

RENEWED INTEREST IN NUCLEAR POWER GENERATION

by
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There is renewed interest in nuclear power generation resulting from increased demand for electricity, global warming, and concerns over the security of our current energy supply from foreign sources. Our nation's need for safe, clean and economical electricity generation grows every year.

Most electricity in the U. S. is generated by burning fossil fuels and has carbon dioxide as a waste product. Nuclear power is generated using the heat given off during nuclear fission.¹ Uranium, the fuel for nuclear generation, is abundant in North America. The waste products of nuclear power generation are spent fuels, other radioactive waste, and heat, but not carbon dioxide. There are 104 licensed nuclear reactors in the U.S. (Figure 1).² About 20% of the electricity produced in the U.S. comes from nuclear generation. In Louisiana, about 8% of the electricity is produced from nuclear generation.

The two types of reactors currently operating in the U.S. are boiling water reactors and pressurized-water reactors.³ In the boiling water reactor, water is allowed to boil in the core, thus generating steam directly in the reactor vessel. The steam is the driving force for the turbine generator. The pressurized-water reactor uses water at very high pressure in a primary circuit and steam is formed in a secondary circuit, which is isolated from direct contact with the reactor core.⁴

Nuclear generation has been used in the U.S. for over 30 years and during that time there have been efficiency improvements such that the capacity factor for nuclear power plants has increased from 60% to 90% (Figure 2). However, no new reactors have been ordered since the 1970s. Cost overruns and increased regulatory oversight following the Three Mile Island accident were factors in ending construction of new nuclear facilities. The Three Mile Island Nuclear Station, Unit 2 (TMI-2) accident in 1979 was the most serious in U.S. commercial power plant history.⁵ The TMI-2 reactor is shut down and defueled, however, the accident did not kill or injure anyone inside the plant or in the surrounding community. The regulation of the industry increased after the accident and the nuclear industry in the U.S. has had an excellent safety record since then.

Louisiana has two operating nuclear reactors. River Bend Station is owned by Entergy Gulf States Inc. It is a boiling water reactor, manufactured by General Electric (turbine generator manufactured by General Electric) with a 966 megawatt capacity. Waterford 3 is owned by Entergy Louisiana Inc. It is a pressurized water reactor, manufactured by Combustion Engineering (turbine generator manufactured by Westinghouse) with a 1,157 megawatt capacity.

¹ "Energy in a nuclear reactor is derived from a process called nuclear fission, in which a neutron strikes the nucleus of a uranium atom and is absorbed. The absorption of the neutron makes the nucleus unstable, causing it to split into two atoms of lighter elements and release heat and new neutrons. The heat is used to produce electricity, while the neutrons can potentially be absorbed by other atoms of uranium, resulting in more nuclear fissions. This continuing process of fissioning is called a chain reaction. It is sustained because, for every atom of uranium fissioned by a neutron, new neutrons are released to continue the process." Source: Department of Energy (URL: <http://www.eia.doe.gov/neic/infosheets/nuclear.html>, accessed 2/23/2007).

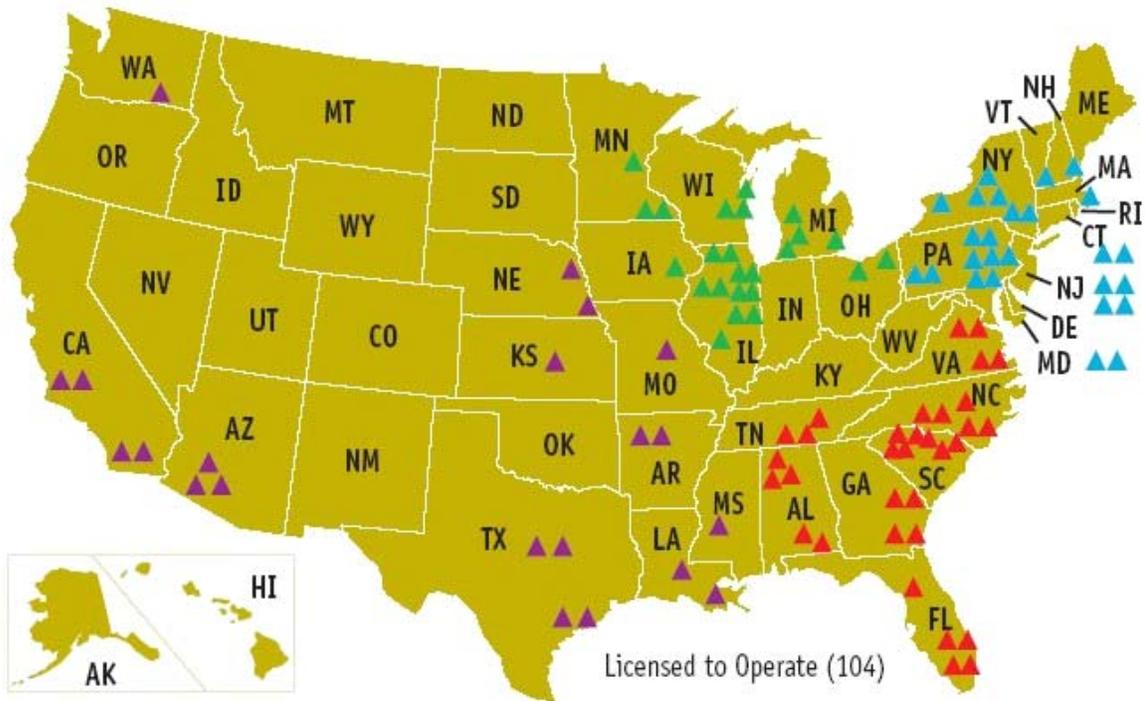
² Brown's Ferry unit 1 reactor has been shut down since 1985.

³ Source: URL: <http://www.world-nuclear.org/info/inf51.html#B>.

⁴ The primary system is the cooling system used to remove energy from the reactor core and transfer that energy either directly or indirectly to the steam turbine. The secondary system is the steam generator tubes, steam turbine, condenser and associated pipes, pumps, and heaters used to convert the heat energy of the reactor coolant system into mechanical energy for electrical generation. Source: Nuclear Regulatory Commission.

⁵ The Chernobyl accident in 1986 in the former Soviet Union was the most severe nuclear reactor accident to occur in any country.

Figure 1. Licensed Nuclear Plants in U.S.



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

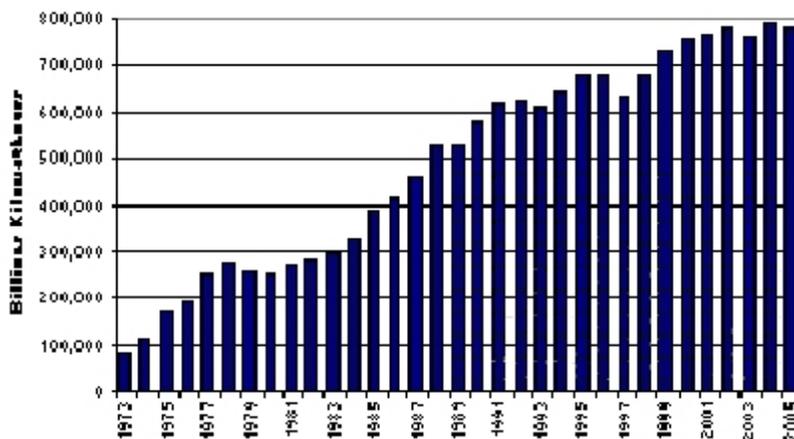
WASHINGTON

- ▲ Columbia Generating Station

Note: Includes Browns Ferry Unit 1, which has no fuel loaded and required Commission approval to restart.

Source: Nuclear Regulatory Commission

Figure 2. Nuclear Generation, 1973 – 2005



Source: Energy Information Administration

Entergy Nuclear, whose parent company, Entergy Corporation (headquartered in New Orleans), is the second largest operator of nuclear power plants in the U.S. Entergy Nuclear operates five reactors at four locations in Arkansas, Mississippi, and Louisiana and five reactors at four sites in Massachusetts, New York, and Vermont, as well as, providing management services to the Cooper Nuclear Station in Nebraska.⁶

It has been decades since the last nuclear plants were constructed; no one really knows what it will cost to build one. In an effort to reduce some of the regulatory uncertainty, and the costs associated with the uncertainty, the Nuclear Regulatory Commission (NRC) established a licensing process that combines a construction permit and an operating license (10 CFR Part 52). The process appears to be sound, but it has not been tested. The new process is designed to resolve regulatory issues before a decision is made to construct the nuclear plant. The old process had only one opportunity for public comment prior to construction. The NRC issued a construction permit based on a preliminary design and did not resolve safety issues until the plant was nearing completion resulting in schedule delays and construction cost overruns.

The new process has three parts:

1. Early site approval (Public Comment Opportunity)
 - Company obtains federal regulatory approval for a new nuclear plant site before committing to construct the plant. The early site permit can be saved for up to 20 years until the company is ready to build.
2. Design certification (Public Comment Opportunity)
 - Design certification resolves all safety issues with the design.
3. Combined license for construction and operation (Public Comment Opportunity)
 - Once the site and the design have been selected, a company can apply for a combined license (to build and operate a nuclear plant) by adding operational and site-specific details.

Entergy is a member of NuStart Energy Development, LLC,⁷ part of the consortium working with the NRC to test the new streamlined nuclear licensing process. NuStart is participating in a 50-50 cost sharing program with the

⁶ Entergy Nuclear, URL: <http://www.entergy-nuclear.com>, accessed 3/6/2007.

Department of Energy (Department of Energy's Nuclear Power 2010 Initiative) to "test" the new combined licensing process. NuStart is pursuing a Construction and Operating License (COL) for a new nuclear unit at Entergy's Grand Gulf Nuclear Station in Mississippi and Tennessee Valley Authority's Bellefonte site in Alabama. No one has committed to build a new reactor site. The Energy Policy Act of 2005, however, includes federal subsidies that will go to the first plants to be built. Cost and nuclear waste are factors which must be addressed before new nuclear reactors will be built. The U.S. Department of Energy plans to store the spent fuel at Yucca Mountain, Nevada (Figure 3). However, there is opposition, and the project has faced delays. Radioactive waste is being stored at reactor sites until a licensed long term repository is designated.

Figure 3. Planned Nuclear Waste Repository



Source: Energy Information Administration

More information on nuclear power generation can be obtained from the following sources:

- Nuclear Regulatory Commission (URL: <http://www.nrc.gov/>)
- World Nuclear Organization (URL: <http://www.world-nuclear.org/info/inf09.html>)
- Energy Information Administration (URL: <http://www.eia.doe.gov/fuelnuclear.html>)
- Secretary of Energy Advisory Board Nuclear Energy Task Force (Draft Report), "[Moving Forward with Nuclear Power: Issues and Key Factors,](http://www.seab.energy.gov/publications/NETF_Final_Draft_0105.pdf)" dated January 10, 2005 (URL: http://www.seab.energy.gov/publications/NETF_Final_Draft_0105.pdf, accessed 3/6/2007)
- NuStart Energy Development, LLC (URL: www.nustartenergy.com)

⁷ NuStart Energy Development, LLC is a limited liability corporation that has nine members (Constellation Energy Group; duke Energy; EDF International North America, Inc.; Entergy Nuclear; Exelon Corporation; FPL Group; Progress Energy; SCANA Corporation; Southern Company). NuStart Energy Development, LLC, the Tennessee Valley Authority (a federal agency) and reactor vendors, GE Energy and Westinghouse Electric Company, LLC form the NuStart Consortium.