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Nuclear Power: You've Come a Long Way, Baby!

By Charles W. Whitney and Antony L. Sanacory

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Even in the midst of the most severe economic downturn since The Great Depression, the Energy Information Administration (EIA) forecasts an increase in demand for electricity of 14% by 2035.¹ Between 2029 and 2035 nearly a third of all existing nuclear capacity (30.8 gigawatts) will reach 60 years in operation (*i.e.*, the end of their originally anticipated licensing and expected plant lifecycle).² How is the power industry going to meet the need for new power?

Why Nuclear?

A number of developments make nuclear an attractive and favored option for meeting this new energy demand. As crude oil continues to gush into the Gulf of Mexico, even the most vocal anti-nuclear advocates pause and blush. Whether fairly or unfairly, the burning of fossil fuel has been blamed for everything from acid rain to lung ailments to global warming. And the current trends in public policy disfavor additional fossil fuel capacity. As stated in the 2010 EIA forecast:

However, Federal tax incentives, State energy programs, and rising prices for fossil fuels increase the competitiveness of renewable and nuclear capacity. In contrast, uncertainty about future limits on GHG emissions and other possible environmental regulations reduces the competitiveness of coal.^{3 4} These are just the *environmental* concerns that have caused people to give nuclear a second look.

Years of increasing volatility in the cost of natural gas and other fossil fuels make coal and gas fueled electricity increasingly difficult to reliably price and forecast. And after three decades of safe nuclear operations in the United States, safety concerns surrounding nuclear are significantly less than years past. Indeed, current EIA projections actually assume the renewal of all existing nuclear plant licenses past the 60 year life expectancy of a nuclear plant. (Id.). In somewhat of an epic comeback, public optimism in nuclear power as a safe, cost-effective, and clean source of electricity is perhaps as high as it has ever been.

New Approach to Construction and New Technology

Enthusiasm within the industry also is growing because newer technologies are being offered to meet cost and scheduling issues that proved problematic when the last round of nuclear plants were ordered and built in the 1970s and 1980s. Anywhere from 1/3 to as much as 1/2 the cost of earlier nuclear power plant projects was direct cost of finance during construction. Indeed, the adage "time is money" perhaps never has been proven to be more true than by the nuclear energy industry a few decades ago. Projects were priced on a time and material (T&M) basis and were constructed "design-as-you-go". T&M contracts contain cost reimbursable aspects that put the risk of scope creep, delay and increased costs in materials largely on the owner. Design as you go invited delays when projects were already underway but the constructor was waiting on design information (sometimes driven by regulatory change) while attempting to sequence work and construct plant components on-site. The cruel and relentless effects of time and financing costs were exaggerated in an already pricey and lengthy nuclear construction process.

Recent improvements in how nuclear plants are constructed creates an opportunity for nuclear to demonstrate itself as a favorable alternative to past nuclear projects and existing non-nuclear power generation technologies. Several major contractors are offering design complete, Engineering Procurement Construction (EPC) contracting, using a modular construction method. EPC contracting puts a greater portion of project control (and risk) with the constructor. For the owner, this means a better understanding of actual project costs and that the EPC contractor will have a greater financial incentive for finishing the project on-time and on-budget. Modular construction is done off-site and plant components such as HVAC or electric services are then "snapped together" on-site. This allows for certain plant components to be built out of the way of other construction activities, in parallel with other construction activities (rather than sequentially), and under conditions that may be better suited for quality control than the construction site itself.

Energy Policy Act of 2005 and New Permitting Process

Even the Federal Government, through the Energy Policy Act of 2005 and the Nuclear Regulatory Commission (NRC)'s new permitting procedures, is doing its part to make new nuclear power more feasible. The Act provides a number of incentives for nuclear research, as well as loan guarantees for new projects, tax incentives for new nuclear capacity and funding for cost-overrun and construction delay support. Specifically, the Act contains the following incentives for new nuclear power construction:

1. A number of provisions in the Act authorize in the aggregate nearly \$3 billion in new research into issues such as new plant design for Generation IV reactors, new reprocessing technologies, promotion of promising technologies, the building of an advanced hydrogen cogeneration reactor at Idaho National Laboratory, and training for individuals in nuclear industry;
2. Section 638 of the Act authorizes the Secretary of Energy to enter contracts for 'standby support' of up to \$2 billion for construction delays for up to six new nuclear power plants. "Covered delays include the failure of the NRC to comply with schedules for review and approval of inspections or the conduct of hearings, in addition to litigation that delays full-power operation."⁵;
3. Section 1306 of the Act allows the Secretary of Treasury (in consultation with the Secretary of Energy) to authorize a tax credit of 1.8 cents per kilowatt-hour to advanced nuclear power facilities for the first eight years the plant is in service; and
4. Title 18 of the Act authorizes the Secretary of Energy to provide loan guarantees for clean air projects such as nuclear of up to 80% of project cost to be repaid within 30 years or 90% of the project's life.

The new permitting process by the NRC may also make new nuclear more approachable for the owner. The objective of the new permitting procedures is to remove some of the uncertainty of past nuclear construction projects by front-loading the permitting process before the NRC. Permitting is done in three steps:

1. Design certification process;
2. Early site permitting; and
3. Combined construction and operating licensing.

The new permitting process combines licensing procedures that previously were treated separately and, importantly, and provides sufficient opportunity for public comment at the beginning of the permitting process, as opposed to after construction. Under this new process, all licensing and permitting is effectively complete before ground is broken⁶ whereas under the previous permitting structure licensing proceedings, only a construction license would issue pre-construction and

operating license hearings (with the opportunity for public comment) occurred post-construction.⁷ Delays in operating licenses proved enormously costly the last time around.

The first step in permitting — design certification — takes a considerable degree of uncertainty out of permitting and plant design. Design certification means that generic reactors go through an approval process with the NRC irrespective of a particular site. According to the NRC website, there currently are four certified reactor designs:

1. Advanced Boiling Water Reactor design by GE Nuclear Energy (May 1997);
2. System 80+ design by Westinghouse (formerly ABB-Combustion Engineering) (May 1997);
3. AP600 design by Westinghouse (December 1999); and
4. AP1000 design (pictured at left) by Westinghouse (January 2006).⁸

During the second step of the NRC's new early permitting — early site permitting (ESP) — the NRC considers issues specific to the proposed site, either concurrently with or independent of an application for construction and operating licensing. Site safety issues, environmental protection issues, and emergency planning are evaluated independent of the review of a specific nuclear plant design. All stakeholders, including the public, are permitted to participate in this phase of permitting.

The third step of the NRC's new early permitting — combined construction and operating licensing (COL) — is perhaps the most dramatic change to the prior permitting process. Issues such as the applicant's qualifications, specific design safety, environmental impacts, operational programs, site safety, and verification of construction with the NRC's Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) are addressed pre-construction. Thus, COL results in approval of a sufficiently detailed plant design and issuance of construction and operation licenses before the plant is even built. Again, all stakeholders, including the public, are permitted to participate in this phase of permitting.

The combined effect of the new permitting process is detailed design pre-construction, complete and expeditious permitting pre-construction, a significantly higher degree of certainty that permission to operate will be obtained, and a considerable reduction in finance costs. Of course, adequate safety measures are preserved; post-construction ITAAC verification is performed and, if appropriate, a hearing may be held on ITAAC compliance.

Recapping Why We're Better Off Today...

Industry Developments	Why We're Better Off
Target Pricing EPC Contracting	<ul style="list-style-type: none">• Certain risks of cost escalation borne by the EPC Contractor.• Incentives for early completion = less direct finance cost.
Modular Construction	<ul style="list-style-type: none">• Reduced field manpower and expedited schedule because shop fabrication is done off-site and in parallel with (not sequential to) other construction activities.

Energy Policy Act of 2005

- Improved quality because off-site conditions typically are more conducive to quality control measures than construction site.
- Newer more efficient designs promise reduction in materials and components.
 - High degree of design completion before ground is broken.
- The Federal Government shares in certain risks of delay, including those associated with permitting process.
 - Federal Loan Guarantees make financing more obtainable.
 - Tax credits enhance financial viability of new nuclear projects.

New Licensing Procedures

- Pre-approved reactors and pre-construction review of design documents promotes certainty and early completion of design documents.
- Considerable reduction in permitting delay due to comprehensive pre-construction permitting process.
- Considerable reduction in uncertainty that constructed plant will not be permitted permitting process completed pre-construction.
- Post-construction inspections and hearings preserves quality and safety standards.

Still Enormous Risk for The Owner

Even with the considerable strides made since the last round of nuclear construction, the risks for the nuclear project owner still are enormous. Cost estimates for planned large nuclear power plants range from \$5 billion to as high as \$9 billion, depending on the particular project. There is just no way to make an investment of that proportion and be able to contract away all risk.

Moreover, even with vast improvements in design, technology, and construction, estimates are that the permitting, construction and commissioning of a nuclear plant will still take eight to ten years. While that is a significant improvement from years past, still, a lot can happen in eight to ten years that might affect the viability of the project. The owner, not the EPC contractor, typically owns the risk in material and labor cost increases. And obviously, the contracting process precedes construction and even permitting in some instances, and the owner is on the hook and pays deposits on major and long lead time components. But even with all of these remaining risks, nuclear power has come a long way... just how far, we'll know soon enough.

Footnotes

1. AEO2010, Executive Summary
2. AEO2010, "U.S. Nuclear Power Plants: Continued Life or Replacement After 60?"
3. AEO2010, Market Trends

4. We note also that the EPA recently issued a proposed rule change related to boiler emissions, which might undermine the viability of pending and future biomass projects. (Federal Register, Vol. 75, No. 107).
5. DOE | New Plant Incentives within the Energy Policy Act of 2005 (EPACT 2005)
6. 10 C.F.R. 52
7. 10 C.F.R. 50
8. NRC | Backgrounder on New Nuclear Plant Designs

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