures the radiation passing through the media or the product. The required information is shown on a local readout or is displayed on a computer monitor. The selection of the type, energy, and strength of radiation is determined by the material and process being monitored.

Nuclear gauges are used as nondestructive devices to measure physical properties of products and industrial processes as a part of quality control and low-cost fabrication, construction, and installations.

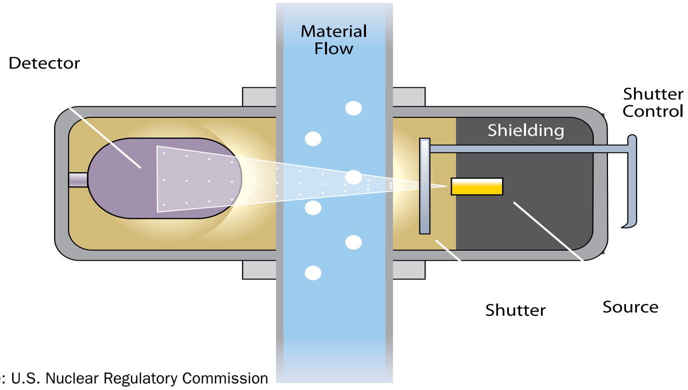
The cross-section (see Figure 30) shows a fixed fluid gauge installed on a process pipe. Such devices are widely used in beverage, food, plastics, process, and chemical industries to measure the densities, flow rates, levels, thicknesses, and weights of a wide variety of materials and surfaces.

Portable Gauges

A portable gauge is a radioactive source or sources and detector mounted together in a portable shielded device. When the device is being used, it is placed on the object to be measured, and the source is either inserted into the object or the gauge relies on a reflection of radiation from the source to bounce back to the bottom of the gauge. The detector in the gauge measures the radiation, either directly from the inserted source or the reflected radiation.

The amount of radiation that the detector measures indicates the thickness, density, moisture content, or some other property that is displayed on a local read out or on a computer monitor. The top of the gauge has sufficient shielding to protect

Figure 30. **Cross-Section of a Fixed Fluid Gauge**



Source: U.S. Nuclear Regulatory Commission

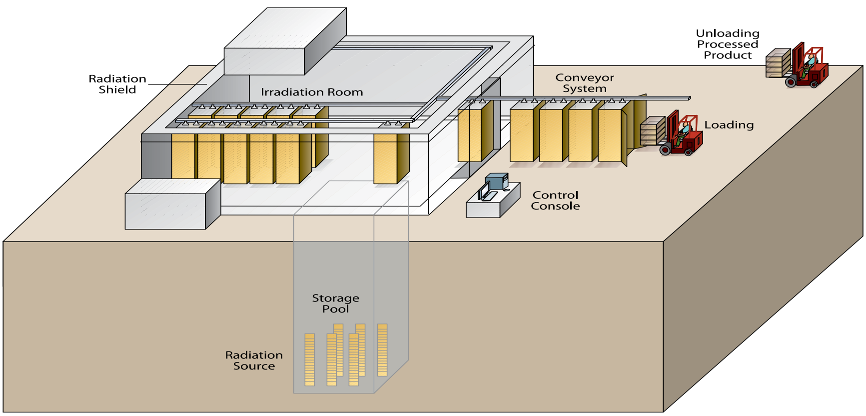
the operator while the source is exposed. When the measuring process is completed, the source is retracted or a shutter closes, minimizing exposure from the source.

COMMERCIAL PRODUCT IRRADIATORS

Figure 31 shows a typical large commercial gamma irradiator that may be used for sterilization of medical supplies and equipment, disinfestation of food products, insect eradication through a sterile male release program, chemical and polymer synthesis and modifications or extension of the shelf-life of poultry and perishable products.

When this type of irradiator is used, the cobalt-60 sealed source is raised out of the pool water and exposed to the product within a radiation volume that is maintained as inaccessible during use by an entry control system.

Figure 31. Commercial Gamma Irradiator



Source: U.S. Nuclear Regulatory Commission

Nuclear waste storage at the Surry Power Station, Surry, Virginia.

RADIOACTIVE WASTE

U.S. LOW-LEVEL RADIOACTIVE WASTE DISPOSAL

Commercial low-level waste disposal facilities must be licensed by either the NRC or Agreement States in accordance with health and safety requirements. The facilities are to be designed, constructed, and operated to meet safety standards. The operator of the facility must also extensively characterize the site on which the facility is located and analyze how the facility will perform for thousands of years into the future. Current low-level waste disposal uses shallow land disposal sites with or without concrete vaults.

The NRC has developed a classification system for low-level waste based on its potential hazards and has specified disposal and waste form requirements for each of the three general classes of waste – A, B, and C. Class A waste contains lower concentrations of radioactive material than Class B waste, and Class B waste, in turn, contains lower concentrations than Class C waste. Class A waste accounts for approximately 90 percent of the total volume of low-level waste. Determination of the classification of waste is a complex process. For more information, see 10 CFR Part 61.

The volume and radioactivity of waste vary from year to year based on the types and quantities of waste shipped each year. Waste volumes currently are several million cubic feet each year from reactor facilities undergoing decommissioning and cleanup of contaminated sites.

The Low-Level Radioactive Waste Policy Amendments Act (LLRWPAA) of 1985 authorized the following:

- Formation of 10 regional compacts (see Table 15)
- Exclusion of waste generated outside a compact
- Active Licensed Disposal Facilities
    - Barnwell, South Carolina
    - Hanford, Washington
    - Clive, Utah (restricted to Class A waste)
- Closed Disposal Facilities
    - Beatty, Nevada – closed 1993
    - Sheffield, Illinois – closed 1978
    - Maxey Flats, Kentucky – closed 1977
    - West Valley, New York – closed 1975

U.S. HIGH-LEVEL RADIOACTIVE WASTE MANAGEMENT: DISPOSAL AND STORAGE

The Yucca Mountain Decision

Policies of the United States that govern permanent disposal of high-level radioactive waste are defined by the Nuclear Waste Policy Act of 1982, as amended, and the Energy Policy Act of 1992. These acts specify that high-level radioactive waste will be disposed of underground in a deep geologic repository and that Yucca Mountain, Nevada, will be the single candidate site for characterization as a potential

Table 15. **U.S. Low-Level Waste Compacts**

Compact	States
Appalachian	Delaware Maryland Pennsylvania West Virginia
Atlantic	New Jersey South Carolina*
Central	Arkansas Kansas Louisiana Nebraska Oklahoma
Central Midwest	Illinois Kentucky
Midwest	Indiana Iowa Minnesota Missouri Ohio Wisconsin
Northwest	Alaska Hawaii Idaho Montana Oregon Utah* Washington* Wyoming
Rocky Mountain	Colorado Nevada New Mexico
Southeast	Alabama Florida Georgia Mississippi Tennessee Virginia
Southwestern	Arizona California North Dakota South Dakota
Texas	Texas Vermont
Unaffiliated	Maine Massachusetts Michigan New Hampshire New York North Carolina Rhode Island

Note: Data as of June 2007
*There are three active, licensed low-level waste disposal facilities located in Agreement States.
Barnwell, located in Barnwell, South Carolina - Currently, Barnwell accepts waste from all U.S. generators. Beginning in 2008, Barnwell will only accept waste from the Atlantic Compact States (Connecticut, New Jersey, and South Carolina). Barnwell is licensed by the State of South Carolina to receive waste for Classes A-C waste.
Energy Solutions, located in Clive, Utah - Energy Solutions accepts waste from all regions of the United States. It is licensed by the State of Utah for Class A waste only.
Hanford, located in Hanford, Washington - Hanford accepts waste from the Northwest and Rocky Mountain compacts. Hanford is licensed by the State of Washington to receive waste for Classes A-C waste.

Source: Low-level Radioactive Waste Forum geologic repository (see Figure 32). Under these two acts, the NRC is one of three Federal agencies that have key roles to perform in disposal of spent nuclear fuel and other high-level radioactive waste. In brief, the three agencies have the following roles:

- The Department of Energy (DOE) has responsibility for developing permanent disposal capacity for spent fuel and other high-level radioactive waste.
- The Environmental Protection Agency (EPA) has responsibility for issuing environmental standards for evaluating safety of a geologic repository at Yucca Mountain.
- The NRC has responsibility for issuing regulations that implement the EPA's standards; deciding whether to license the proposed repository; and ensuring that DOE, if granted a license, safely constructs and operates the repository.

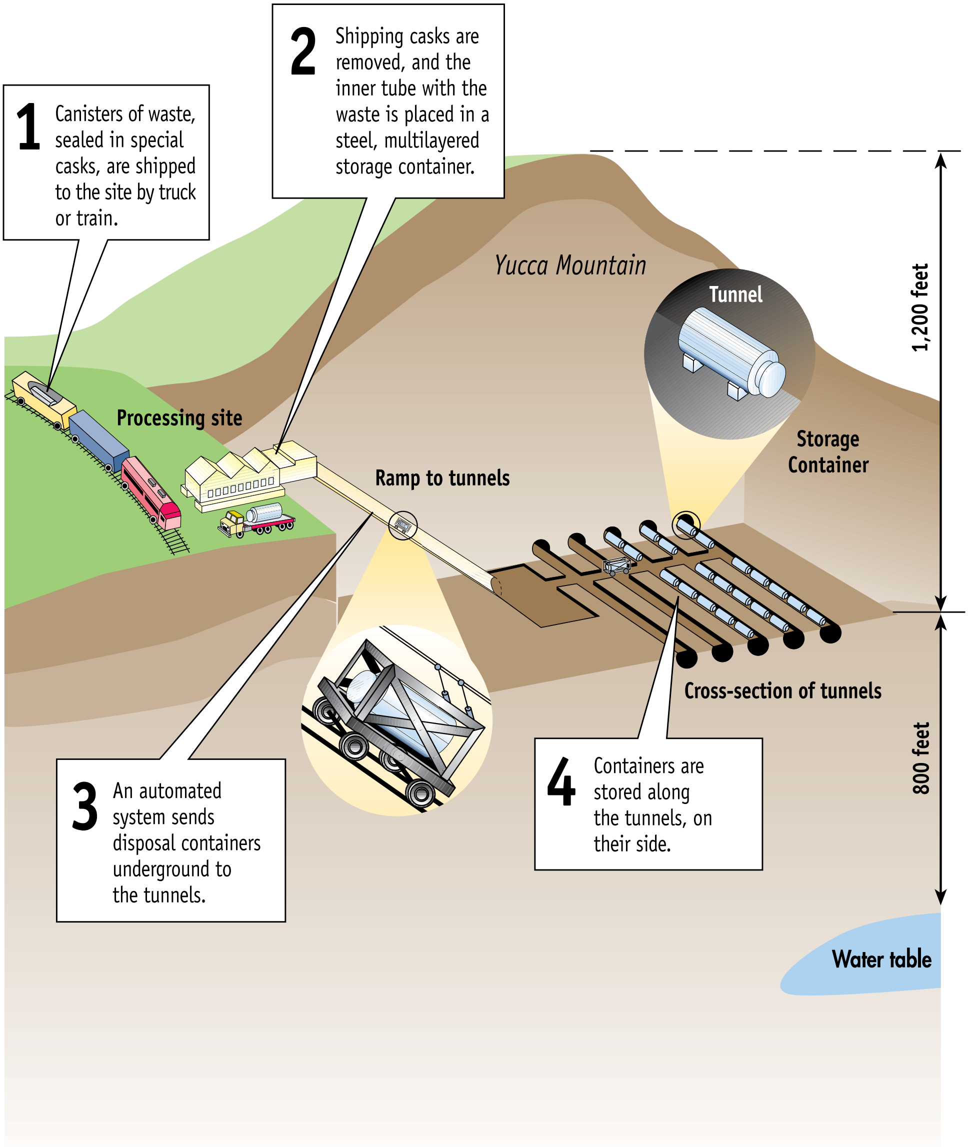
For many years, the NRC has engaged the DOE in pre-license application activities, consistent with a public prelicensing agreement. Through open public dialogue with the DOE, the NRC has actively sought to increase its confidence that a license application from the DOE will be complete and of sufficient quality for the NRC to conduct an informed safety review.

On February 15, 2002, after receiving a recommendation from the Secretary of Energy, the President notified Congress that he considered Yucca Mountain qualified for a construction permit application. Congress approved the recommendation, and on July 23, 2002, the President signed a joint Congressional resolution directing the DOE to prepare an application for constructing a repository at Yucca Mountain. At this time, the DOE expects to submit a license application to the NRC in 2008. The NRC will issue a license to the DOE only if the DOE can demonstrate that it can safely construct and operate a repository in compliance with the NRC's regulations.

The NRC's regulations provide that decisions about the licensing of a geologic repository will occur in three phases. In the first phase, the DOE must submit a license application to the NRC. Once the DOE submits an application, if the NRC accepts it for review, the law allows the NRC four years to make a decision. Within that timeframe, the NRC must complete its safety review, conduct a public hearing before an independent licensing board, and decide whether to allow construction of the repository.

Should the NRC authorize construction, the process enters a second phase. As construction of the repository nears completion, the DOE must update its license to receive high-level radioactive waste. The NRC must again complete a safety review, conduct a public hearing before an independent licensing board, and decide whether the DOE can safely receive and dispose of waste at the repository. If the NRC grants the license, the DOE will begin placing high-level radioactive waste

Figure 32. **The Yucca Mountain Disposal Plan**



Source: Department of Energy and the Nuclear Energy Institute.

in the repository. In the third phase, when the repository is full, the DOE will apply for a license amendment to decommission and permanently close the repository.

SPENT NUCLEAR FUEL STORAGE

The U.S. Energy Information Administration's 2002 survey found that approximately 46,000 metric tons of spent nuclear fuel were stored at commercial nuclear power reactors. Currently, there are over 50,000 metric tons of spent fuel stored in the United States.

- All operating nuclear power reactors are storing spent fuel in NRC-licensed onsite spent fuel pools (SFPs) (see Figure 33).
- Most reactors were not designed to store the full amount of spent fuel generated during their operational life. Utilities originally planned for spent fuel to remain in SFPs for a few years after discharge and then to be sent to a reprocessing facility. However, the U.S. Government declared a moratorium on reprocessing in 1977. Although the ban was later lifted, reprocessing was eliminated as a feasible option. Consequently, utilities expanded the storage capacity of their SFPs by using high-density storage racks.
- The NRC authorizes storage of spent fuel at an independent spent fuel storage installation (ISFSI) under two licensing options: site-specific licensing and general licensing. Currently, there are 45 licensed/operating ISFSIs in the United States (see Figure 34).
- Under a site-specific license, an applicant submits a license application to the NRC, and the NRC performs a technical review of all of the safety aspects of the proposed ISFSI. If the application is approved, the NRC issues a license. A spent fuel storage license contains technical requirements and operating conditions for the ISFSI and specifies what the licensee is authorized to store at the site. The license expires 20 years from the date of issuance, with a renewal option.
- A general license authorizes a licensee who operates a nuclear power reactor to store spent fuel onsite in dry storage systems approved by the NRC. Several dry storage designs have received Certificates of Compliance or NRC approvals. A Certificate of Compliance indicates that the approved storage cask has been shown to meet all NRC requirements when used appropriately, and expires 20 years from the date of issuance, with a reapproval option. Prior to first use, general licensees are required to perform evaluations for their sites to demonstrate that their site is adequate for storing spent fuel in dry casks. These evaluations must show that the Certificate of Compliance conditions and technical specifications can be met prior to use of the dry storage system. Refer to Appendix H for a list of dry spent fuel storage systems that are approved for use with a general license.
- With respect to public involvement, stakeholders can and do participate in the NRC licensing process. The Atomic

Energy Act of 1954, as amended, and the NRC's regulations contain provisions for public hearings for site-specific licensing actions and commenting on rulemaking actions prior to issue of a license or certificate of compliance, respectively. The public also has other means, such as petitions and rulemaking requests, to challenge NRC decisions and licensing actions.

- Appendix I lists dry spent fuel storage licensees.
- Additional information on storage of spent fuel at an ISFSI is available on the NRC's Web site at **http://www.nrc.gov/waste/spent-fuel-storage.html**.

U.S. NUCLEAR MATERIALS TRANSPORTATION

About 3 million packages of radioactive materials are shipped each year in the United States, either by highway, rail, air, or water. Regulating the safety of these shipments is the joint responsibility of the NRC and the U.S. Department of Transportation (DOT) under a memorandum of understanding. The NRC establishes requirements for the design and manufacture of packages for radioactive material shipments. DOT regulates the shipments while in transit and sets standards for labeling and smaller quantity packages.

The NRC reviews and approves package designs used for shipping nuclear material (see Figure 35). If the package meets NRC requirements, the NRC issues a radioactive material package certificate of compliance. Holders of the certificate of compliance are authorized to ship radioactive material in a package approved for use under the general licensing provisions of 10 CFR Part 71.

For a transportation package to be certified by the NRC, it must be demonstrated by actual test or computer analysis to withstand a series of accident conditions and still maintain its intended functions. The tests are performed in sequence to determine their cumulative effects on one package.

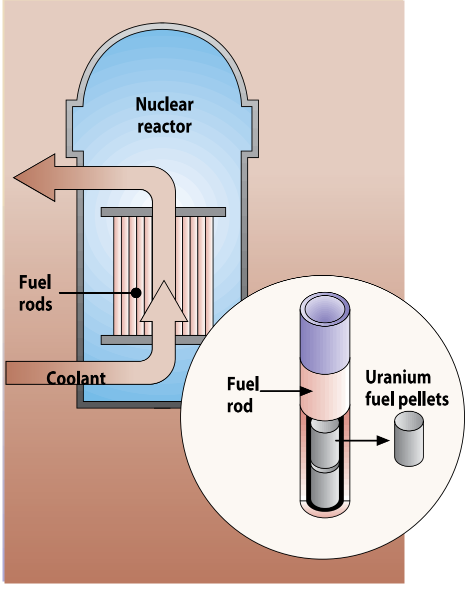
Safety in the shipment of nuclear material is achieved by a combination of factors, including the ruggedness of the package used for shipment, the operating procedures applicable to both the transportation package and the vehicle, and NRC inspections to ensure that the packages are constructed and used as approved in the certificate of compliance. The NRC inspectors verify the following:

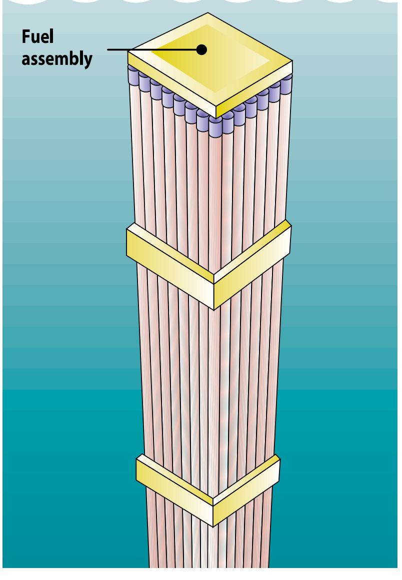
- Transportation package users have taken the appropriate radiation measurements around the package to ensure regulatory radiation levels are not exceeded;
- Transportation package users have performed package inspections for certain specific criteria, such as leak-tightness; and
- Bolts and other equipment are intact, and the packages are in good condition.

Both the NRC and the DOE continue joint operation of a national database and information support system to track movement of domestic and foreign nuclear materials under safeguards control.

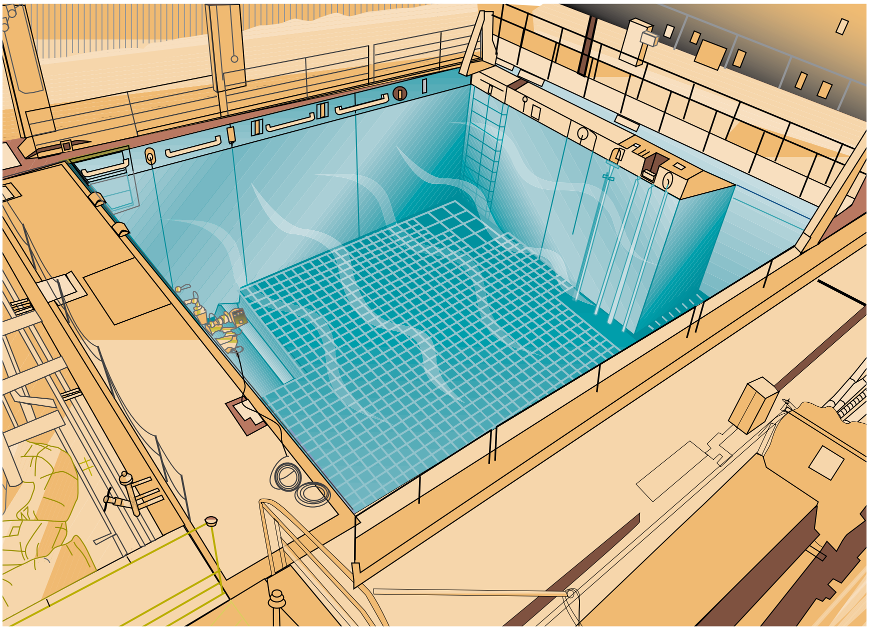
Figure 33. **Spent Fuel Generation and Storage After Use**

1 Nuclear reactors are powered by enriched U^{235} fuel. Fission generates heat, which produces steam that turns turbines to produce electricity. A reactor rated at several hundred megawatts may contain 100 or more tons of fuel in the form of bullet-sized pellets loaded into long rods.





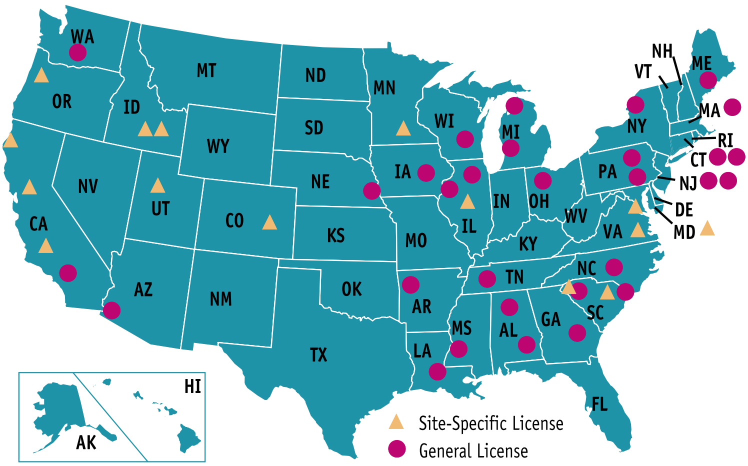
2 After about 6 years, spent fuel assemblies — typically 14 feet long and containing nearly 200 fuel rods — are removed from the reactor and allowed to cool in storage pools for a few years. At this point, the 900-pound assemblies contain only about one-fifth the original amount of U^{235}.



3 Commercial light-water nuclear reactors store spent fuel outside the primary containment in a steel-lined, seismically designed concrete pool. The spent fuel is cooled while in the spent fuel storage pool by water that is force-circulated using electrically powered pumps. Makeup water to the pool is provided by other pumps that can be powered from an onsite emergency diesel generator. Support features, such as water and radiation level detectors, are also provided. Spent fuel is stored in the spent fuel storage pool until it can be transferred on site to a dry-cask storage location (see Figure 34) or transported off site to a high-level radioactive waste disposal site. Pressurized-water reactors contain between 150-200 fuel assemblies. Boiling-water reactors contain between 378-800 fuel assemblies.

Source: Department of Energy and the Nuclear Energy Institute

Figure 34. **Licensed/Operating Independent Spent Fuel Storage Installations**



ALABAMA
- ● Brown's Ferry
- ● Farley

ARIZONA
- ● Palo Verde

ARKANSAS
- ● Arkansas Nuclear

CALIFORNIA
- ▲ Diablo Canyon
- ▲ Rancho Seco
- ● San Onofre
- ▲ Humboldt Bay

COLORADO
- ▲ Fort St. Vrain

CONNECTICUT
- ● Haddam Neck
- ● Millstone

GEORGIA
- ● Hatch

IDAHO
- ▲ DOE: TMI-2 Fuel Debris
- ▲ Idaho Spent Fuel Facility

ILLINOIS
- ▲ GE Morris
- ● Dresden
- ● Quad Cities

IOWA
- ● Duane Arnold

LOUISIANA
- ● River Bend

MAINE
- ● Maine Yankee

MARYLAND
- ▲ Calvert Cliffs

MASSACHUSETTS
- ● Yankee Rowe

MICHIGAN
- ● Big Rock Point
- ● Palisades

MINNESOTA
- ▲ Prairie Island

MISSISSIPPI
- ● Grand Gulf

NEBRASKA
- ● Ft. Calhoun

NEW JERSEY
- ● Hope Creek
- ● Oyster Creek

NEW YORK
- ● James A. FitzPatrick

NORTH CAROLINA
- ● McGuire

OHIO
- ● Davis-Besse

OREGON
- ▲ Trojan

PENNSYLVANIA
- ● Susquehanna
- ● Peach Bottom

SOUTH CAROLINA
- ● ▲ Oconee
- ● ▲ H.B. Robinson

TENNESSEE
- ● Sequoyah

UTAH
- ▲ Private Fuel Storage

VIRGINIA
- ▲ Surry
- ▲ North Anna

WASHINGTON
- ● Columbia Generating Station

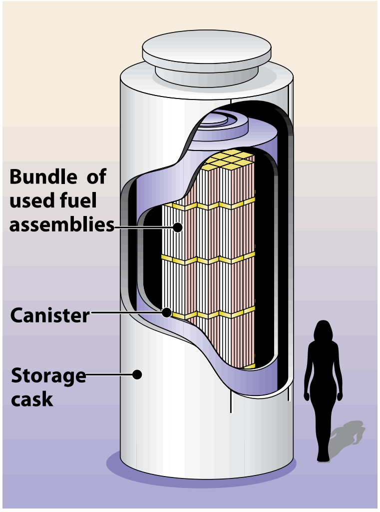
WISCONSIN
- ● Point Beach

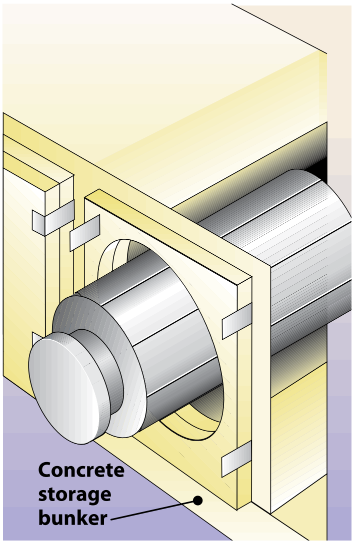
Data as of March 2007
Source: U.S. Nuclear Regulatory Commission

Figure 35. **Dry Storage of Spent Fuel**

At some nuclear reactors across the country, spent fuel is kept on site, above ground, in systems basically similar to the ones shown here.

1 Once the spent fuel has cooled, it is loaded into special canisters which are designed to hold pressurized-water reactor (PWR) and boiling-water reactor (BWR) assemblies. Water and air are removed. The canister is filled with inert gas, welded shut, and rigorously tested for leaks. It is then placed in a cask for storage or transportation. In addition, NRC has approved the storage of up to 40 PWR assemblies and up to 68 BWR assemblies in dry storage cask storage systems.





2 The canisters can also be stored in above-ground concrete bunkers, each of which is about the size of a one-car garage. Eventually they may be transported elsewhere for storage.

3 Eventually the canisters shown in (1) or (2) may be placed inside a transportation package for shipment.

Source: Department of Energy and the Nuclear Energy Institute

Principal Licensing and Inspection Activities

- The NRC examines transport-related safety during approximately 1,000 safety inspections of fuel, reactor, and materials licensees annually.
- The NRC reviews, evaluates, and certifies approximately 80 new, renewal, or amended container-design applications for the transport of nuclear materials annually.
- The NRC reviews and evaluates approximately 150 license applications for the import/export of nuclear materials from the United States annually.
- The NRC inspects about 20 dry storage and transport package licensees annually.
- Additional information on materials transportation is available on the NRC's Web site at **http://www.nrc.gov/materials** by selecting "Transportation" from the Nuclear Materials dropdown menu.

DECOMMISSIONING

Decommissioning is the safe removal of a facility from service and reduction of residual radioactivity to a level that permits release of the property and termination of the license (see Glossary). The NRC rules on decommissioning establish site release criteria and provide for unrestricted and, under certain conditions, restricted release of a site.

Decommissioning of Trojan Nuclear Power Plant

Reactor vessel being transported during decommissioning of the Trojan Nuclear Power Plant.

The NRC regulates the decontamination and decommissioning of materials and fuel cycle facilities, power reactors, research and test reactors, and uranium recovery facilities, with the ultimate goal of license termination. Approximately 200 materials licenses are terminated each year. Most of these license terminations are routine, and the sites require little, if any, remediation to meet the NRC's unrestricted release criteria. The decommissioning program focuses on the termination of licenses that are not routine because the sites involve more complex decommissioning activities. Currently, there are 16 nuclear power reactors, 12 research and test reactors, 30 complex decommissioning materials facilities, 3 fuel cycle facilities (partial decommissioning), and 12 uranium recovery facilities in safe storage under NRC jurisdiction. Table 16, Appendix B, and Appendix F list complex decommissioning sites and permanently shutdown and decommissioning nuclear power reactors and research and test reactors. NUREG-1814, "Annual Decommissioning Report," provides additional information on the NRC's Decommissioning Program.

Table 16. **Complex Decommissioning Sites**

Company	Location
AAR Manufacturing, Inc. (Brooks & Perkins)	Livonia, MI
Army, Department of, Jefferson Proving Ground	Madison, IN
Army, Department of, Ft. McClellan	Ft. McClellan, AL
Babcock & Wilcox SLDA	Vandergrift, PA
Battelle Columbus Laboratories	Columbus, OH
Cabot Corporation	Reading, PA
ABB Prospects	Windsor, CT
Curtis-Wright	Cheswick, PA
Dow Chemical Company	Bay City and Midland, MI
Eglin AFB	Walton County, FL
Englehard Minerals	Great Lakes, IL
Fansteel, Inc.	Muskogee, OK
Homer Laughlin China	Newell, WV
Kerr-McGee	Cimarron, OK
Mallinckrodt	St. Louis, MO
Molycorp, Inc.	Washington, PA
NWI Breckenridge	Breckenridge, MI
Pathfinder	Sioux Falls, SD
Quehanna	Media, PA
Royersford Wastewater Treatment Facility	Royersford, PA
Safety Light Corporation	Bloomsburg, PA
Salmon River	Salmon, ID
Shieldalloy Metallurgical Corporation	Newfield, NJ
Stepan Chemical Corporation	Maywood, NJ
Superior Steel/Superbolt	Pittsburgh, PA
UNC Naval Products	New Haven, CT
Westinghouse Electric Corporation — Churchill	Pittsburgh, PA
Westinghouse Electric Corporation — Hematite	Festus, MO
Westinghouse Electric Corporation — Waltz Mill	Madison, PA
West Valley Demonstration Project	West Valley, NY
Whittaker Corporation	Greenville, PA

Source: U.S. Nuclear Regulatory Commission

Oconee Nuclear Power Plant, Seneca, South Carolina.

APPENDICES

ABBREVIATIONS USED IN APPENDICES

AC	Allis Chalmers
ACLF	ACECO/Creusot-loire/ Framatome/Westinghouse-Europe
AE	Architect-Engineer
AEC	Atomic Energy Commission
AECL	Atomic Energy of Canada, Ltd.
AEE	Atomenergoexport
AEP	American Electric Power
AGN	Aerojet-General Nucleonics
AI	Atomics International
ASEA	Asea Brown Boveri-Asea Atom
B&R	Burns & Roe
B&W	Babcock & Wilcox
BALD	Baldwin Associates
BECH	Bechtel
BLH	Baldwin Lima Hamilton
BRRT	Brown & Root
BWR	Boiling Water Reactor
CE	Combustion Engineering
COMB	Combustion Engineering
COMM.OP.	Date of Commercial Operation
CON TYPE	Containment Type
DRYAMB	Dry, Ambient Pressure
DRYSUB	Dry, Subatmospheric
HTG	High-Temperature Gas-Cooled
ICECND	Wet, Ice Condenser
LMFB	Liquid Metal Fast Breeder
MARK 1	Wet, Mark I
MARK 2	Wet, Mark II
MARK 3	Wet, Mark III
OCM	Organic Cooled & Moderated
PTHW	Pressure Tube, Heavy Water
SCF	Sodium Cooled, Fast
SCGM	Sodium Cooled, Graphite Moderated
CP	Construction Permit
CP ISSUED	Date of Construction Permit Issuance
CWE	Commonwealth Edison Company
CX	Critical Assembly
DANI	Daniel International
DBDB	Duke & Bechtel
DOE	Department of Energy
DPR	Demonstration Power Reactor
DUKE	Duke Power Company
EVESR	ESADA (Empire States Atomic Development Associates) Vallecitos Experimental Superheat Reactor
EBSO	Ebasco
EXP. DATE	Expiration Date of Operating License
FENOC	FirstEnergy Nuclear Operating Co.
FLUR	Fluor Pioneer
G&H	Gibbs & Hill
GA	General Atomic
GE	General Electric
GETR	General Electric Test Reactor
GHDR	Gibbs & Hill & Durham & Richardson
GIL	Gilbert Associates
GPC	Georgia Power Company
HIT	Hitachi
HTG	High-Temperature Gas-Cooled
HWR	Pressurized Heavy-Water Reactor
IES	Iowa Electric
ISFSI	Spent Fuel Storage Installation
JONES	J.A. Jones
KAIS	Kaiser Engineers
kW	Kilowatt
CP	Construction Permit
OL-FP	Operating License-Full Power

OL-LP	Operating License-Low Power
MHI	Mitsubishi Heavy Industries, Ltd.
MW	Megawatts
MWe	Megawatts Electrical
MWh	Megawatthour
MWt	Megawatts Thermal
NIAG	Niagara Mohawk Power Corporation
NPF	Nuclear Power Facility
NSP	Northern States Power Company
NSS	Nuclear Steam System Supplier & Design Type
1	GE Type 1
2	GE Type 2
3	GE Type 3
4	GE Type 4
5	GE Type 5
6	GE Type 6
2LP	Westinghouse Two-Loop
3LP	Westinghouse Three-Loop
4LP	Westinghouse Four-Loop
CE	Combustion Engineering
CE80	CE Standard Design
LLP	B&W Lowered Loop
RLP	B&W Raised Loop
OCM	Office of the Commission
OL	Operating License
OL ISSUED	Date of Latest Full Power Operating License
PECO	Philadelphia Energy Company
PG&E	Pacific Gas & Electric Company
PHWR	Pressurized Heavy-Water-Moderated Reactor
PSE	Pioneer Services & Engineering
PTHW	Pressure Tube Heavy Water
PUBS	Public Service Electric & Gas Company
PWR	Pressurized-Water Reactor
R	Research
S&L	Sargent & Lundy
S&W	Stone & Webster
SBEC	Southern Services & Bechtel
SCGM	Sodium Cooled Graphite Moderated
SSI	Southern Services Incorporated
STP	South Texas Project
TNPG	The Nuclear Power Group
TR	Test Reactor
TRIGA	Training Reactor and Isotopes Production, General Atomics
TVA	Tennessee Valley Authority
TXU	Texas Utilities
UE&C	United Engineers & Constructors
USEC	U.S. Enrichment Corporation
VT	Vermont
WDCO	Westinghouse Development Corporation
WEST	Westinghouse Electric
WMT	Waste Management Tank

APPENDIX A
U.S. Commercial Nuclear Power Reactors

Unit, Operating Utility Company Location Docket Number	NRC Region	Con Type NSSS AE Constructor	Licensed MWt	Net Summer Capacity (MW)*	CP Issued OL Issued Comm. Op Exp. Date	License Type & Number	2001-2006** Average Capacity Factor (Percent)
Arkansas Nuclear One 1 Entergy Nuclear Operations Inc. 6 miles WNW of Russellville, AR 050-00313	IV	PWR-DRYAMB B&W LLP BECH BECH	2568	0836	12/06/1968 05/21/1974 12/19/1974 05/20/2034	OL-FP DPR-51	93.9 89.7 92.0 92.4 77.9 102.1
Arkansas Nuclear One 2 Entergy Nuclear Operations, Inc. 6 miles WNW of Russellville, AR 050-00368	IV	PWR-DRYAMB COMB CE BECH BECH	3026	0998	12/06/1972 09/01/1978 03/26/1980 07/17/2038	OL-FP NPF-6	105.3 106.5 90.4 98.6 91.2 88.7
Beaver Valley 1 FirstEnergy Nuclear Operating Company 17 miles W of McCandless, PA 050-00334	I	PWR-DRYAMB WEST 3LP S&W S&W	2900	0821	06/26/1970 07/02/1976 10/01/1976 01/29/2016	OL-FP DPR-66	83.3 97.2 83.2 92.6 101.4 81.0
Beaver Valley 2 FirstEnergy Nuclear Operating Company 17 miles W of McCandless, PA 050-00412	I	PWR-DRYAMB WEST 3LP S&W S&W	2900	0821	05/03/1974 08/14/1987 11/17/1987 05/27/2027	OL-FP NPF-73	98.8 90.7 91.2 100.2 91.8 87.7
Braidwood 1 Exelon Generation Co. LLC 24 miles SSW of Joilet, IL 050-00456	III	PWR-DRYAMB WEST 4LP S&L CWE	3586.6	1178	12/31/1975 07/02/1987 07/29/1988 10/17/2026	OL-FP NPF-72	93.4 104.3 97.2 94.8 99.6 96.4
Braidwood 2 Exelon Generation Co. LLC 24 miles SSW of Joilet, IL 050-00457	III	PWR-DRYAMB WEST 4LP S&L CWE	3586.6	1152	12/31/1975 05/20/1988 10/17/1988 12/18/2027	OL-FP NPF-77	98.2 93.5 96.3 100.8 94.3 95.4

APPENDIX A
U.S. Commercial Nuclear Power Reactors (continued)

Unit, Operating Utility Company Location Docket Number	NRC Region	Con Type NSSS AE Constructor	Licensed MWt	Net Summer Capacity (MW)*	CP Issued OL Issued Comm. Op Exp. Date	License Type & Number	2001-2006** Average Capacity Factor (Percent)
Browns Ferry 1 Tennessee Valley Authority 10 miles NW of Decatur, AL 050-00259	II	BWR-MARK 1 GE 4 TVA TVA	3458	1065	05/10/1967 12/20/1973 08/01/1974 12/20/2033	OL-FP DPR-33	0.0 0.0 0.0 0.0 0.0 0.0
Browns Ferry 2 Tennessee Valley Authority 10 miles NW of Decatur, AL 050-00260	II	BWR-MARK 1 GE 4 TVA TVA	3458	1118	05/10/1967 08/02/1974 03/01/1975 06/28/2034	OL-FP DPR-52	85.9 91.0 85.5 99.6 89.9 94.3
Browns Ferry 3 Tennessee Valley Authority 10 miles NW of Decatur, AL 050-00296	II	BWR-MARK 1 GE 4 TVA TVA	3458	1114	07/31/1968 08/18/1976 03/01/1977 07/02/2036	OL-FP DPR-68	100.1 94.6 95.6 88.9 93.8 88.5
Brunswick 1 Progress Energy 2 miles N of Southport, NC 050-00325	II	BWR-MARK 1 GE 4 UE&C BRRT	2923	0938	02/07/1970 11/12/1976 03/18/1977 09/08/2036	OL-FP DPR-71	101.7 93.2 100.8 86.1 94.4 87.4
Brunswick 2 Progress Energy 2 miles N of Southport, NC 050-00324	II	BWR-MARK 1 GE 4 UE&C BRRT	2923	0900	02/07/1970 12/27/1974 11/03/1975 12/27/2034	OL-FP DPR-62	92.1 99.6 98.9 98.1 86.0 93.4
Byron 1 Exelon Generation Co. LLC 17 miles SW of Rockford, IL 050-00454	III	PWR-DRYAMB WEST 4LP S&L CWE	3586.6	1164	12/31/1975 02/14/1985 09/16/1985 10/31/2024	OL-FP NPF-37	102.0 96.5 94.2 101.5 94.2 91.4

APPENDIX A
U.S. Commercial Nuclear Power Reactors (continued)

Unit, Operating Utility Company Location Docket Number	NRC Region	Con Type NSSS AE Constructor	Licensed MWt	Net Summer Capacity (MW)*	CP Issued OL Issued Comm. Op Exp. Date	License Type & Number	2001-2006** Average Capacity Factor (Percent)
Byron 2 Exelon Generation Co. LLC 17 miles SW of Rockford, IL 050-00455	III	PWR-DRYAMB WEST 4LP S&L CWE	3586.6	1136	12/31/1975 01/30/1987 08/21/1987 11/06/2026	OL-FP NPF-66	99.2 96.3 101.1 96.4 95.7 102.2
Callaway AmerenUE 10 miles SE of Fulton, MO 050-00483	IV	PWR-DRYAMB WEST 4LP BECH DANI	3565	1190	04/16/1976 10/18/1984 12/19/1984 10/18/2024	OL-FP NPF-30	101.1 85.1 97.4 78.4 80.6 97.0
Calvert Cliffs 1 Constellation Energy 40 miles S of Annapolis, MD 050-00317	I	PWR-DRYAMB COMB CE BECH BECH	2700	0873	07/07/1969 07/31/1974 05/08/1975 07/31/2034	OL-FP DPR-53	103.2 64.3 101.8 91.3 99.5 84.2
Calvert Cliffs 2 Constellation Energy 40 miles S of Annapolis, MD 050-00318	I	PWR-DRYAMB COMB CE BECH BECH	2700	0862	07/07/1969 08/13/1976 04/01/1977 08/13/2036	OL-FP DPR-69	84.8 102.3 81.9 99.9 93.9 97.7
Catawba 1 Duke Energy Power Company, LLC 6 miles NNW of Rock Hill, SC 050-00413	II	PWR-ICECND WEST 4LP DUKE DUKE	3411	1129	08/07/1975 01/17/1985 06/29/1985 12/05/2043	OL-FP NPF-35	100.9 95.9 82.7 97.9 92.8 82.1
Catawba 2 Duke Energy Power Company, LLC 6 miles NNW of Rock Hill, SC 050-00414	II	PWR-ICECND WEST 4LP DUKE DUKE	3411	1129	08/07/1975 05/15/1986 08/19/1986 12/05/2043	OL-FP NPF-52	86.7 102.9 94.2 89.1 102.1 88.8

APPENDIX A
U.S. Commercial Nuclear Power Reactors (continued)

Unit, Operating Utility Company Location Docket Number	NRC Region	Con Type NSSS AE Constructor	Licensed MWt	Net Summer Capacity (MW)*	CP Issued OL Issued Comm. Op Exp. Date	License Type & Number	2001-2006** Average Capacity Factor (Percent)
Clinton Exelon Generating Co. LLC 6 miles E of Clinton, IL 050-00461	III	BWR-MARK 3 GE 6 S&L BALD	3473	1052	02/24/1976 04/17/1987 11/24/1987 09/29/2026	OL-FP NPF-62	96.7 85.5 96.8 87.5 95.1 89.3
Columbia Generating Station Energy Northwest 12 miles NW of Richland, WA 050-00397	IV	BWR-MARK 2 GE 5 B&R BECH	3486	1131	03/19/1973 04/13/1984 12/13/1984 12/20/2023	OL-FP NPF-21	85.1 92.6 78.5 91.1 83.9 94.2
Comanche Peak 1 TXU Generation Company LP 4 miles N of Glen Rose, TX 050-00445	IV	PWR-DRYAMB WEST 4LP G&H BRRT	3458	1150	12/19/1974 04/17/1990 08/13/1990 02/08/2030	OL-FP NPF-87	83.8 87.3 101.4 89.5 91.5 102.2
Comanche Peak 2 TXU Generation Co. LP 4 miles N of Glen Rose, TX 050-00446	IV	PWR-DRYAMB WEST 4LP BECH BRRT	3458	1150	12/19/1974 04/06/1993 08/03/1993 02/02/2033	OL-FP NPF-89	98.1 87.3 82.5 99.2 91.6 95.3
Cooper Nebraska Public Power District 23 miles S of Nebraska City, NE 050-00298	IV	BWR-MARK 1 GE 4 B&R B&R	2381	0760	06/04/1968 01/18/1974 07/01/1974 01/18/2014	OL-FP DPR-46	77.8 94.4 67.8 92.9 89.0 88.7
Crystal River 3 Progress Energy 7 miles NW of Crystal River, FL 050-00302	II	PWR-DRYAMB B&W LLP GIL JONES	2568	0838	09/25/1968 01/28/1977 03/13/1977 12/03/2016	OL-FP DPR-72	97.2 89.2 99.9 90.1 99.2 94.7

APPENDIX A
U.S. Commercial Nuclear Power Reactors (continued)

Unit, Operating Utility Company Location Docket Number	NRC Region	Con Type NSSS AE Constructor	Licensed MWt	Net Summer Capacity (MW)*	CP Issued OL Issued Comm. Op Exp. Date	License Type & Number	2001- 2006** Average Capacity Factor (Percent)
Davis-Besse FirstEnergy Nuclear Operating Co. 21 miles ESE of Toledo, OH 050-00346	III	PWR-DRYAMB B&W RLP BECH	2772	0873	03/24/1971 04/22/1977 07/31/1978 04/22/2017	OL-FP NPF-3	99.5 12.0 -0.9 74.6 93.6 83.3
D.C. Cook 1 Indiana/Michigan Power Co. 11 miles S of Benton Harbor, MI 050-00315	III	PWR-ICECND WEST 4LP AEP AEP	3304	1016	03/25/1969 10/25/1974 08/28/1975 10/25/2034	OL-FP DPR-58	89.0 88.4 73.8 99.0 90.5 82.0
D.C. Cook 2 Indiana/Michigan Power Co. 11 miles S of Benton Harbor, MI 050-00316	III	PWR-ICECND WEST 4LP AEP AEP	3468	1077	03/25/1969 12/23/1977 07/01/1978 12/23/2037	OL-FP DPR-74	85.8 82.8 75.4 83.9 99.8 88.9
Diablo Canyon 1 Pacific Gas & Electric Co. 12 miles WSW of San Luis Obispo, CA 050-00275	IV	PWR-DRYAMB WEST 4LP PG&E PG&E	3338	1087	04/23/1968 11/02/1984 05/07/1985 09/22/2021	OL-FP DPR-80	99.8 74.0 100.7 75.6 87.3 103.9
Diablo Canyon 2 Pacific Gas & Electric Co. 12 miles WSW of San Luis Obispo, CA 050-00323	IV	PWR-DRYAMB WEST 4LP PG&E PG&E	3411	1087	12/09/1970 08/26/1985 03/13/1986 04/26/2025	OL-FP DPR-82	90.9 97.5 80.9 84.0 99.2 85.2
Dresden 2 Exelon Generation Co. LLC 9 miles E of Morris, IL 050-00237	III	BWR-MARK 1 GE 3 S&L UE&C	2957	0867	01/10/1966 02/20/1991 06/09/1970 12/22/2029	OL-FP DPR-19	89.8 101.1 90.2 77.6 86.8 95.7

APPENDIX A
U.S. Commercial Nuclear Power Reactors (continued)

Unit, Operating Utility Company Location Docket Number	NRC Region	Con Type NSSS AE Constructor	Licensed MWt	Net Summer Capacity (MW)*	CP Issued OL Issued Comm. Op Exp. Date	License Type & Number	2001-2006** Average Capacity Factor (Percent)
Dresden 3 Exelon Generation Co. LLC 9 miles E of Morris, IL 050-00249	III	BWR-MARK 1 GE 3 S&L UE&C	2957	0867	10/14/1966 01/12/1971 11/16/1971 01/12/2031	OL-FP DPR-25	95.5 81.4 93.5 84.5 92.6 94.4
Duane Arnold Florida Power and Light Co. 8 miles NW of Cedar Rapids, IA 050-00331	III	BWR-MARK 1 GE 4 BECH BECH	1912	581	06/22/1970 02/22/1974 02/01/1975 02/21/2014	OL-FP DPR-49	77.9 92.5 81.0 99.8 92.1 100.2
Edwin I. Hatch 1 Southern Nuclear Operating Co. 11 miles N of Baxley, GA 050-00321	II	BWR-MARK 1 GE 4 BECH GPC	2804	876	09/30/1969 10/13/1974 12/31/1975 08/06/2034	OL-FP DPR-57	99.2 88.4 95.3 90.3 91.9 83.6
Edwin I. Hatch 2 Southern Nuclear Operating Co. 11 miles N of Baxley, GA 050-00366	II	BWR-MARK 1 GE 4 BECH GPC	2804	0883	12/27/1972 06/13/1978 09/05/1979 06/13/2038	OL-FP NPF-5	85.6 97.4 90.0 97.0 87.0 98.8
Fermi 2 The Detroit Edison Co. 25 miles NE of Toledo, OH 050-00341	III	BWR-MARK 1 GE 4 S&L DANI	3430	1111	09/26/1972 07/15/1985 01/23/1988 03/20/2025	OL-FP NPF-43	89.8 97.5 83.4 86.6 90.0 76.8
Fort Calhoun Omaha Public Power District 19 miles N of Omaha, NE 050-00285	IV	PWR-DRYAMB COMB CE GHDR GHDR	1500	478	06/07/1968 08/09/1973 09/26/1973 08/09/2033	OL-FP DPR-40	84.2 91.0 84.0 97.3 69.8 73.8

APPENDIX A
U.S. Commercial Nuclear Power Reactors (continued)

Unit, Operating Utility Company Location Docket Number	NRC Region	Con Type NSSS AE Constructor	Licensed MWt	Net Summer Capacity (MW)*	CP Issued OL Issued Comm. Op Exp. Date	License Type & Number	2001- 2006** Average Capacity Factor (Percent)
R.E. Ginna Constellation Energy 20 miles NE of Rochester, NY 050-00244	I	PWR-DRYAMB WEST 2LP GIL BECH	1775	0498	04/25/1966 09/19/1969 07/01/1970 09/18/2029	OL-FP DPR-18	101.9 91.4 88.6 98.6 91.7 94.5
Grand Gulf 1 Entergy Nuclear Operations, Inc. 25 miles S of Vicksburg, MS 050-00416	IV	BWR-MARK 3 GE 6 BECH BECH	3833	1266	09/04/1974 11/01/1984 07/01/1985 06/16/2022	OL-FP NPF-29	93.6 95.1 98.5 91.7 90.6 93.9
H.B. Robinson 2 Progress Energy 26 miles from Florence, SC 050-00261	II	PWR-DRYAMB WEST 3LP EBSO EBSO	2339	0710	04/13/1967 09/23/1970 03/07/1971 07/31/2030	OL-FP DPR-23	92.2 93.7 103.5 92.1 92.8 103.9
Hope Creek 1 PSE&G 18 miles SE of Wilmington, DE 050-00354	I	BWR-MARK 1 GE 4 BECH BECH	3339	1061	11/04/1974 07/25/1986 12/20/1986 04/11/2026	OL-FP NPF-57	80.3 87.8 79.0 65.4 83.5 92.3
Indian Point 2 Entergy Nuclear Operations Inc 24 miles N of New York City, NY 050-00247	I	PWR-DRYAMB WEST 4LP UE&C WDCO	3216	1020	10/14/1966 09/28/1973 08/01/1974 09/28/2013	OL-FP DPR-26	93.5 90.7 99.1 87.5 103.2 89.4
Indian Point 3 Entergy Nuclear Operations Inc 24 miles N of New York City, NY 050-00286	I	PWR-DRYAMB WEST 4LP UE&C WDCO	3216	1025	08/13/1969 12/12/1975 08/30/1976 12/12/2015	OL-FP DPR-64	93.9 98.3 88.2 100.5 92.6 99.9

APPENDIX A
U.S. Commercial Nuclear Power Reactors (continued)

Unit, Operating Utility Company Location Docket Number	NRC Region	Con Type NSSS AE Constructor	Licensed MWt	Net Summer Capacity (MW)*	CP Issued OL Issued Comm. Op Exp. Date	License Type & Number	2001-2006** Average Capacity Factor (Percent)
James A. FitzPatrick Entergy Nuclear Operations Inc 8 miles NE of Oswego, NY 050-00333	I	BWR-MARK 1 GE 4 S&W S&W	2536	0852	05/20/1970 10/17/1974 07/28/1975 10/17/2014	OL-FP DPR-59	99.6 92.6 96.4 87.1 95.4 90.5
Joseph M. Farley 1 Southern Nuclear Operating Co. 18 miles SE of Dothan, AL 050-00348	II	PWR-DRYAMB WEST 3LP SSI DANI	2775	0851	08/16/1972 06/25/1977 12/01/1977 06/25/2037	OL-FP NPF-2	87.6 99.0 90.5 85.9 99.3 86.1
Joseph M. Farley 2 Southern Nuclear Operating Co. 18 miles SE of Dothan, AL 050-00364	II	PWR-DRYAMB WEST 3LP SSI BECH	2775	0860	08/16/1972 03/31/1981 07/30/1981 03/31/2041	OL-FP NPF-8	78.2 87.6 100.0 89.0 84.1 101.2
Kewaunee Power Station Dominion Generation 27 miles E of Green Bay, WI 050-00305	III	PWR-DRYAMB WEST 2LP PSE PSE	1772	0556	08/06/1968 12/21/1973 06/16/1974 12/21/2013	OL-FP DPR-43	77.3 99.8 88.1 78.8 62.1 75.4
La Salle County 1 Exelon Generation Co LLC 11 miles SE of Ottawa, IL 050-00373	III	BWR-MARK 2 GE 5 S&L CWE	3489	1118	09/10/1973 04/17/1982 01/01/1984 04/17/2022	OL-FP NPF-11	101.2 91.7 92.4 92.2 100.2 92.8
La Salle County 2 Exelon Generation Co LLC 11 miles SE of Ottawa, IL 050-00374	III	BWR-MARK 2 GE 5 S&L CWE	3489	1120	09/10/1973 02/16/1983 10/19/1984 12/16/2023	OL-FP NPF-18	99.5 92.4 91.0 101.0 90.7 102.1

APPENDIX A
U.S. Commercial Nuclear Power Reactors (continued)

Unit, Operating Utility Company Location Docket Number	NRC Region	Con Type NSSS AE Constructor	Licensed MWt	Net Summer Capacity (MW)*	CP Issued OL Issued Comm. Op Exp. Date	License Type & Number	2001-2006** Average Capacity Factor (Percent)
Limerick 1 Exelon Generation Co LLC 21 miles NW of Philadelphia, PA 050-00352	I	BWR-MARK 2 GE 4 BECH BECH	3458	1134	06/19/1974 08/08/1985 02/01/1986 10/26/2024	OL-FP NPF-39	101.2 93.5 100.9 95.1 99.2 93.2
Limerick 2 Exelon Generation Co LLC 21 miles NW of Philadelphia, PA 050-00353	I	BWR-MARK 2 GE 4 BECH BECH	3458	1134	06/19/1974 08/25/1989 01/08/1990 06/22/2029	OL-FP NPF-85	92.3 100.8 9.4 99.2 91.2 100.1
McGuire 1 Duke Energy Power Company, LLC 17 miles N of Charlotte, NC 050-00369	II	PWR-ICECND WEST 4LP DUKE DUKE	3411	1100	02/23/1973 07/08/1981 12/01/1981 06/12/2041	OL-FP NPF-9	90.1 94.4 102.9 85.3 93.1 103.4
McGuire 2 Duke Energy Power Company, LLC 17 miles N of Charlotte, NC 050-00370	II	PWR-ICECND WEST 4LP DUKE DUKE	3411	1100	02/23/1973 05/27/1983 03/01/1984 03/03/2043	OL-FP NPF-17	102.5 92.5 93.7 103.4 88.7 87.4
Millstone 2 Dominion Generation 3.2 miles WSW of New London, CT 050-00336	I	PWR-DRYAMB COMB CE BECH BECH	2700	0882	12/11/1970 09/26/1975 12/26/1975 07/31/2035	OL-FP DPR-65	95.6 81.3 80.3 97.8 88.8 84.1
Millstone 3 Dominion Generation 3.2 miles WSW of New London, CT 050-00423	I	PWR-DRYSUB WEST 4LP S&W S&W	3411	1155	08/09/1974 01/31/1986 04/23/1986 11/25/2045	OL-FP NPF-49	82.1 88.3 100.8 88.3 86.4 99.7

APPENDIX A
U.S. Commercial Nuclear Power Reactors (continued)

Unit, Operating Utility Company Location Docket Number	NRC Region	Con Type NSSS AE Constructor	Licensed MWt	Net Summer Capacity (MW)*	CP Issued OL Issued Comm. Op Exp. Date	License Type & Number	2001- 2006** Average Capacity Factor (Percent)
Monticello Nuclear Management Co. 30 miles NW of Minneapolis, MN 050-00263	III	BWR-MARK 1 GE 3 BECH BECH	1775	572	06/19/1967 01/09/1981 06/30/1971 09/08/2030	OL-FP DPR-22	76.5 99.0 91.8 100.7 89.8 101.2
Nine Mile Point 1 Constellation Energy 6 miles NE of Oswego, NY 050-00220	I	BWR-MARK 1 GE 2 NIAG S&W	1850	0621	04/12/1965 12/26/1974 12/01/1969 08/22/2029	OL-FP DPR-63	88.5 99.1 80.4 91.7 84.6 98.5
Nine Mile Point 2 Constellation Energy 6 miles NE of Oswego, NY 050-00410	I	BWR-MARK 2 GE 5 S&W S&W	3467	1135	06/24/1974 07/02/1987 03/11/1988 10/31/2046	OL-FP NPF-69	90.3 85.8 95.5 86.3 99.7 90.8
North Anna 1 Dominion Generation 40 miles NW of Richmond, VA 050-00338	II	PWR-DRYSUB WEST 3LP S&W S&W	2893	0924	02/19/1971 04/01/1978 06/06/1978 04/01/2038	OL-FP NPF-4	87.9 100.8 80.5 91.3 95.0 88.2
North Anna 2 Dominion Generation 40 miles NW of Richmond, VA 050-00339	II	PWR-DRYSUB WEST 3LP S&W S&W	2893	0910	02/19/1971 08/21/1980 12/14/1980 08/21/2040	OL-FP NPF-7	74.4 68.6 90.4 91.7 87.0 99.7
Oconee 1 Duke Energy Power Company, LLC 30 miles W of Greenville, SC 050-00269	II	PWR-DRYAMB B&W LLP DBDB DUKE	2568	0846	11/06/1967 02/06/1973 07/15/1973 02/06/2033	OL-FP DPR-38	94.0 89.2 70.8 97.7 90.7 78.5

APPENDIX A
U.S. Commercial Nuclear Power Reactors (continued)

Unit, Operating Utility Company Location Docket Number	NRC Region	Con Type NSSS AE Constructor	Licensed MWt	Net Summer Capacity (MW)*	CP Issued OL Issued Comm. Op Exp. Date	License Type & Number	2001- 2006** Average Capacity Factor (Percent)
Oconee 2 Duke Energy Power Company, LLC 30 miles W of Greenville, SC 050-00270	II	PWR-DRYAMB B&W LLP DBDB DUKE	2568	0846	11/06/1967 10/06/1973 09/09/1974 10/06/2033	OL-FP DPR-47	90.2 89.2 102.1 76.3 89.9 99.7
Oconee 3 Duke Energy Power Company, LLC 30 miles W of Greenville, SC 050-00287	II	PWR-DRYAMB B&W LLP DBDB DUKE	2568	0846	11/06/1967 07/19/1974 12/16/1974 07/19/2034	OL-FP DPR-55	72.8 100.7 85.2 77.2 97.7 90.5
Oyster Creek Exelon Generating Co. LLC 9 miles S of Toms River, NJ 050-00219	I	BWR-MARK 1 GE 2 B&R B&R	1930	0619	12/15/1964 07/02/1991 12/01/1969 04/09/2009	OL-FP DPR-16	96.4 92.8 96.9 89.3 99.1 85.7
Palisades Entergy Nuclear Operations Inc 5 miles S of South Haven, MI 050-00255	III	PWR-DRYAMB COMB CE BECH BECH	2565	778	03/14/1967 02/21/1971 12/31/1971 03/24/2031	OL-FP DPR-20	36.8 99.6 91.6 79.3 98.9 86.6
Palo Verde 1 Arizona Public Service Company 36 miles W of Phoenix, AZ 050-00528	IV	PWR-DRYAMB COMB CE80 BECH BECH	3990	1314	05/25/1976 06/01/1985 01/28/1986 12/31/2024	OL-FP NPF-41	87.8 89.1 97.2 84.6 66.3 42.3
Palo Verde 2 Arizona Public Service Company 36 miles W of Phoenix, AZ 050-00529	IV	PWR-DRYAMB COMB CE80 BECH BECH	3990	1314	05/25/1976 04/24/1986 09/19/1986 12/09/2025	OL-FP NPF-51	92.6 92.0 72.2 92.4 81.9 85.2

APPENDIX A
U.S. Commercial Nuclear Power Reactors (continued)

Unit, Operating Utility Company Location Docket Number	NRC Region	Con Type NSSS AE Constructor	Licensed MWt	Net Summer Capacity (MW)*	CP Issued OL Issued Comm. Op Exp. Date	License Type & Number	2001-2006** Average Capacity Factor (Percent)
Palo Verde 3 Arizona Public Service Company 36 miles W of Phoenix, AZ 050-00530	IV	PWR-DRYAMB COMB CE80 BECH BECH	3990	1247	05/25/1976 11/25/1987 01/08/1988 03/25/2027	OL-FP NPF-74	83.9 102.0 87.5 75.0 83.9 86.5
Peach Bottom 2 Exelon Generating Co LLC 17.9 miles S of Lancaster, PA 050-00277	I	BWR-MARK 1 GE 4 BECH BECH	3514	1112	01/31/1968 10/25/1973 07/05/1974 08/08/2033	OL-FP DPR-44	97.9 92.3 95.4 90.6 98.2 82.7
Peach Bottom 3 Exelon Generating Co LLC 17.9 miles S of Lancaster, PA 050-00278	I	BWR-MARK 1 GE 4 BECH BECH	3514	1112	01/31/1968 07/02/1974 12/23/1974 07/02/2034	OL-FP DPR-56	89.0 100.8 91.3 102.1 90.6 101.5
Perry 1 FirstEnergy Nuclear Operating Co. 7 miles NE of Painesville, OH 050-00440	III	BWR-MARK 3 GE 6 GIL KAIS	3758	1235	05/03/1977 11/13/1986 11/18/1987 03/18/2026	OL-FP NPF-58	71.6 92.2 79.0 94.3 70.9 96.8
Pilgrim 1 Entergy Nuclear Operations Inc 4 miles SE of Plymouth, MA 050-00293	I	BWR-MARK 1 GE 3 BECH BECH	2028	0685	08/26/1968 09/15/1972 12/01/1972 06/08/2012	OL-FP DPR-35	89.9 100.9 83.0 98.7 91.3 92.7
Point Beach 1 Florida Power and Light Co. 13 miles NNW of Manitowoc, WI 050-00266	III	PWR-DRYAMB WEST 2LP BECH BECH	1540	0512	07/19/1967 10/05/1970 12/21/1970 10/05/2030	OL-FP DPR-24	82.9 89.0 96.8 80.7 81.2 99.6

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U.S. Commercial Nuclear Power Reactors (continued)

Unit, Operating Utility Company Location Docket Number	NRC Region	Con Type NSSS AE Constructor	Licensed MWt	Net Summer Capacity (MW)*	CP Issued OL Issued Comm. Op Exp. Date	License Type & Number	2001-2006** Average Capacity Factor (Percent)
Point Beach 2 Florida Power & Light Co. 13 miles NNW of Manitowoc, WI 050-00301	III	PWR-DRYAMB WEST 2LP BECH BECH	1540	0514	07/25/1968 03/08/1973 10/01/1972 03/08/2033	OL-FP DPR-27	96.8 89.3 82.5 97.1 71.8 90.9
Prairie Island 1 Nuclear Management Co. 28 miles SE of Minneapolis, MN 050-00282	III	PWR-DRYAMB WEST 2LP FLUR NSP	1650	0523	06/25/1968 04/05/1974 12/16/1973 08/09/2013	OL-FP DPR-42	79.6 95.6 100.5 78.5 98.8 89.5
Prairie Island 2 Nuclear Management Co. 28 miles SE of Minneapolis, MN 050-00306	III	PWR-DRYAMB WEST 2LP FLUR NSP	1650	0522	06/25/1968 10/29/1974 12/21/1974 10/29/2014	OL-FP DPR-60	93.4 93.9 92.7 101.6 84.0 87.7
Quad Cities 1 Exelon Generating Co. LCC 20 miles NE of Moline, IL 050-00254	III	BWR-MARK 1 GE 3 S&L UE&C	2957	0867	02/15/1967 12/14/1972 02/18/1973 12/14/2032	OL-FP DPR-29	99.6 76.2 89.9 85.4 82.7 88.8
Quad Cities 2 Exelon Generating Co. LLC 20 miles NE of Moline, IL 050-00265	III	BWR-MARK 1 GE 3 S&L UE&C	2511	0867	02/15/1967 12/14/1972 03/10/1973 12/14/2032	OL-FP DPR-30	93.1 87.5 92.0 81.1 92.7 86.4
River Bend 1 Entergy Nuclear Operations, Inc. 24 miles NNW of Baton Rouge, LA 050-00458	IV	BWR-MARK 3 GE 6 S&W S&W	3091	0966	03/25/1977 11/20/1985 06/16/1986 08/29/2025	OL-FP NPF-47	95.3 100.1 89.2 87.3 92.1 88.2

APPENDIX A
U.S. Commercial Nuclear Power Reactors (continued)

Unit, Operating Utility Company Location Docket Number	NRC Region	Con Type NSSS AE Constructor	Licensed MWt	Net Summer Capacity (MW)*	CP Issued OL Issued Comm. Op Exp. Date	License Type & Number	2001- 2006** Average Capacity Factor (Percent)
Salem 1 PSE&G Nuclear 18 miles S of Wilmington, DE 050-00272	I	PWR-DRYAMB WEST 4LP PUBS UE&C	3459	1174	09/25/1968 08/13/1976 06/30/1977 08/13/2016	OL-FP DPR-70	80.3 89.8 93.5 72.0 92.0 99.3
Salem 2 PSE&G Nuclear 18 miles S of Wilmington, DE 050-00311	I	PWR-DRYAMB WEST 4LP PUBS UE&C	3459	1130	09/25/1968 05/20/1981 10/13/1981 04/18/2020	OL-FP DPR-75	99.5 87.5 81.9 88.4 92.2
San Onofre 2 Southern California Edison Co. 4 miles SE of San Clemente, CA 050-00361	IV	PWR-DRYAMB COMB CE BECH BECH	3438	1070	10/18/1973 09/07/1982 08/08/1983 02/16/2022	OL-FP NPF-10	101.3 90.8 103.6 85.7 95.3 72.0
San Onofre 3 Southern California Edison Co. 4 miles SE of San Clemente, CA 050-00362	IV	PWR-DRYAMB COMB CE BECH BECH	3438	1080	10/18/1973 09/16/1983 04/01/1984 11/15/2022	OL-FP NPF-15	60.0 100.9 90.9 73.6 100.1 72.1
Seabrook 1 Florida Power & Light Co. 13 miles S of Portsmouth, NH 050-00443	I	PWR-DRYAMB WEST 4LP UE&C UE&C	3648	1220	07/07/1976 03/15/1990 08/19/1990 10/17/2026	OL-FP NPF-86	85.9 91.8 91.3 99.9 93.1 87.9
Sequoyah 1 Tennessee Valley Authority 9.5 miles NE of Chattanooga, TN 050-00327	II	PWR-ICECND WEST 4LP TVA TVA	3411	1150	05/27/1970 09/17/1980 07/01/1981 09/17/2020	OL-FP DPR-77	91.8 100.9 72.9 92.0 100.0 90.2

APPENDIX A
U.S. Commercial Nuclear Power Reactors (continued)

Unit, Operating Utility Company Location Docket Number	NRC Region	Con Type NSSS AE Constructor	Licensed MWt	Net Summer Capacity (MW)*	CP Issued OL Issued Comm. Op Exp. Date	License Type & Number	2001-2006** Average Capacity Factor (Percent)
Sequoyah 2 Tennessee Valley Authority 9.5 miles NE of Chattanooga, TN 050-00328	II	PWR-ICECND WEST 4LP TVA TVA	3411	1127	05/27/1970 09/15/1981 06/01/1982 09/15/2021	OL-FP DPR-79	101.6 86.6 83.6 95.6 90.4 90.3
Shearon Harris 1 Progress Energy 20 miles SW of Raleigh, NC 050-00400	II	PWR-DRYAMB WEST 3LP EBSO DANI	2900	0900	01/27/1978 01/12/1987 05/02/1987 10/24/2026	OL-FP NPF-63	71.3 99.4 91.8 88.7 100.6 89.2
South Texas Project 1 STP Nuclear Operating Co. 12 miles SSW of Bay City, TX 050-00498	IV	PWR-DRYAMB WEST 4LP BECH EBSO	3853	1280	12/22/1975 03/22/1988 08/25/1988 08/20/2027	OL-FP NPF-76	94.4 99.2 60.6 98.5 88.0 90.5
South Texas Project 2 STP Nuclear Operating Co. 12 miles SSW of Bay City, TX 050-00499	IV	PWR-DRYAMB WEST 4LP BECH EBSO	3853	1280	12/22/1975 03/28/1989 06/19/1989 12/15/2028	OL-FP NPF-80	87.1 75.0 79.3 91.6 88.5 100.1
St. Lucie 1 Florida Power & Light Co. 12 miles SE of Ft. Pierce, FL 050-00335	II	PWR-DRYAMB COMB CE EBSO EBSO	2700	0839	07/01/1970 03/01/1976 12/21/1976 03/01/2036	OL-FP DPR-67	91.3 94.1 102.1 85.8 82.8 101.5
St. Lucie 2 Florida Power & Light Co. 12 miles SE of Ft. Pierce, FL 050-00389	II	PWR-DRYAMB COMB CE EBSO EBSO	2700	0839	05/02/1977 06/10/1983 08/08/1983 04/06/2043	OL-FP NPF-16	91.3 101.0 80.1 92.0 85.5 82.3

APPENDIX A
U.S. Commercial Nuclear Power Reactors (continued)

Unit, Operating Utility Company Location Docket Number	NRC Region	Con Type NSSS AE Constructor	Licensed MWt	Net Summer Capacity (MW)*	CP Issued OL Issued Comm. Op Exp. Date	License Type & Number	2001-2006** Average Capacity Factor (Percent)
Summer South Carolina Electric & Gas Co. 26 miles NW of Columbia, SC 050-00395	II	PWR-DRYAMB WEST 3LP GIL DANI	2900	0966	03/21/1973 11/12/1982 01/01/1984 08/06/2022	OL-FP NPF-12	79.9 87.2 86.9 97.2 88.3 89.9
Surry 1 Dominion Generation 17 miles NW of Newport News, VA 050-00280	II	PWR-DRYSUB WEST 3LP S&W S&W	2546	0799	06/25/1968 05/25/1972 12/22/1972 05/25/2032	OL-FP DPR-32	83.7 100.8 76.4 92.0 96.4 90.2
Surry 2 Dominion Generation 17 miles NW of Newport News, VA 050-00281	II	PWR-DRYSUB WEST 3LP S&W S&W	2546	0799	06/25/1968 01/29/1973 05/01/1973 01/29/2033	OL-FP DPR-37	94.1 91.4 78.6 100.5 92.6 88.4
Susquehanna 1 PPL Susquehanna, LLC 7 miles NE of Berwick, PA 050-00387	I	BWR-MARK 2 GE 4 BECH BECH	3489	1135	11/02/1973 11/12/1982 06/08/1983 07/17/2022	OL-FP NPF-14	98.6 82.9 96.3 80.3 94.6 86.2
Susquehanna 2 PPL Susquehanna, LLC 7 miles NE of Berwick, PA 050-00388	I	BWR-MARK 2 GE 4 BECH BECH	3489	1140	11/02/1973 06/27/1984 02/12/1985 03/23/2024	OL-FP NPF-22	86.3 95.6 85.5 100.0 88.7 92.5
Three Mile Island 1 Exelon Generating Co. LLC 10 miles SE of Harrisburg, PA 050-00289	I	PWR-DRYAMB B&W LLP GIL UE&C	2568	786	05/18/1968 04/19/1974 09/02/1974 04/19/2014	OL-FP DPR-50	78.7 104.1 90.0 102.2 95.2 105.0

APPENDIX A
U.S. Commercial Nuclear Power Reactors (continued)

Unit, Operating Utility Company Location Docket Number	NRC Region	Con Type NSSS AE Constructor	Licensed MWt	Net Summer Capacity (MW)*	CP Issued OL Issued Comm. Op Exp. Date	License Type & Number	2001-2006** Average Capacity Factor (Percent)
Turkey Point 3 Florida Power & Light Co. 25 miles S of Miami, FL 050-00250	II	PWR-DRYAMB WEST 3LP BECH BECH	2300	0693	04/27/1967 07/19/1972 12/14/1972 07/19/2032	OL-FP DPR-31	91.0 102.4 89.7 77.7 95.5 91.9
Turkey Point 4 Florida Power & Light Co. 25 miles S of Miami, FL 050-00251	II	PWR-DRYAMB WEST 3LP BECH BECH	2300	0693	04/27/1967 04/10/1973 09/07/1973 04/10/2033	OL-FP DPR-41	100.6 96.4 91.6 99.9 69.8 88.6
Vermont Yankee Entergy Nuclear Operations, Inc 5 miles S of Brattleboro, VT 050-00271	I	BWR-MARK 1 GE 4 EBSO EBSO	1912	0506	12/11/1967 02/28/1973 11/30/1972 03/21/2012	OL-FP DPR-28	93.4 88.7 100.3 86.8 91.9 115.2
Vogtle 1 Southern Nuclear Operating Co. 26 miles SE of Augusta, GA 050-00424	II	PWR-DRYAMB WEST 4LP SBEC GPC	3565	1152	06/28/1974 03/16/1987 06/01/1987 01/16/2027	OL-FP NPF-68	100.9 85.9 93.3 100.4 91.4 85.9
Vogtle 2 Southern Nuclear Operating Co. 26 miles SE of Augusta, GA 050-00425	II	PWR-DRYAMB WEST 4LP SBEC GPC	3565	1149	06/28/1974 03/31/1989 05/20/1989 02/09/2029	OL-FP NPF-81	94.0 83.6 96.7 90.8 85.4 92.2
Waterford 3 Entergy Nuclear Operations, Inc. 20 miles W of New Orleans, LA 050-00382	IV	PWR-DRYAMB COMB CE EBSO EBSO	3716	1158	11/14/1974 03/16/1985 09/24/1985 12/18/2024	OL-FP NPF-38	101.3 94.0 88.9 101.1 82.6 91.4

APPENDIX A
U.S. Commercial Nuclear Power Reactors (continued)

Unit, Operating Utility Company Location Docket Number	NRC Region	Con Type NSSS AE Constructor	Licensed MWt	Net Summer Capacity (MW)*	CP Issued OL Issued Comm. Op Exp. Date	License Type & Number	2001-2006** Average Capacity Factor (Percent)
Watts Bar 1 Tennessee Valley Authority 10 miles S of Spring City, TN 050-00390	II	PWR-ICECND WEST 4LP TVA TVA	3459	1121	01/23/1973 02/07/1996 05/27/1996 11/09/2035	OL NPF-90	97.7 92.1 87.1 100.1 89.7 68
Wolf Creek 1 Wolf Creek Nuclear Operating Corp. 3.5 miles NE of Burlington, KS 050-00482	IV	PWR-DRYAMB WEST 4LP BECH DANI	3565	1166	05/31/1977 06/04/1985 09/03/1985 03/11/2025	OL-FP NPF-42	101.0 88.6 87.1 98.9 86.4 91.5

*Data complied by Nuclear Energy Institute
**Note: Average Capacity Factors are listed in year order starting with 2001. Source: Nuclear Energy Institute Web site.
Source: U.S. Nuclear Regulatory Commission and licensee data as compiled by the U.S. Nuclear Regulatory Commission.

APPENDIX B
U.S. Commercial Nuclear Power Reactors Formerly Licensed to Operate (Permanently Shut Down)

Unit Location	Reactor Type WMt	NSSS Vendor	OL Issued Shut Down	Decommissioning Alternative Selected Current Status
Big Rock Point Charleviox, MI	BWR 240	GE	05/01/1964 08/29/1997	DECON DECON Completed
GE Bonus * Punta Higuera, PR	BWR 50	COMB	04/02/1964 06/01/1968	ENTOMB ENTOMB
CVTR ** Parr, SC	PTHW 65	WEST	11/27/1962 01/01/1967	SAFSTOR SAFSTOR
Dresden 1 Morris, IL	BWR 700	GE	09/28/1959 10/31/1978	SAFSTOR SAFSTOR
Elk River * Elk River, MN	BWR 58	AC/S&L	11/06/1962 02/01/1968	DECON DECON Completed
Fermi 1 Newport, MI	SCF 200	COMB	05/10/1963 09/22/1972	SAFSTOR SAFSTOR
Fort St. Vrain Platteville, CO	HTG 842	GA	12/21/1973 08/18/1989	DECON DECON Completed
GE VBWR Pleasanton, CA	BWR 50	GE	08/31/1957 12/09/1963	SAFSTOR SAFSTOR
Haddam Neck Meriden, CT	PWR 1825	WEST	12/27/1974 12/05/1996	DECON DECON In Progress
Hallam * Hallam, NE	SCGM 256	BLH	01/02/1962 09/01/1964	ENTOMB ENTOMB

APPENDIX B
U.S. Commercial Nuclear Power Reactors Formerly Licensed to Operate (Permanently Shut Down) (continued)

Unit Location	Reactor Type WMt	NSSS Vendor	OL Issued Shut Down	Decommissioning Alternative Selected Current Status
Humboldt Bay 3 Eureka, CA	BWR 200	GE	08/28/1962 07/02/1976	DECON DECON In Progress
Indian Point 1 Buchanan, NY	PWR 615	B&W	03/26/1962 10/31/1974	SAFSTOR SAFSTOR
La Crosse Genoa, WI	BWR 165	AC	07/03/1967 04/30/1987	SAFSTOR SAFSTOR
Maine Yankee Wiscasset, ME	PWR 2700	COMB	06/29/1973 12/06/1996	DECON DECON Completed
Millstone 1 Waterford, CT	BWR 2011	GE	10/31/1986 07/21/1998	SAFSTOR SAFSTOR
Pathfinder Sioux Falls, SD	BWR 190	AC	03/12/1964 09/16/1967	DECON DECON Completed
Peach Bottom 1 Peach Bottom, PA	HTG 115	GA	01/24/1966 10/31/1974	SAFSTOR SAFSTOR
Piqua * Piqua, OH	OCM 46	AI	08/23/1962 01/01/1966	ENTOMB ENTOMB
Rancho Seco Herald, CA	PWR 2772	B&W	08/16/1974 06/07/1989	DECON DECON In Progress
San Onofre 1 San Clemente, CA	PWR 1347	WEST	03/27/1967 11/30/1992	DECON DECON In Progress

APPENDIX B
U.S. Commercial Nuclear Power Reactors Formerly Licensed to Operate (Permanently Shut Down) (continued)

Unit Location	Reactor Type WMt	NSSS Vendor	OL Issued Shut Down	Decommissioning Alternative Selected Current Status
Saxton Saxton, PA	PWR 23.5	WEST	11/15/1961 05/01/1972	DECON DECON Completed
Shippingport * Shippingport, PA	PWR 236	WEST	N/A 1982	DECON DECON Completed
Shoreham Wading River, NY	BWR 2436	GE	04/21/1989 06/28/1989	DECON DECON Completed
Three Mile Island 2 Londonderry Township, PA	PWR 2770	B&W	02/08/1978 03/28/1979	(1)
Trojan Rainier, OR	PWR 3411	WEST	11/21/1975 11/09/1992	DECON DECON Completed
Yankee-Rowe Franklin County, MA	PWR 0600	WEST	12/24/1963 10/01/1991	DECON DECON In Progress
Zion 1 Zion, IL	PWR 3250	WEST	10/19/1973 02/21/1997	SAFSTOR SAFSTOR
Zion 2 Zion, IL	PWR 3250	WEST	11/14/1973 09/19/1996	SAFSTOR SAFSTOR

*AEC/DOE owned; not regulated by the NRC.
**Holds byproduct license from State of South Carolina.
Notes: See Glossary for definitions of decommissioning alternatives.
1 Three Mile Island 2 has been placed in a post-defueling monitored storage mode until Unit 1 permanently ceases operation, at which time both units are planned to be decommissioned.
Source: DOE Integrated Data Base for 1990; U.S. Spent Fuel and Radioactive Waste, Inventories, Projections, and Characteristics (DOE/RW-0006, Rev. 6), and U.S. Nuclear Regulatory Commission, Nuclear Power Plants in the World, Edition #6

APPENDIX C
Canceled U.S. Commercial Nuclear Power Reactors

Unit Utility Location	Con Type MWe per Unit	Canceled Date Status
Allens Creek 1 Houston Lighting & Power Company 4 miles NW of Wallis, IN	BWR 1150	1982 Under CP Review
Allens Creek 2 Houston Lighting & Power Company 4 miles NW of Wallis, IN	BWR 1150	1976 Under CP Review
Atlantic 1 & 2 Public Service Electric & Gas Company Floating Plants off the Coast of NJ	PWR 1150	1978 Under CP Review
Bailly Northern Indiana Public Service Company 12 miles NNE of Gary, IN	BWR 645	1981 With CP
Barton 1 & 2 Alabama Power & Light 15 miles SE of Clanton, Alabama	BWR 1159	1977 Under CP Review
Barton 3 & 4 Alabama Power & Light 15 miles SE of Clanton, Alabama	BWR 1159	1975 Under CP Review
Bellefonte 1 & 2 Tennessee Valley Authority 6 miles NE of Scottsboro, AL	PWR 1235	2006 With CP
Black Fox 1 & 2 Public Service Company of Oklahoma 3.5 miles South of Inola, Oklahoma	BWR 1150	1982 Under CP Review
Blue Hills 1 & 2 Gulf States Utilities Company SW tip of Toledo Bend Reservoir, County, Texas	PWR 918	1978 Under CP Review
Callaway 2 Union Electric Company 10 miles SE of Fulton, MO	PWR 1150	1981 With CP
Cherokee 1 Duke Power Company 6 miles SSW of Blacksburg, SC	PWR 1280	1983 With CP

APPENDIX C
Canceled U.S. Commercial Nuclear Power Reactors (continued)

Unit Utility Location	Con Type MWe per Unit	Canceled Date Status
Cherokee 2 & 3 Duke Power Company 6 miles SSW of Blacksburg, SC	PWR 1280	1982 With CP
Clinch River Project Management Corp.; DOE; TVA 23 miles West of Knoxville, in Oak Ridge, TN	LMFB 350	1983 Under CP Review
Clinton 2 Illinois Power Company 6 miles East of Clinton, IL	BWR 933	1983 With CP
Davis-Besse 2 & 3 Toledo Edison Company 21 miles ESE of Toledo, OH	PWR 906	1981 Under CP Review
Douglas Point 1 & 2 Potomac Electric Power Company 5.7 miles SSE of Quanitico, VA	BWR 1146	1977 Under CP Review
Erie 1 & 2 Ohio Edison Company Berlin, OH	PWR 1260	1980 Under CP Review
Forked River 1 Jersey Central Power & Light Company 2 miles South of Forked River, NJ	PWR 1070	1980 With CP
Fort Calhoun 2 Omaha Public Power District 19 miles North of Omaha, NE	PWR 1136	1977 Under CP Review
Fulton 1 & 2 Philadelphia Electric Company 17 miles South of Lancaster, PA	HTG 1160	1975 Under CP Review
Grand Gulf 2 Entergy Operations, Incorporated 25 miles South of Vicksburg, MS	BWR 1250	1990 With CP
Greene County Power Authority of the State of NY 20 miles North of Kingston, MS	PWR 1191	1980 Under CP Review
Greenwood 2 & 3 Detroit Edison Company Greenwood Township, MS	PWR 1200	1980 Under CP Review

APPENDIX C
Canceled U.S. Commercial Nuclear Power Reactors (continued)

Unit Utility Location	Con Type MWe per Unit	Canceled Date Status
Hartsville A1 & A2 Tennessee Valley Authority 5 miles SE of Hartsville, TN	BWR 1233	1984 With CP
Hartsville B1 & B2 Tennessee Valley Authority 5 miles SE of Hartsville, TN	BWR 1233	1982 With CP
Haven 1 (formerly Koshkonong) Wisconsin Electric Power Company 4.2 miles SSW of Fort Atkinson, WI	PWR 900	1980 Under CP Review
Haven 2 (formerly Koshkonong) Wisconsin Electric Power Company 4.2 miles SSW of Fort Atkinson, WI	PWR 900	1978 Under CP Review
Hope Creek 2 Public Service Electric & Gas Company 18 miles SE of Washington, DE	BWR 1067	1981 With CP
Jamesport 1 & 2 Long Island Lighting Company 65 miles East of New York City, NY	PWR 1150	1980 With CP
Marble Hill 1 & 2 Public Service of Indiana 6 miles NE of New Washington, IN	PWR 1130	1985 With CP
Midland 1 Consumers Power Company South of City of Midland, MI	PWR 492	1986 With CP
Midland 2 Consumers Power Company South of City of Midland, MI	PWR 818	1986 With CP
Montague 1 & 2 Northeast Nuclear Energy Company 1.2 miles SSE of Turners Falls, MA	BWR 1150	1980 Under CP Review
New England 1 & 2 New England Power Company 8.5 Miles East of Westerly, RI	PWR 1194	1979 Under CP Review
New Haven 1 & 2 New York State Electric & Gas Corporation	PWR 1250	1980 Under CP Review
North Anna 3 Virginia Electric & Power Company 40 miles NW of Richmond, VA	PWR 907	1982 With CP

APPENDIX C
Canceled U.S. Commercial Nuclear Power Reactors (continued)

Unit Utility Location	Con Type MWe per Unit	Canceled Date Status
North Anna 4 Virginia Electric & Power Company 40 miles NW of Richmond, VA	PWR 907	1980 With CP
North Coast 1 Puerto Rico Water Resources Authority 4.7 miles ESE of Salinas, PR	PWR 583	1978 Under CP Review
Palo Verde 4 & 5 Arizona Public Service Company 36 miles West of Phoenix, AZ	PWR 1270	1979 Under CP Review
Pebble Springs 1 & 2 Portland General Electric Company 55 miles WSW of Tri Cities (Kenewick-Pasco-Richland), OR	PWR 1260	1982 Under CP Review
Perkins 1, 2, & 3 Duke Power Company 10 miles North of Salisbury, NC	PWR 1280	1982 Under CP Review
Perry 2 Cleveland Electric Illuminating Co. 7 miles NE of Painsville, OH	BWR 1205	1994 Under CP Review
Phipps Bend 1 & 2 Tennessee Valley Authority 15 miles SW of Kingsport, TN	BWR 1220	1982 With CP
Pilgrim 2 Boston Edison Company 4 miles SE of Plymouth, MA	PWR 1180	1981 Under CP Review
Pilgrim 3 Boston Edison Company 4 miles SE of Plymouth, MA	PWR 1180	1974 Under CP Review
Quanicassee 1 & 2 Consumers Power Company 6 miles East of Essexville, MI	PWR 1150	1974 Under CP Review
River Bend 2 Gulf States Utilities Company 24 miles NNW of Baton Rouge, LA	BWR 934	1984 With CP
Seabrook 2 Public Service Co. of New Hampshire 13 Miles South of Portsmouth, NH	PWR 1198	1988 With CP

APPENDIX C
Canceled U.S. Commercial Nuclear Power Reactors (continued)

Unit Utility Location	Con Type MWe per Unit	Canceled Date Status
Shearon Harris 2 Carolina Power & Light Company 20 miles SW of Raleigh, NC	PWR 900	1983 With CP
Shearon Harris 3 & 4 Carolina Power & Light Company 20 miles SW of Raleigh, NC	PWR 900	1981 With CP
Skagit/Hanford 1 & 2 Puget Sound Power & Light Company 23 miles SE of Bellingham, WA	PWR 1277	1983 Under CP Review
Sterling Rochester Gas & Electric Corporation 50 miles East of Rochester, NY	PWR 1150	1980 With CP
Summit 1 & 2 Delmarva Power & Light Company 15 Miles SSW of Wilmington, DE	HTG 1200	1975 Under CP Review
Sundesert 1 & 2 San Diego Gas & Electric Company 16 miles SW of Blythe, CA	PWR 974	1978 Under CP Review
Surry 3 & 4 Virginia Electric & Power Company 17 miles NW of Newport News, VA	PWR 882	1977 With CP
Tyrone 1 Northern States Power Company 8 miles NE of Durond, WI	PWR 1150	1981 Under CP Review
Tyrone 2 Northern States Power Company 8 miles NE of Durond, WI	PWR 1150	1974 With CP
Vogtle 3 & 4 Georgia Power Company 26 miles SE of Augusta, GA	PWR 1113	1974 With CP
Washington Nuclear 1 Energy Northwest 10 miles East of Aberdeen, WA	PWR 1266	1995 With CP
Washington Nuclear 3 Energy Northwest 16 miles East of Aberdeen, WA	PWR 1242	1995 With CP

APPENDIX C
Canceled U.S. Commercial Nuclear Power Reactors (continued)

Unit Utility Location	Con Type MWe per Unit	Canceled Date Status
Washington Nuclear 4 Energy Northwest 10 miles East of Aberdeen, WA	PWR 1218	1982 With CP
Washington Nuclear 5 Energy Northwest 16 miles East of Aberdeen, WA	PWR 1242	1982 With CP
Watts Bar 2 Tennessee Valley Authority 10 miles South of Spring City, TN	PWR 1165	(1) With CP
Yellow Creek 1 & 2 Tennessee Valley Authority 15 miles East of Corinth, MS	BWR 1285	1984 With CP
Zimmer 1 Cincinnati Gas & Electric Company 25 miles SE of Cincinnati, OH	BWR 810	1984 With CP

Note: Cancellation is defined as public announcement of cancellation or written notification to the NRC.
Only docketed applications are indicated.
1 Watts Bar 2 has not been formally cancelled; however TVA has stopped construction and is presently evaluating options (e.g., cancellation or completion).
Source: DOE/EIA Commercial Nuclear Power 1991 (DOE/EIA-0438 (91)), Appendix E (page 105) and U.S. Nuclear Regulatory Commission

APPENDIX D
U.S. Commercial Nuclear Power Reactors by Licensee

Utility	Unit
AmerenUE	Callaway*
Arizona Public Service Company	Palo Verde 1, 2, & 3*
Constellation Energy	Calvert Cliffs 1 & 2 Ginna Nine Mile Point 1 & 2
Detroit Edison Company	Fermi 2
Dominion Generation	Kewaunee Millstone 2 & 3 North Anna 1 & 2 Surry 1 & 2
Duke Energy Power Company, LLC	Catawba 1 & 2 McGuire 1 & 2 Oconee 1, 2, & 3
Energy Northwest	Columbia
Entergy Nuclear Operations, Inc	Arkansas Nuclear 1 & 2 James A. FitzPatrick Grand Gulf 1 Indian Point 2 & 3 Palisades Pilgrim 1 River Bend 1 Vermont Yankee Waterford 3

APPENDIX D
U.S. Commercial Nuclear Power Reactors by Licensee (continued)

Utility	Unit
Exelon Generation Co., LLC	Braidwood 1 & 2 Byron 1 & 2 Clinton Dresden 2 & 3 La Salle County 1 & 2 Limerick 1 & 2 Oyster Creek Peach Bottom 2 & 3 Quad Cities 1 & 2 Three Mile Island 1
FirstEnergy Nuclear Operating Company	Beaver Valley 1 & 2 Davis-Besse Perry 1
Florida Power & Light Company	Duane Arnold Point Beach 1 & 2 Seabrook 1 St. Lucie 1 & 2 Turkey Point 3 & 4
Indiana/Michigan Power Company	D.C. Cook 1 & 2
Nebraska Public Power District	Cooper
Nuclear Management Company, LLC	Monticello Prairie Island 1 & 2
Omaha Public Power District	Fort Calhoun
Pacific Gas & Electric Company	Diablo Canyon 1 & 2*
PPL Susquehanna, LLC	Susquehanna 1 & 2
Progress Energy	Brunswick 1 & 2 Crystal River 3 H.B. Robinson 2 Shearon Harris 1
PSE&G Nuclear	Hope Creek 1 Salem 1 & 2

APPENDIX D
U.S. Commercial Nuclear Power Reactors by Licensee (continued)

Utility	Unit
South Carolina Electric & Gas Company	Summer
Southern California Edison Company	San Onofre 2 & 3
Southern Nuclear Operating Company	Edwin I. Hatch 1 & 2 Joseph M. Farley 1 & 2 Vogtle 1 & 2
STP Nuclear Operating Company	South Texas Project 1 & 2*
Tennessee Valley Authority	Browns Ferry 1, 2, & 3 Sequoyah 1 & 2 Watts Bar 1
TXU Generation Company, LP	Comanche Peak 1 & 2*
Wolf Creek Nuclear Operating Corporation	Wolf Creek 1*

* These plants have a joint program called the Strategic Teaming and Resource Sharing (STARS) group. They share resources for refueling outages and to develop some shared licensing applications.

Source: U.S. Nuclear Regulatory Commission

APPENDIX E
U.S. Nuclear Research and Test Reactors (Operating) Regulated by the NRC

Licensee Location	Reactor Type OL Issued	Power Level (kW)	License Number Docket Number
Aerotest San Ramon, CA	TRIGA (Indus) 07/02/1965	250	R-98 50-228
Armed Forces Radiobiology Research Institute Bethesda, MD	TRIGA 06/26/1962	1,100	R-84 50-170
Dow Chemical Company Midland, MI	TRIGA 07/03/1967	300	R-108 50-264
General Electric Company Sunol, CA	Nuclear Test 10/31/1957	100	R-33 50-73
Idaho State University Pocatello, ID	AGN-201 #103 10/11/1967	0.005	R-110 50-284
Kansas State University Manhattan, KS	TRIGA 10/16/1962	250	R-88 50-188
Massachusetts Institute of Technology Cambridge, MA	HWR Reflected 06/09/1958	5,000	R-37 50-20
National Institute of Standards & Technology Gaithersburg, MD	Nuclear Test 05/21/1970	20,000	TR-5 50-184
North Carolina State University Raleigh, NC	Pulstar 08/25/1972	1,000	R-120 50-297
Ohio State University Columbus, OH	Pool 02/24/1961	500	R-75 50-150
Oregon State University Corvallis, OR	TRIGA Mark II 03/07/1967	1,100	R-106 50-243
Pennsylvania State University University Park, PA	TRIGA 07/08/1955	1,100	R-2 50-5

APPENDIX E
U.S. Nuclear Research and Test Reactors (Operating) Regulated by the NRC (continued)

Licensee Location	Reactor Type OL Issued	Power Level (kW)	License Number Docket Number
Purdue University West Lafayette, IN	Lockheed 08/16/1962	1	R-87 50-182
Reed College Portland, OR	TRIGA Mark I 07/02/1968	250	R-112 50-288
Rensselaer Polytechnic Institute Troy, NY	Critical Assembly 07/03/1964	0.1	CX-22 50-225
Rhode Island Atomic Energy Commission Narragansett, RI	GE Pool 07/23/1964	2,000	R-95 50-193
Texas A&M University College Station, TX	AGN-201M #106 08/26/1957	0.005	R-23 50-59
Texas A&M University College Station, TX	TRIGA 12/07/1961	1,000	R-128 50-128
U.S. Geological Survey Denver, CO	TRIGA Mark I 02/24/1969	1,000	R-113 50-274
University of Arizona Tucson, AZ	TRIGA Mark I 12/05/1958	110	R-52 50-113
University of California/Davis Sacramento, CA	TRIGA 08/13/1998	2,300	R-130 50-607
University of California/Irvine Irvine, CA	TRIGA Mark I 11/24/1969	250	R-116 50-326
University of Florida Gainesville, FL	Argonaut 05/21/1959	100	R-56 50-83
University of Maryland College Park, MD	TRIGA 10/14/1960	250	R-70 50-166

APPENDIX E
U.S. Nuclear Research and Test Reactors (Operating) Regulated by the NRC (continued)

Licensee Location	Reactor Type OL Issued	Power Level (kW)	License Number Docket Number
University of Massachusetts/ Lowell Lowell, MA	GE Pool 12/24/1974	1,000	R-125 50-223
University of Missouri/Columbia Columbia, MO	Tank 10/11/1966	10,000	R-103 50-186
University of Missouri/Rolla Rolla, MO	Pool 11/21/1961	200	R-79 50-123
University of New Mexico Albuquerque, NM	AGN-201M#112 09/17/1966	0.005	R-102 50-252
University of Texas Austin, TX	TRIGA Mark II 01/17/1992	1,100	R-92 50-602
University of Utah Salt Lake City, UT	TRIGA Mark I 09/30/1975	100	R-126 50-407
University of Wisconsin Madison, WI	TRIGA 11/23/1960	1,000	R-74 50-156
Washington State University Pullman, WA	TRIGA 03/06/1961	1,000	R-76 50-27
Worcester Polytechnic Institute Worcester, MA	GE 12/16/1959	10	R-61 50-134

Source: U.S. Nuclear Regulatory Commission

APPENDIX F
U.S. Nuclear Research and Test Reactors (Under Decommissioning) Regulated by the NRC

Licensee Location	Reactor Type Power Level (kW)	OL Issued Shutdown	Decommissioning Alternative Selected Current Status
Cornell University Ithaca, NY	TRIGA Mark II 500	01/11/1962 4/21/2003	DECON DECON In Progress
Cornell University Ithaca, NY	Tank (ZPR) 0.1	12/11/62 2/12/97	DECON DECON In Progress
General Atomics San Diego, CA	TRIGA Mark F 1,500	7/01/60 9/7/94	DECON SAFSTOR
General Atomics San Diego, CA	TRIGA Mark I 250	5/03/58 12/17/96	DECON DECON
General Electric Company Sunol, CA	GETR (Tank) 50,000	1/7/59 6/26/85	SAFSTOR SAFSTOR
General Electric Company Sunol, CA	EVESR 17,000	11/12/63 2/1/67	SAFSTOR SAFSTOR
National Aeronautics and Space Administration Sandusky, OH	Test 60,000	5/2/62 7/7/73	DECON DECON In Progress
National Aeronautics and Space Administration Sandusky, OH	Mockup 100	6/14/61 7/7/73	DECON DECON In Progress
University of Buffalo Buffalo, NY	Pulstar 2,000	3/24/61 7/23/96	DECON SAFSTOR
University of Illinois Urbana-Champaign, IL	TRIGA 1,500	7/22/69 4/12/99	DECON DECON

APPENDIX F
U.S. Nuclear Research and Test Reactors (Under Decommissioning) Regulated by the NRC (continued)

Licensee Location	Reactor Type Power Level (kW)	OL Issued Shutdown	Decommissioning Alternative Selected Current Status
University of Michigan Ann Arbor, MI	Pool 2,000	09/13/57 1/29/04	DECON DECON in progress
University of Washington Seattle, WA	Argonaut 100	3/31/61 6/30/88	DECON DECON in progress
Veterans Administration Omaha, NE	TRIGA 20	6/26/59 11/05/01	DECON SAFSTOR
Viacom Waltz Mill, PA	Tank 20,000	6/19/59 3/25/63	SAFSTOR SAFSTOR

Source: U.S. Nuclear Regulatory Commission

APPENDIX G
Industry Performance Indicators: Annual Industry Averages, FYs 1991–2006

Indicator	1991	1992	1993	1994	1995	1996	1997	1998
Automatic Scrams	1.57	1.52	1.18	1.05	1.04	0.80	0.54	0.48
Safety System Actuations	1.06	0.81	0.81	0.62	0.46	0.39	0.35	0.31
Significant Events	0.40	0.25	0.26	0.21	0.17	0.08	0.10	0.04
Safety System Failures	3.44	3.78	3.09	2.32	2.03	2.89	2.71	2.76
Forced Outage Rate	7.90	8.89	7.79	9.40	6.76	7.54	10.21	10.73
Equipment Forced Outage Rate	0.36	0.35	0.24	0.26	0.23	0.24	0.24	0.18
Collective Radiation Exposure	286.00	277.00	244.00	215.00	202.00	178.00	176.00	140.00

Indicator	1999	2000	2001	2002	2003	2004	2005	2006
Automatic Scrams	0.64	0.52	0.57	0.44	0.75	0.56	0.47	0.32
Safety System Actuations	0.29	0.29	0.19	0.18	0.41	0.24	0.38	0.22
Significant Events	0.03	0.04	0.07	0.05	0.07	0.04	0.05	0.01
Safety System Failures	1.68	1.40	0.82	0.88	0.96	0.77	0.96	0.58
Forced Outage Rate	5.20	4.24	3.00	1.70	3.04	1.88	2.44	1.47
Equipment Forced Outage Rate	0.16	0.13	0.11	0.12	0.16	0.15	0.13	0.10
Collective Radiation Exposure	128.00	115.00	123.00	111.00	125.00	100.00	118.00	95.00

Source: Licensee data as compiled by the U.S. Nuclear Regulatory Commission

APPENDIX H
Dry Spent Fuel Storage Designs: NRC-Approved for General Use

Vendor	Docket #	Storage Design Model
General Nuclear Systems, Inc.	72-1000	CASTOR V/21
NAC International, Inc.	72-1002 72-1003 72-1015 72-1025	NAC S/T NAC-C28 S/T NAC-UMS NAC-MPC
Holtec International	72-1008 72-1014	HI-STAR 100 HI-STORM 100
BNG Fuel Solutions, Corporation	72-1007 72-1026	VSC-24 Fuel Solutions (WSNF-220,-221,-223) W-150 Storage Cask W-100 Transfer Cask W-21, W-74 Canisters
Transnuclear, Inc.	72-1005 72-1027 72-1021 72-1004 72-1029 72-1030	TN-24 TN-68 TN-32, 32A, 32B Standardized NUHOMS-24P, 24PHB, 24PTH, 52B, 61BT, 32PT Standardized Advanced NUHOMS-24PT1, 24PT4 NUHOMS HD-32PTH

Source: U.S. Nuclear Regulatory Commission data as of December 31, 2006 (10 CFR 72.214)

APPENDIX I
Dry Spent Fuel Storage Licensees

Reactor Utility	Date Issued	Vendor	Storage Model	Docket#
Surry 1, 2 Virginia Electric & Power Company	07/02/1986	General Nuclear Systems, Inc. Transnuclear, Inc. NAC International, Inc. Westinghouse, Inc.	CASTOR V/21 TN-32 NAC-128 CASTOR X/33 MC-10	72-2
H. B. Robinson 2 Carolina Power & Light Company	08/13/1986 Under General License 09/06/2005	Transnuclear, Inc. Transnuclear, Inc.	NUHOMS-7P NUHOMS-24P	72-3 72-60
Oconee 1, 2, 3 Duke Energy Company	01/29/1990 Under General License 03/05/1999	Transnuclear, Inc.	NUHOMS-24P	72-4 72-40
Fort St. Vrain* Department of Energy	11/04/1991	FW Energy Applications, Inc.	Modular Vault Dry Store	72-9
Calvert Cliffs 1, 2 Calvert Cliffs Nuclear Power Plant	11/25/1992	Transnuclear, Inc.	NUHOMS-24P NUHOMS-32P	72-8
Palisades Nuclear Management Company, LLC	Under General License 05/11/1993	BNG Fuel Solutions Transnuclear, Inc.	VSC-24 NUHOMS-32PT	72-7
Prairie Island 1, 2 Nuclear Management Company, LLC	10/19/1993	Transnuclear, Inc.	TN-40	72-10
Point Beach 1, 2 Nuclear Management Company, LLC	Under General License 05/26/1996	BNG Fuel Solutions Transnuclear, Inc.	VSC-24 NUHOMS-32PT	72-5
Davis-Besse First Energy Nuclear Operating Company	Under General License 01/01/1996	Transnuclear, Inc.	NUHOMS-24P	72-14
Arkansas Nuclear 1,2 Entergy Operations, Inc.	Under General License 12/17/1996	BNG Fuel Solutions Holtec International	VSC-24 HI-STORM 100	72-13
North Anna Virginia Electric & Power Company	06/30/1998	Transnuclear, Inc.	TN-32	72-16

APPENDIX I
Dry Spent Fuel Storage Licensees (continued)

Reactor Utility	Date Issued	Vendor	Storage Model	Docket#
Trojan Portland General Electric Corp.	03/31/1999	Holtec International	HI-STORM 100	72-17
INEEL ISFSI TMI-2 Fuel Debris, Department of Energy	03/19/1999	Transnuclear, Inc.	NUHOMS-12T	72-20
Susquehanna Pennsylvania Power & Light	Under General License 10/18/1999	Transnuclear, Inc.	NUHOMS-52B NUHOMS-61BT	72-28
Peach Bottom 2, 3 Exelon Generating Company	Under General License 06/12/2000	Transnuclear, Inc.	TN-68	72-29
Hatch 1, 2 Southern Nuclear Operating	Under General License 07/06/2000	Holtec International	HI-STAR 100 HI-STORM 100	72-36
Dresden 1, 2, 3 Exelon Generating	Under General License 07/10/2000	Holtec International	HI-STAR 100 HI-STORM 100	72-37
Rancho Seco Sacramento Municipal Utility District	06/30/2000	Transnuclear, Inc.	NUHOMS-24P	72-11
McGuire Duke Power	Under General License 02/01/2001	Transnuclear, Inc.	TN-32	72-38
Big Rock Point Consumers Energy	Under General License 11/18/2002	BNG Fuel Solutions	Fuel Solutions W74	72-43
James A. FitzPatrick Entergy Nuclear Operations, Incorporated	Under General License 04/25/2002	Holtec International	HI-STORM 100	72-12
Maine Yankee Maine Yankee Atomic Power Company	Under General License 08/24/2002	NAC International, Inc.	NAC-UMS	72-30
Columbia Generating Station Energy North West	Under General License 09/02/2002	Holtec International	HI-STORM 100	72-35

APPENDIX I
Dry Spent Fuel Storage Licensees (continued)

Reactor Utility	Date Issued	Vendor	Storage Model	Docket#
Oyster Creek AmeriGen Energy Company	Under General License 04/11/2002	Transnuclear, Inc.	NUHOMS-61BT	72-15
Yankee Rowe Yankee Atomic Electric	Under General License 06/26/2002	NAC International, Inc.	NAC-MPC	72-31
Duane Arnold Nuclear Management Corporation	Under General License 09/01/2003	Transnuclear, Inc.	NUHOMS-61BT	72-32
Palo Verde Arizona Public Service Company	Under General License 03/15/2003	NAC International, Inc.	NAC-UMS	72-44
San Onofre Southern California Edison Company	Under General License 10/03/2003	Transnuclear, Inc.	NUHOMS-24PT	72-41
Diablo Canyon Pacific Gas & Electric	03/22/2004	Holtec International	HI-STORM 100	72-26
Haddam Neck CT Yankee Atomic Power	Under General License 05/21/2004	NAC International, Inc.	NAC-MPC	72-39
Sequoyah Tennessee Valley Authority	Under General License 07/13/2004	Holtec International	HI-STORM 100	72-34
Idaho Spent Fuel Facility Foster Wheeler Environmental Corp.	11/30/2004	Multiple	Multiple	72-25
Humboldt Bay Pacific Gas & Electric Co.	Under General License 11/30/2005	Holtec International	HI-STORM 100HB	72-27
Private Fuel Storage Facility	Under General License 02/21/2006	Holtec International	HI-STORM 100	72-22

APPENDIX I
Dry Spent Fuel Storage Licensees (continued)

Reactor Utility	Date Issued	Vendor	Storage Model	Docket#
Browns Ferry TVA	Under General License 08/21/2005	Holtec International	HI-STORM 100S	72-52
Farley Southern Nuclear Operating Co.	Under General License 08/25/2005	Transnuclear, Inc.	NUHOMS-32PT	72-42
Millstone Dominion Generation	Under General License 02/15/2005	Transnuclear, Inc.	NUHOMS-32PT	72-47
Quad Cities Exelon	Under General License 12/02/2005	Holtec International	HI-STORM 100S	72-53
River Bend Entergy	Under General License 12/29/2005	Holtec International	HI-STORM 100S	72-49
Fort Calhoun	Under General License 7/29/06	Transnuclear Standardized, Inc.	NUHOMS-32PT	72-54
Grand Gulf 1	Under General License 11/18/06	Holtec International	HI-STORM 100S-B	72-50
Hope Creek/ Salem	Under General License 12/8/06	Holtec International	HI-STORM 100	72-48

*Plant is undergoing decommissioning and was transferred to DOE on June 4, 1999.
Source: U.S. Nuclear Regulatory Commission

APPENDIX J
Nuclear Power Units by Nation

	In Operation		Under Construction, or on Order as of December 31, 2006		Total	
Country	Number of Units	Net MWe	Number of Units	Net MWe	Number of Units	Net MWe
Argentina	2	935	1	692	3	1,627
Armenia	1	376	0	0	1	376
Belgium	7	5,801	0	0	7	5,801
Brazil	2	1,901	1	1,275	3	3,176
Bulgaria	2	1,906	2	2,000	4	3,906
Canada	22	15,164	0	0	22	15,164
China	9	6,694	10	9,620	19	16,314
China, Taiwan	6	4,884	2	2,600	8	7,484
Czech Republic	6	3,472	0	0	6	3,472
Finland	4	2,656	1	1,600	5	4,256
France	59	63,363	1	1,330	60	64,693
Germany	17	20,303	0	0	17	20,303
Hungary	4	1,755	0	0	4	1,755
India	16	3,530	7	3,142	23	6,672
Iran	0	0	1	915	1	915
Japan	55	47,589	3	2,416	58	50,005
Lithuania	1	1,185	0	0	1	1,185
Mexico	2	1,360	0	0	2	1,360
Netherlands	1	485	0	0	1	485
Pakistan	2	425	1	300	3	725
Romania	1	706	4	2,566	5	3,272
Russia	31	21,743	6	3,635	37	25,378
Slovakia	5	2,034	2	810	7	2,844
Slovenia	1	656	0	0	1	656
South Africa	2	1,800	0	0	2	1,800
South Korea	20	16,810	6	6,800	26	23,610
Spain	8	7,439	0	0	8	7,439

APPENDIX J
Nuclear Power Units by Nation (continued)

	In Operation		Under Construction, or on Order as of December 31, 2006		Total	
Country	Number of Units	Net MWe	Number of Units	Net MWe	Number of Units	Net MWe
Sweden	10	8,916	0	0	10	8,916
Switzerland	5	3,220	0	0	5	3,220
Ukraine	15	13,107	3	2,850	18	15,957
United Kingdom	19	10,982	0	0	19	10,982
United States	104	101,513.7	1	1,177	105	102,690.7
Total	439	372,710.7	52	43,728	491	416,438.7

Note: Operable, under construction or on order as of December 31, 2006.
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APPENDIX K
Nuclear Power Units by Reactor Type, Worldwide

	In Operation		Total	
Reactor Type	Number of Units	Net MWe	Number of Units	Net MWe
Pressurized light-water reactors (PWR)	263	241,138.6	299	266,257.6
Boiling light-water reactors (BWR)	94	85,442.1	97	89,415.1
Gas-cooled reactors, all types	18	9,794	18	9,794
Heavy-water reactors, all types	46	24,139	55	28,205
Graphite-moderated light-water reactors	16	11,404	17	12,329
Liquid metal cooled fast-breeder reactors	2	793	5	2,289
Total	439	372,710.7	491	408,289.7

Note: Operable, under construction, on order (30 MWe and over) as of December 31, 2006.

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APPENDIX L
Top 50 Reactors by Capacity Factor, Worldwide

Nation	Unit	Reactor Type	Vendor	2006 Gross Generation (MWh)	2006 Gross Capacity Factor (Percent)
U.S.	St. Lucie-1	PWR	CE	7,850,860	102.78
U.S.	Vermont Yankee	BWR	GE	5,331,146	102.16
U.S.	Limerick-2	BWR	GE	10,357,600	101.67
U.S.	Byron-2	PWR	West.	10,730,105	101.23
Japan	Kashiwazaki-Kariwa-2	BWR	Toshiba	9,740,440	101.08
U.S.	Farley-2	PWR	West.	8,005,416	100.98
U.S.	South Texas-2	PWR	West.	11,768,176	100.75
U.S.	LaSalle-2	BWR	GE	10,360,736	100.40
U.S.	Point Beach-1	PWR	West.	4,661,380	100.40
South Korea	Wolsong-4	PHWR	AECL	6,419,831	100.39
U.S.	Comanche Peak-1	PWR	West.	10,672,575	100.27
U.S.	Calvert Cliffs-2	PWR	CE	7,723,882	100.20
South Korea	Yonggwang-4	PWR	KHIC-CE	9,093,269	99.91
Japan	Higashidori-1	BWR	Toshiba	9,610,399	99.73
South Korea	Wolsong-2	PHWR	AECL	6,375,727	99.70
U.S.	Noth Anna-2	PWR	West.	8,383,447	99.69
South Korea	Yonggwang-2	PWR	West.	8,536,903	99.65
U.S.	Millstone-3	PWR	West.	10,521,409	99.59
U.S.	Indian Point-3	PWR	West.	9,261,182	99.27
U.S.	Diablo Canyon-1	PWR	West.	10,389,478	99.08
Canada	Bruce-6	PHWR	AECL	7,545,778	98.78
U.S.	Arkansas Nuclear I-1	PWR	B&W	7,794,979	98.54
Canada	Darlington-2	PHWR	AECL	8,056,448	98.47

APPENDIX L
Top 50 Reactors by Capacity Factor, Worldwide (continued)

Nation	Unit	Reactor Type	Vendor	2006 Gross Generation (MWh)	2006 Gross Capacity Factor (Percent)
U.S.	Hatch-2	BWR	GE	7,963,866	98.39
U.S.	Peach Bottom-3	BWR	GE	10,175,700	98.27
U.S.	Salem-1	PWR	West.	10,614,030	98.27
U.S.	Monticello	BWR	GE	5,278,693	98.26
Japan	Genkai-3	PWR	MHI	10,129,226	97.99
U.S.	Three Mile Island-1	PWR	B&W	7,624,884	97.80
Taiwan	Chinshan-1	BWR	GE	5,445,726	97.75
U.S.	Robinson-2	PWR	West.	6,761,888	97.71
U.S.	Duane Arnold	BWR	GE	5,383,312	97.54
U.S.	Grand Gulf-1	BWR	GE	11,247,218	97.36
Belgium	Tihange-1	PWR	ACLF	8,602,450	97.33
Canada	Bruce-5	PHWR	AECL	7,156,541	97.26
Japan	Ohi-1	PWR	West.	10,001,691	97.17
Japan	Fukushima I-1	BWR	GE	3,915,139	97.16
Canada	Darlington-4	PHWR	AECL	7,942,016	97.07
Finland	Olkiluoto-2	BWR	Asea	7,553,385	96.88
South Korea	Ulchin-3	PWR	B&W	8,878,123	96.80
U.S.	Oconee-2	PWR	B&W	7,717,103	96.70
Germany	Isar-2	PWR	Siemens	12,442,254	96.29
U.S.	McGuire-1	PWR	West.	10,333,386	96.29
Switzerland	Beznau-2	PWR	West.	3,201,967	96.19
Argentina	Embalse	PHWR	AECL	5,459,891	96.18
Spain	Cofrentes	BWR	GE	9,218,719	96.11
South Korea	Ulchin-2	PWR	Areva	8,277,922	96.03

APPENDIX L
Top 50 Reactors by Capacity Factor, Worldwide (continued)

Nation	Unit	Reactor Type	Vendor	2006 Gross Generation (MWh)	2006 Gross Capacity Factor (Percent)
U.S.	Dresden-2	BWR	GE	7,643,434	95.99
Pakistan	Chasnupp-1	PWR	CNNC	2,730,960	95.92
Germany	Emsland	PWR	Siemens	11,764,056	95.92

Note: Source: Excerpted from Nucleonics Week © February 15, 2007 by McGraw Hill, Inc. Reproduced by permission. Further reproduction prohibited.

APPENDIX M
Top 50 Reactors by Generation, Worldwide

Nation	Unit	Reactor Type	Vendor	2006 Gross Generation (MWh)	2006 Gross Capacity Factor (Percent)
Germany	Isar-2	PWR	Siemens	12,442,254	96.29
Germany	Brokdorf	PWR	Siemens	11,784,443	93.42
U.S.	South Texas-2	PWR	West.	11,768,176	100.75
Germany	Emsland	PWR	Siemens	11,764,056	95.92
Germany	Grohnde	PWR	Siemens	11,645,049	92.96
France	Civaux-2	PWR	Areva	11,638,125	85.11
Germany	Neckar-2	PWR	Siemens	11,620,800	95.10
Germany	Philippsburg-2	PWR	Siemens	11,548,400	90.42
U.S.	Grand Gulf-1	BWR	GE	11,247,218	97.36
Germany	Gundremmingen-C	BWR	Siemens	11,052,134	93.87
France	Paluel-3	PWR	Areva	10,994,785	90.82
Germany	Unterweser	PWR	Siemens	10,928,594	88.48
U.S.	Perry	BWR	GE	10,900,131	94.91
France	Civaux-1	PWR	Areva	10,809,382	79.05
U.S.	Byron-2	PWR	West.	10,730,105	101.23
U.S.	ComanchePeak-1	PWR	West.	10,672,575	100.27

APPENDIX M
Top 50 Reactors by Generation, Worldwide (continued)

Nation	Unit	Reactor Type	Vendor	2006 Gross Generation (MWh)	2006 Gross Capacity Factor (Percent)
U.S.	South Texas-1	PWR	West.	10,634,521	91.04
Germany	Gundremmingen-B	BWR	Siemens	10,614,038	90.15
U.S.	Salem-1	PWR	West.	10,614,030	98.27
Germany	Kruemmel	BWR	Siemens	10,593,451	91.89
U.S.	Callaway	PWR	West.	10,560,397	94.27
France	Flamanville-2	PWR	Areva	10,549,477	87.14
U.S.	Millstone-3	PWR	West.	10,521,409	99.59
France	Nogent-2	PWR	Areva	10,471,414	87.70
U.S.	Braidwood-1	PWR	West.	10,393,775	95.53
U.S.	Diablo Canyon-1	PWR	West.	10,389,478	99.08
France	Cattenom-2	PWR	Areva	10,381,136	87.01
Brazil	Angra-2	PWR	Siemens	10,369,984	87.69
U.S.	LaSalle-2	BWR	GE	10,360,736	100.40
U.S.	Limerick-2	BWR	GE	10,357,600	101.67
U.S.	Palo Verde-2	PWR	CE	10,344,832	82.70
U.S.	McGuire-1	PWR	West.	10,333,386	96.29
France	Penly-2	PWR	Areva	10,309,587	85.16
France	Chooz-B1	PWR	Areva	10,243,789	74.96
U.S.	Peach Bottom-3	BWR	GE	10,175,700	98.27
Japan	Genkai-3	PWR	MHI	10,129,226	97.99
U.S	Braidwood-2	PWR	West.	10,101,722	95.27
Japan	Ohi-1	PWR	West.	10,001,691	97.17
U.S.	Comanche Peak-2	PWR	West.	9,981,348	93.78
Germany	Grafenrheinfeld	PWR	Siemens	9,960,284	84.54
Sweden	Oskarshamn-3	BWR	Asea	9,934,424	94.82

APPENDIX M
Top 50 Reactors by Generation, Worldwide (continued)

Nation	Unit	Reactor Type	Vendor	2006 Gross Generation (MWh)	2006 Gross Capacity Factor (Percent)
France	Penly-1	PWR	Areva	9,932,429	82.04
Sweden	Forsmark-3	PWR	Asea	9,924,786	94.41
U.S.	Palo Verde-3	PWR	CE	9,908,877	82.69
France	Golfech-1	PWR	Areva	9,892,846	82.86
France	Chooz-B2	PWR	Areva	9,858,879	72.14
U.S.	Byron-1	PWR	West.	9,849,589	90.53
Switzerland	Leibstadt	BWR	GE	9,837,492	93.58
U.S.	Columbia	BWR	GE	9,758,833	94.97
Japan	Hashiwazaki-Kariwa-2	BWR	Toshiba	9,740,440	101.08

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APPENDIX N
Quick-Reference Metric Conversion Tables

SPACE AND TIME

Quantity	From Inch-Pound Units	To Metric Units	Multiply by
Length	mi (statute)	km	1.609 347
	yd	m	*0.914 4
	ft (int)	m	*0.304 8
	in	cm	*2.54
Area	mi^2	km^2	2.589 998
	acre	m^2	4 046.873
	yd^2	m^2	0.836 127 4
	ft^2	m^2	*0.092 903 04
	in^2	cm^2	*6.451 6
Volume	acre foot	m^3	1 233.489
	yd^3	m^3	0.764 554 9
	ft^3	m^3	0.028 316 85
	ft^3	L	28.316 85
	gallon	L	3.785 412
	fl oz	mL	29.573 53
	in^3	cm^3	16.387 06
Velocity	mi/h	km/h	1.609 347
	ft/s	m/s	*0.304 8
Acceleration	ft/s^2	m/s^2	*0.304 8

NUCLEAR REACTION AND IONIZING RADIATION

Quantity	From Inch-Pound Units	To Metric Units	Multiply by
Activity (of a radionuclide)	curie (Ci)	MBq	*37,000.0
	dpm	Bq (becquerel)	0.016 667
Absorbed dose	rad	Gy (gray)	*0.01
	rad	cGy	*1.0
Dose equivalent	rem	Sv (sievert)	*0.01
	rem	mSv	*10.0
	mrem	mSv	*0.01
	mrem	μSv	*10.0

APPENDIX N
Quick-Reference Metric Conversion Tables (continued)

NUCLEAR REACTION AND IONIZING RADIATION

Quantity	From Inch-Pound Units	To Metric Units	Multiply by
Exposure (X-rays and gamma rays)	roentgen (R)	C/kg (coulomb)	0.000 258

HEAT

Quantity	From Inch-Pound Units	To Metric Units	Multiply by
Thermodynamic temperature	°F	°K	*°K = (°F + 59.67)/1.8
Celsius temperature	°F	°C	*°C = (°F–32)/1.8
Linear expansion coefficient	°F–1	°K-1 or °C-1	*1.8
Thermal conductivity	(Btu · in)/(ft^2 · h · °F)	W/(m · °C)	0.144 227 9
Coefficient of heat transfer	Btu / (ft^2 · h · °F)	W/(m^2 · °C)	5.678 263
Heat capacity	Btu/°F	kJ/°C	1.899 108
Specific heat capacity	Btu/(lb · °F)	kJ/(kg · °C)	*4.186 8
Entropy	Btu/°F	kJ/°C	1.899 108
Specific entropy	Btu/(lb · °F)	kJ/(kg · °C)	*4.186 8
Specific internal energy	Btu/lb	kJ/kg	*2.326

APPENDIX N
Quick-Reference Metric Conversion Tables (continued)

MECHANICS

Quantity	From Inch-Pound Units	To Metric Units	Multiply by
Mass (weight)	ton (short) lb (avdp)	t (metric ton) kg	*0.907 184 74 *0.453 592 37
Moment of mass	lb · ft	kg · m	0.138 255
Density	ton (short)/yd^3 lb/ft^3	t/m^3 kg/m^3	1.186 553 16.018 46
Concentration (mass)	lb/gal	g/L	119.826 4
Momentum	lb · ft/s	kg ·m/s	0.138 255
Angular momentum	lb · ft^2/s	kg ·m^2/s	0.042 140 11
Moment of Inertia	lb · ft^2	kg ·m^2	0.042 140 11
Force	kip (kilopound) lbf	kN (kilonewton) N (newton)	4.448 222 4.448 222
Moment of Force, torque	lbf · ft lbf · in	N · m N · m	1.355 818 0.122 984 8
Pressure	atm (std) bar lbf/in^2 (formerly psi) inHg (32°F) ftH2O (39.2°F) inH2O (60°F) mmHg (0°C)	kPa (kilopascal) kPa kPa kPa kPa kPa kPa	*101.325 *100.0 6.894 757 3.386 38 2.988 98 0.248 84 0.133 322
Stress	kip/in^2 (formerly ksi) lbf/in^2 (formerly psi) lbf/in^2 (formerly psi) lbf/ft^2	MPa MPa kPa kPa	6.894 757 0.006 894 757 6.894 757 0.047 880 26

APPENDIX N
Quick-Reference Metric Conversion Tables (continued)

MECHANICS

Quantity	From Inch-Pound Units	To Metric Units	Multiply by
Energy, work	kwh	MJ	*3.6
	calth	J (joule)	*4.184
	Btu	kJ	1.055 056
	ft • lbf	J	1.355 818
	therm (US)	MJ	105.480 4
Power	Btu/s	kW	1.055 056
	hp (electric)	kW	*0.746
	Btu/h	W	0.293 071 1

To convert from metric units to inch-pound units, divide the metric unit by the conversion factor.
* Exact conversion factors
Note: The information contained in this table is intended to familiarize NRC personnel with commonly used SI units and provide a quick reference to aid in the understanding of documents containing SI units. The conversion factors provided have not been approved as NRC guidelines for development of licensing actions, regulations, or policy.
Source: Federal Standard 376A (May 5, 1983), Preferred Metric Units for General Use by the Federal Government; and International Commission of Radiation Units and Measurements, ICRU Report 33 (1980), Radiation Quantities and Unit

GLOSSARY

AGREEMENT STATE: A State that has signed an agreement with the NRC allowing the State to regulate the use of radioactive material within that State.

BOILING WATER REACTOR (BWR): A nuclear reactor in which water, used as both coolant and moderator, is allowed to boil in the core.

CAPABILITY: The maximum load that a generating station can carry under specified conditions for a given period of time without exceeding approved limits of temperature and stress. Net summer capability is used in the digest. Measured in watts except as noted otherwise.

CAPACITY FACTOR (Gross): The ratio of the gross electricity generated, for the period of time considered, to the energy that could have been generated at continuous full-power operation during the same period.

CAPACITY FACTOR (Net): The ratio of the net electricity generated, for the period of time considered, to the energy that could have been generated at continuous full-power operation during the same period.

CASK: A heavily shielded container used to store and/or ship radioactive materials. Lead and steel are common materials used in the manufacture of casks.

COMPACT: A group of two or more States formed to dispose of low-level radioactive waste on a regional basis. Forty-four States have formed 10 compacts.

CONSTRUCTION RECAPTURE: The maximum number of years that could be added to the license expiration date to recover the period from the construction permit to the date when the operating license was granted. A licensee is required to submit an application for such a change.

CONTAMINATION: The deposition of unwanted radioactive material on the surfaces of structures, areas, objects, or personnel.

DECOMMISSION: Safely removing a facility from reducing residual radioactivity to a level that permits the release of the property for unrestricted and, under certain conditions, restricted use.

DECON: A method of decommissioning in which the equipment, structures, and portions of a facility and site containing radioactive contaminants are removed or decontaminated to a level that permits the property to be released for unrestricted use shortly after cessation of operations.

DECONTAMINATION: The reduction or removal of contaminated radioactive material from a structure, area, object, or person.

ENTOMB: A method of decommissioning in which radioactive contaminants are encased in a structurally long-lived material, such as concrete. The entombment structure is appropriately maintained, and continued surveillance is carried out, until the radioactivity decays to a level permitting unrestricted release of the property.

ECONOMIC SIMPLIFIED BOILING WATER REACTOR (ESBWR): A nuclear reactor that has a passive safety features and uses natural circulation with no recirculation pumps or associated piping.

FISCAL YEAR: The 12-month period, from October 1 through September 30, used by the Federal Government in budget formulation and execution. The fiscal year is designated by the calendar year in which it ends.

FUEL CYCLE: The series of steps involved in supplying fuel for nuclear power reactors.

FULL-TIME EQUIVALENT: A measurement equal to one staff person working a full-time work schedule for 1 year.

GENERATION (Gross): The total amount of electric energy produced by a generating station as measured at the generator terminals. Measured in watthours except as noted otherwise.

GENERATION (Net): The gross amount of electric energy produced minus the electric energy consumed at a generating station for station use. Measured in watthours except as noted otherwise.

GIGAWATT: One billion watts.

GIGAWATTHOUR: One billion watthours.

HIGH-LEVEL WASTE: High-level radioactive waste (HLW) means (1) irradiated (spent) reactor fuel; (2) liquid waste resulting from the operation of the first cycle solvent extraction system, and the concentrated wastes from subsequent extraction cycles, in a facility for reprocessing irradiated reactor fuel; and (3) solids into which such liquid wastes have been converted. HLW is primarily in the form of spent fuel discharged from commercial nuclear power reactors. It also includes some reprocessed HLW from defense activities and a small quantity of reprocessed commercial HLW.

KILOWATT (KW): One thousand watts.

LOW-LEVEL WASTE: Low-level radioactive waste (LLW) is a general term for a wide range of wastes. Industries; hospitals and medical, educational, or research institutions; private or Government laboratories; and nuclear fuel cycle facilities (e.g., nuclear power reactors and fuel fabrication plants) using radioactive materials generate low-level wastes as part of their normal operations. These wastes are generated in many physical and chemical forms and levels of contamination.

MAXIMUM DEPENDABLE CAPACITY (Gross): Dependable main-unit gross capacity, winter or summer, whichever is smaller. The dependable capacity varies because the unit efficiency varies during the year because of temperature variations in cooling water. It is the gross electrical output as measured at the output terminals of the turbine generator during the most restrictive seasonal conditions (usually summer). Measured in watts except as noted otherwise.

MAXIMUM DEPENDABLE CAPACITY (Net): Gross maximum dependable capacity minus the normal station service loads. Measured in watts except as noted otherwise.

MEGAWATT (MW): One million watts.

MEGAWATTHOUR (MWh): One million watthours.

METRIC TON: Approximately 2,200 pounds.

NET SUMMER CAPABILITY: The steady hourly output that generating equipment is expected to supply to system load exclusive of auxiliary power, as demonstrated by tests at the time of summer peak demand. Measured in watts except as noted otherwise.

NONPOWER REACTOR: A nuclear reactor used for research, training, and test purposes and for the production of radioisotopes for medical and industrial uses.

POSSESSION-ONLY LICENSE: A form of license that allows possession but not operation.

PRESSURIZED-WATER REACTOR (PWR): A nuclear reactor in which heat is transferred from the core to a heat exchanger via water kept under high pressure without boiling the water.
PRODUCTION EXPENSE: Production expenses are a component of generation expenses and include costs associated with operation, maintenance, and fuel.

RADIOACTIVITY: The rate at which radioactive material emits radiation. Measured in units of becquerels or disintegrations per second.

SAFSTOR: A method of decommissioning in which the nuclear facility is placed and maintained in such condition that the nuclear facility can be safely stored and subsequently decontaminated (deferred decontamination) to levels that permit release for unrestricted use.

SPENT NUCLEAR FUEL: Fuel that has been removed from a nuclear reactor because it can no longer sustain power production for economic or other reasons.

URANIUM FUEL FABRICATION FACILITY: A facility that (1) manufactures reactor fuel containing uranium for any of the following: (i) preparation of fuel materials; (ii) formation of fuel materials into desired shapes; (iii) application of protective cladding; (iv) recovery of scrap material; and (v) storage associated with such operations; or (2) conducts research and development activities.

URANIUM HEXAFLUORIDE PRODUCTION FACILITY: A facility that receives natural uranium in the form of ore concentrate and converts it into uranium hexafluoride (UF_6).

VIABILITY ASSESSMENT: A DOE decisionmaking process to judge the prospects for geologic disposal of high-level radioactive wastes at Yucca Mountain based on (1) specific design work on the critical elements of the repository and waste package, (2) a total system performance assessment that will describe the probable behavior of the repository, (3) a plan and cost estimate for the work required to complete a license application, and (4) an estimate of the costs to construct and operate the repository.

WATT: An electrical unit of power, the rate of energy transfer equivalent to 1 ampere flowing under a pressure of 1 volt at unity power factor.

WATTHOUR: An electrical energy unit of measure equal to 1 watt of power supplied to, or taken from, an electrical circuit steadily for 1 hour.

WHEELING SERVICE: The movement of electricity from one system to another over transmission facilities of intervening systems. Wheeling service contracts can be established between two or more systems.

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