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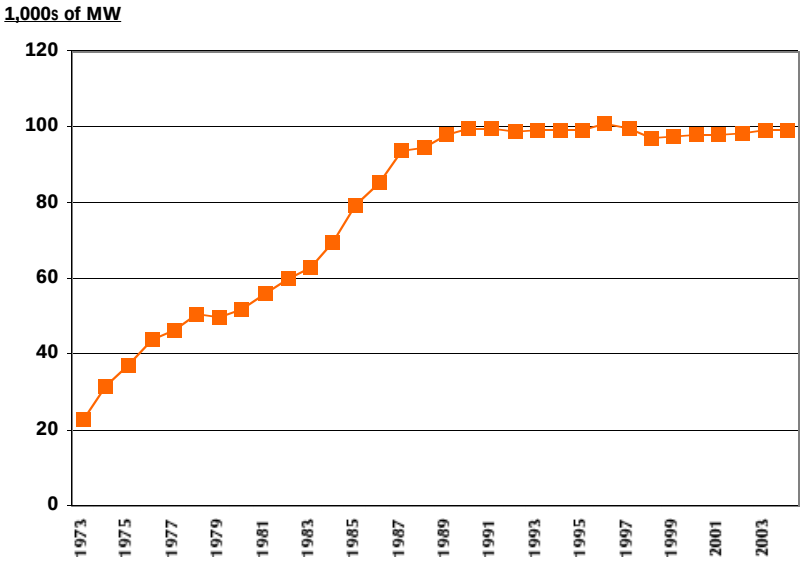
Have the Stars Aligned for New Nukes in the U.S.?

October 20, 2005

The United States currently generates twenty percent of its power from nuclear energy. And with good reason: from a variable cost standpoint this energy is very inexpensive, air emissions are virtually non-existent, operating reliability is increasingly high, and energy companies with a large amount of nuclear generation have been among the industry's most profitable in recent years. Even so, the U.S. has not begun construction of a new nuclear unit since the 1980s and the last unit to be brought on line was TVA's Watts Bar unit nearly a decade ago. Why? The public's negative perception of nuclear power, high capital costs, concerns over waste disposal, and the structure of the partially deregulated electricity industry have created barriers too large for the nuclear industry to overcome. But recent developments suggest that this may be about to change. In fact, expectations are that one or more consortiums will initiate a license filing with the Nuclear Regulatory Commission (NRC) for a new nuclear unit as early as the next year.

U.S. Nuclear Power Capacity



Source: EIA

The History of Nuclear Power

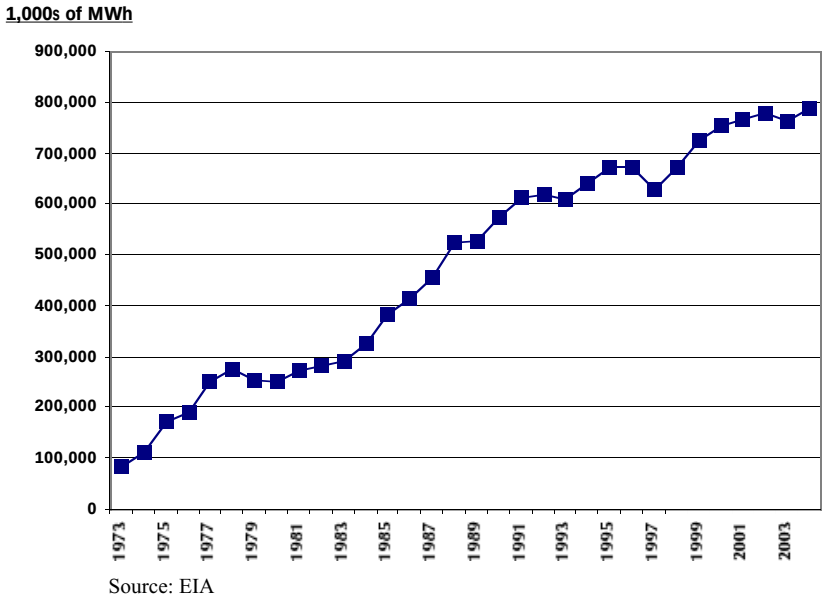
Following the intensive nuclear weapons research and development efforts during WWII, the Atomic Energy Commission (AEC) encouraged use of this nuclear technology for power generation (i.e., using the release of heat from nuclear fission to create steam, which can then be run through a steam generator). A handful of experimental reactors were built in the 1950s with heavy support from the U.S. government. The first wholly commercial generator was a 200 MW unit built by Commonwealth Edison in Illinois which came on line in 1960.

Through the 1960s and 1970s nuclear power was a favored resource for utilities needing new capacity. The size of units steadily increased with later units having typical capacities in the 1,000-1,200 MW range. By 1973 the U.S. had built 22,700 MW of nuclear capacity. This capacity was expanded to 51,800 MW by 1981 and to 99,600 MW by 1990. Unfortunately for ratepayers and utilities, cost overruns, changes in regulation, and extensive outages and expensive repairs resulted in a huge increase in construction costs for nuclear power. As an example, the average cost per kW of nuclear power units finished between 1968 and 1971 was $161/kW. For units finished between 1979 and 1984 average costs rose to $1373/kW and, for at least one unit, over $5000/kW. The subsequent rise in utility rates was just the beginning of nuclear's bad luck. Accidents occurred at Three Mile Island in the U.S. and Chernobyl in the USSR, a number of utilities cancelled partially built units, the Washington Public Power Supply System defaulted on bonds for nuclear power construction, and Public Service of New Hampshire declared bankruptcy due to problems associated with a failed attempt to build a nuclear unit. The future of new nuclear construction appeared dead in the U.S.

But in the 1990s and the 2000s, nuclear power's fortunes took another turn. While no plans emerged for new construction during this time, the existing units

became valuable sources of reliable baseload power. As operating companies gained experience, fewer outages and lower maintenance costs became the norm. And as capital costs were depreciated, nuclear power finally became the low-cost source that had been promised many years ago. Not coincidentally, output from nuclear generation increased from 576,974,000 MWh in 1990 to 788,556,000 MWh by 2004 and the current owners of nuclear generation are some of the most profitable electric companies in the U.S.

U.S. Nuclear Power Output



Source: EIA

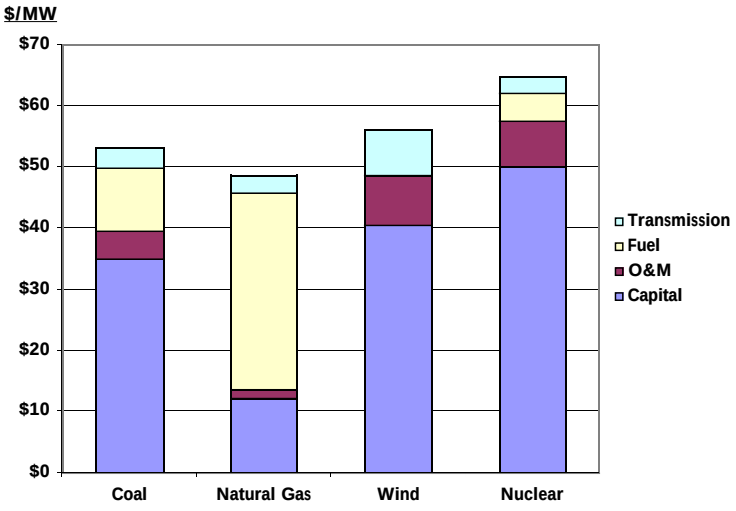
Why the Tide May Be Changing

Heightened concerns about global warming coupled with a three-fold increase in market prices for natural gas have caused many to rethink the nuclear generation conundrum. Although the current U.S. administration does not favor regulation of greenhouse gas emissions, many U.S. states and most of the rest of the developed world are moving forward with regulations that would implement economic penalties for excess emissions. The imminent implementation of these regulations, combined with pressures from investors and environmental groups, has led many energy companies to re-evaluate their current mix of power generation[1]. A few years ago, when world natural gas prices ranged from $2.50 to 4.50/MMBtu, most everyone assumed that greenhouse gas emissions would be reduced by a transition from coal-fired to natural gas-fired generation. But with current world natural gas prices ranging from $6.00 to over $13.00/MMBtu the fuel costs associated with gas generation seem prohibitive. These events have led some industry insiders – and, ironically, even some environmentalists – to call for a new look at nuclear generation. Global perceptions are changing as well. Finland recently began construction on the first nuclear unit to be built in Europe in a decade, China has announced plans to add 30 new units to its existing nine, and new capacity is being built or considered in India, Japan, Taiwan, and South Korea.

Barriers to Nuclear Power

In the U.S., barriers to new nuclear power remain high. There is no approved permanent waste storage for spent fuel (currently, spent fuel is stored on site at nuclear power plants in pools or cement encased dry-cask storage). The proposed permanent nuclear waste repository in Yucca Flats, Nevada, remains mired in political contro-

Long-term Total Cost of New Generation Sources



Estimated costs for year 2010
Source: EIA

[1]See Enerdynamics' May 22, 2005, Energy Insider *A New World of Greenhouse Gas Limits*. http://www.enerdynamics.com/section05/documents/Insider32205.pdf

versy and the Department of Energy has yet to file the necessary application with the Nuclear Regulatory Commission to begin the approval process. Memories of Chernobyl and Three Mile Island have proved difficult to erase, and the public's fear of accidents continues to be an obstacle. And in the post 9/11 world, fears of nuclear security issues also register high in the public psyche. While fuel and operating costs for nuclear units are low, the capital cost associated with a new unit is high – as much as twice that for coal generation and four times that for gas generation (on a $/kW basis). This leads to one of the biggest barriers to new nuclear power – who will finance the two billion dollars estimated necessary to get a unit built?

In the past, units were built on the backs of ratepayers – with lenders confident that regulators would protect generation owners from loss. In today's paradigm of merchant-owned generation units, the risk of building and financing a unit is shifted to shareholders and creditors of merchant generation companies. Risks of cost overruns and technological problems as a new generation of units is designed and constructed, uncertain regulatory oversight and political risk, competition with other generation sources, and the possibility of terrorist strikes make investments in new nuclear units appear risky indeed.

The current U.S. administration is a big supporter of nuclear power and encouraged Congress to fill some of the gaps through provisions in the recently passed Energy Policy Act of 2005. The Act provides a 1.8 cent/kWh production tax credit for generation from new nuclear units, extends government-provided accident liability indemnification to new units, provides insurance against the cost of construction delays due to changes in regulation or lawsuits, and contributes billions of dollars to R&D funding. Some states, including Alabama, Mississippi and Louisiana have also announced state level incentives to encourage new nuclear units.

A Brighter Future?

While still uncertain, the future of nuclear construction in the U.S. is brighter than it's been in decades. The Chairman of the largest owner of nuclear generation in the U.S., Exelon's John W. Rowe recently said Exelon believes in new nuclear construction, but won't go first due to too many uncertainties. Others, however, may be willing to step up. We may soon know if increasing government support and a coalition of large energy companies willing to take a high capital risk in hopes of big returns will be sufficient to overcome the many barriers to new nuclear construction in the U.S.

Nuclear Power Coalitions

Dominion	NuStart	TVA
Dominion Energy	Constellation Energy	Bechtel
Atomic Energy of Canada	Duke Power	General Electric
Bechtel	EDF International North America	Tennessee Valley Authority
Hitachi America	Entergy	Toshiba
	Exelon	USEC
	FPL Group	
	General Electric	
	Progress Energy	
	Southern Company	
	Westinghouse	

Enerdynamics' Washington, DC Seminar Schedule:

The Omni Shoreham Hotel, Washington, CD

- **Natural Gas Business Understanding**
- **Renewable Energy Overview** New Class!
- **Electric Business Understanding**
- **Electric System Fundamentals**

Natural Gas Business Understanding (October 31 and November 1) $1190/$1090 earlybird

This beginning level two-day seminar presents an in-depth overview of the natural gas business from wellhead to burnertip. You will learn how the physical system was designed and delivers gas to end users, the various components of the natural gas value chain, who the key industry participants are and the strategies they use for success, how physical and financial strategies are used to make money and manage risk, how deregulation and technology are dramatically changing the face of the industry, and much more.
More information: http://www.enerdynamics.com/section03/GBU.asp

Renewable Energy Overview (November 1) $695/$595 earlybird

Enerdynamics is proud to present our newest seminar, Renewable Energy Overview. Green power is one of the fastest growing segments of the energy industry. This seminar will provide an in-depth overview of this dynamic and fast-moving industry and is designed for those with limited knowledge of renewable energy. The seminar is highly interactive and stresses participation from all attendees. Topics covered include Introduction to Renewables, Sources of Renewable Energy, Delivery Mechanisms, Key Industry Participants, Value Propositions for Renewables, Regulatory and Governmental Issues, and Market Dynamics and The Future.
More information: http://www.enerdynamics.com/section03/Renewable.asp

Electric Business Understanding (November 2 and 3) $1190/$1090 earlybird

This beginning level two-day seminar presents an in-depth overview of the electric business from generation to end user. You will learn how the electric business operates, who the key players are, how the physical electric system was designed and delivers electricity to end users, who are end users and what are their needs, regulatory structures and rate designs, market design models and how deregulation has dramatically evolved, how physical and financial strategies are used to make money and manage risk, why we've seen such dramatic turmoil in the industry, and much more.
More information: http://www.enerdynamics.com/section03/EBU.asp

Electric System Fundamentals (November 4) $695/$595 earlybird

This beginning level course is designed for those with a limited knowledge of the electrical system and its operation. The course provides a basic overview of common industry jargon and leads participants on a tour of the electrical system from the generator to the customer's outlet. Learn various generation types and their advantages/disadvantages, how the primary and secondary distribution systems are structured, basic laws and principles of electricity, how electricity is delivered and metered at a customer facility, various rate structures covering electricity service, and much more. More information: http://www.enerdynamics.com/section03/ESF2.asp

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