REDUCING REGULATORY AND ECONOMIC UNCERTAINTY IN THE NEXT GENERATION OF U.S. NUCLEAR POWER PLANTS

Ronald L. Simard, Russell J. Bell
Nuclear Energy Institute, U.S.A.

This year marks the 25th anniversary of the 1973 Arab oil embargo, an event that shaped today's national energy policy for the United States and the world. At that time, some 20 percent of U.S. electricity supply came from oil fired power plants, and in some regions, such as the Northeast, the percentage was even higher.

A few years later, during the unusually harsh winter of 1976-1977, acute shortages of natural gas caused widespread economic disruptions. Obtaining natural gas for power plants became impossible. In fact, a year later, the U.S. Congress passed legislation prohibiting the use of natural gas in new power plants.

For the U.S. electricity industry, the lesson of the 1970's was the critical importance of fuel diversity, and the risks of excessive reliance on any one fuel source. The industry responded by adjusting its energy supply portfolio—reducing dependence on oil-fired power plants from 20 percent of supply in 1973 to just three percent today—and increasing use of coal and nuclear energy. Nuclear power plants have accounted for 40 percent of all new electricity supply in the past 25 years, and today account for some 15 percent of installed capacity, but some 20 percent of electricity generated in the United States annually. Nuclear energy and coal fired plants together account for approximately three quarters of the current electricity supply.

In addition to assuring reliability and diversity of energy supply, U.S. nuclear plants proved their value in another critical area of the national energy policy—managing environmental impacts. Since 1973, the use of nuclear energy in lieu of fossil fuels has prevented the emission of more than 2 billion tons of carbon in the form of carbon dioxide, 80 million tons of sulfur dioxide and 35 million tons of nitrogen oxides.

Now looking ahead to the next 25 years, the challenge is to maintain reliability of energy supply, while meeting increasingly urgent needs to minimize environmental impacts from the electricity sector. Fossil fired power plants face increasing regulatory requirements and constraints on emissions, including:

- emission limitations and new ambient air quality standards under Title I of the Clean Air Act;
- acid rain controls mandated by Title IV of the Clean Air Act;
- possible restrictions on carbon dioxide stemming from the U.S. commitment at the December 1997 Kyoto conference to cut carbon emissions by seven percent below 1990 levels in the next decade.

The response to the challenges of the future must include aggressive development of renewable energy sources and increased reliance on nuclear energy—the only non-emitting sources of electricity available for deployment in the near term.

But if "past is prologue," a new nuclear plant order in the United States seems unlikely. The reasons for this are clear, and both the U.S. nuclear industry and Federal government have put a high priority on fixing the past problems that led to spiraling costs and loss of public confidence during construction of the current fleet of plants.

The primary conditions that will restore operator, investor, and public confidence in the next generation of U.S. nuclear energy plants are:

- assurance that future designs have high safety margins and are cost competitive with other baseload generating options;
- assurance that cost and schedule estimates will be met;
- assurance of safe, reliable performance and competitive operating costs over the plant life;
- thoroughly addressing public concerns with design safety, site suitability, and protection of the public from radiological hazards, and;
- a stable and predictable regulatory framework.

An additional, overarching condition is the continued excellent safety record of the existing fleet of plants. The major policy initiatives that will create these essential conditions for new U.S. nuclear plant orders are described in *A Strategic Plan for Nuclear Energy in the 21st Century.*[1]

They include:

- rigorous technical reviews and Nuclear Regulatory Commission certification of standardized, advanced designs;
- close collaboration between the advanced plant designers and the utility operators who have specified the cost targets and detailed design and operational requirements for future designs;
- ensuring predictability of costs and schedules through standardization of design, construction, and operating practices, as well as through experience gained from overseas construction of advanced reactor designs;
- developing a new regulatory framework to ensure meaningful public participation in the licensing process;
- developing clear guidance for future regulators and licensees on implementing the reformed licensing process for future plants;
- developing a new regulatory framework for licensing and plant operations that reflects the enhanced safety margins and commitment to life cycle standardization of the advanced plant designs;
- implementing the elements of the new regulatory framework and licensing process in way that reassures potential future operators, investors, and the public.

The progress to date toward creating those conditions is thoroughly documented in *The U.S. Nuclear Energy Industry's Strategic Plan for Building New Nuclear Power Plants.*[2] Two main elements of the plan are (1) maximizing safety and cost competitiveness through extensive standardization of design, construction, and operating practices across a fleet of like plants; and (2) a reformed licensing process that meets both the licensee's needs for predictability and the public's needs for meaningful involvement in the design, siting, construction and operation of new plants.

THE BENEFITS OF STANDARDIZATION

The next generation of U.S. nuclear energy plants will be standardized to an unprecedented extent. First, there are three standardized, advanced plant designs that have been based on detailed owner/operator specifications[3] covering all areas of design and construction, and many aspects of operation and maintenance. This is a major step because it represents the consensus of future customers on design features that improve plant safety, simplicity and economics.

Second, a new process of design certification is a key part of the new Nuclear Regulatory Commission (NRC) licensing process described below. Building upon the owner/operator specifications and incorporating the lessons learned from 40 years of nuclear plant design and operation in the U.S. and abroad, plant designers have submitted detailed design information to the NRC for thorough review and a certification of high safety levels. Once this certification has been awarded, the new NRC licensing process imposes high barriers and regulatory controls for any proposed design changes affecting those high safety levels or the approved standard design.

Third, building upon the design specifications and details locked in by NRC certification, additional engineering will bring the entire plant design to sufficient completion to provide a dependable cost and construction schedule estimate. At this point, some 80 percent of the design details will be complete, leaving only site- specific engineering to be done by a potential customer. This is in stark contrast to past practices, when major design changes were made as the plant was being built, extending construction schedules and raising costs. Potential customers will have the additional assurance of seeing these designs already built and in operation overseas, for example, at Kashiwazaki in Japan and Lungmen in Taiwan.

Finally, standardization will be extended throughout the life cycle of a fleet of like plants. Standardized procedures will be used in areas such as operations, maintenance, training, and work control. A framework will be developed for an organizational entity to oversee maintenance of life cycle standardization across the fleet of like plants. This commitment will help realize the full benefits of standardization in maintaining high levels of safety, simplicity of operation, and cost competitiveness of future U.S. nuclear energy plants.

THE REFORMED LICENSING PROCESS

This unprecedented level of standardization will not be enough, however, to create the conditions for future U.S. nuclear plant orders. Another main element of the strategy for the next century is the development of a new regulatory framework that

- provides potential customers and investors with a predictable licensing process that resolves safety and siting issues before a substantial investment, and;
- thoroughly addresses any public concerns with design safety, site suitability, and adequacy of defense-in-depth, such as radiological emergency preparedness planning.

The current U.S. nuclear energy plants were licensed by the NRC, under the Code of Federal Regulations, under a regulation known as 10 CFR Part 50. In a two stage process, a construction permit was issued, and construction began, even as the plant design was evolving and new regulatory requirements were being issued. Under these circumstances, construction costs and schedule estimates were often exceeded. In the second stage, another round of technical reviews and public hearings were conducted before a plant was issued a license to operate. Because the plant was essentially complete, significant issues raised at this point concerning the site or design could be very difficult and expensive to address.

A more common—and frustrating—problem was that the old process lacked clear criteria to distinguish between significant safety issues and concerns that were insubstantial or unrelated to safe plant operations. Thus, needless and costly delays were often caused by issues that need not or should not have affected plant start-up and operation. Issues such as these were often raised by third parties who had learned to use the existing regulations and the courts to frustrate the licensing process and prevent a new plant from operating.

This process served neither utilities nor the public well. Because relatively little information was available at the construction permit stage, the first public hearing was often too early to be meaningful. Because the public hearing at the operating license stage was held when the plant was essentially complete and ready for operation, design changes were difficult to make.

In contrast, future U.S. nuclear energy plants will be licensed under a new regulation known as 10 CFR Part 52, that was issued by the NRC in 1989, and affirmed by the U.S. Congress in the 1992 Energy Policy Act.[4] The new process gives operators, investors, and the American public the necessary confidence that nuclear energy will remain a safe and reliable part of the national energy mix. **Figure 1** shows how the new process assures that design and siting issues will be resolved, even before a decision to proceed with a plant order.

The new process offers four major improvements over the previous licensing process. First, design certification assures a thorough technical review and NRC approval of the design. It documents the safety findings and, importantly, imposes a high threshold against proposed changes to that design over time, either by NRC regulation, or by the industry. Second, early site permitting allows for a similar Federal pre-approval of a nuclear plant site, again resolving siting concerns well in advance of a proposal to build a plant on that site. Third, a combined construction permit and operating license is issued before construction begins that reflects resolution of all design, site, operation and environmental issues and establishes the specific tests, inspections, analyses and acceptance criteria that will be used later to verify that the completed plant conforms to its license requirements.

Finally, public involvement is enhanced in this new, multistage process by allowing opportunities for timely hearings and resolution of safety concerns at every stage, as shown in **Figure 2**.

As the U.S. nuclear energy industry prepares for the challenges of the 21st Century, a major goal is completion of the policy initiatives, outlined above, that will restore operator, investor, and public confidence that nuclear energy remains a safe, environmentally responsible and cost competitive generating option, as well as an essential part of the U.S. energy supply mix.

REFERENCES

1. *Nuclear Energy: 2000 and Beyond - A Strategic Plan for Nuclear Energy in the 21st Century*, Nuclear Energy Institute, May 1998.
2. *The U.S. Nuclear Energy Industry's Strategic Plan for Building New Nuclear Power Plants*, seventh annual update, Nuclear Energy Institute, May 1998.
3. *Advanced Light Water Reactor Utility Requirements Document*, Electric Power Research Institute, December 1995.
4. Energy Policy Act of 1992, PL: 102-486

Fig.1

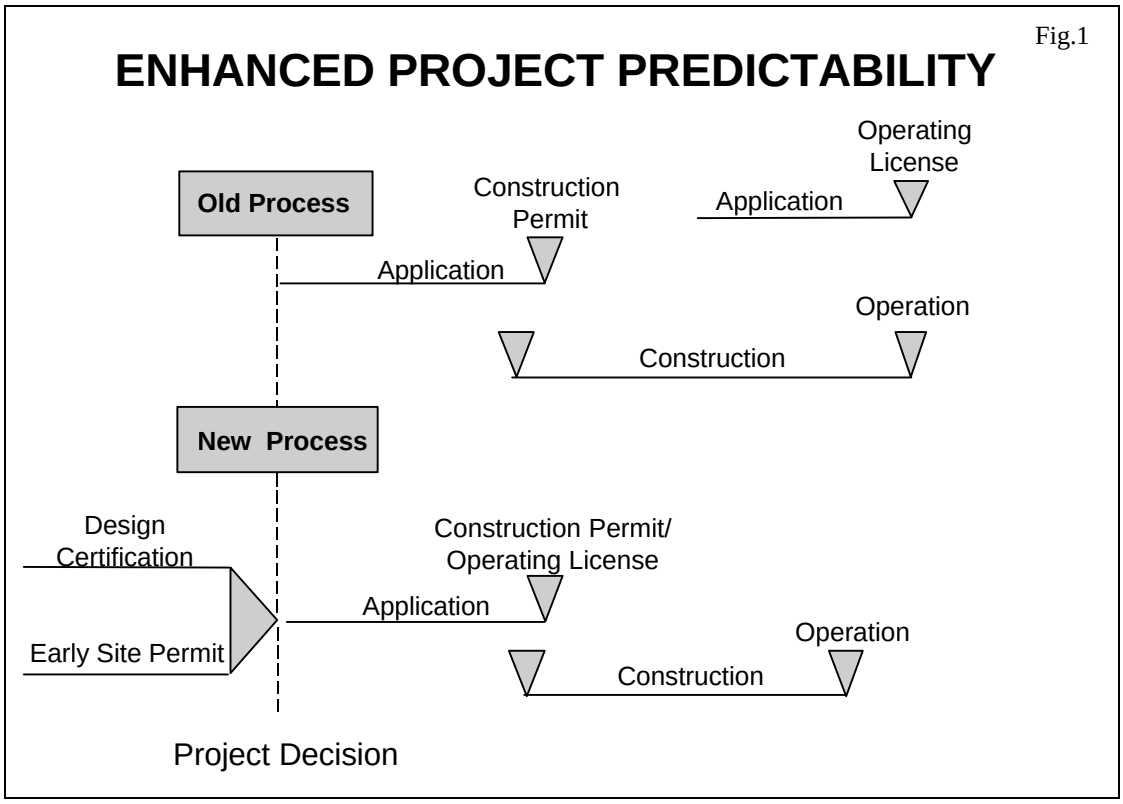
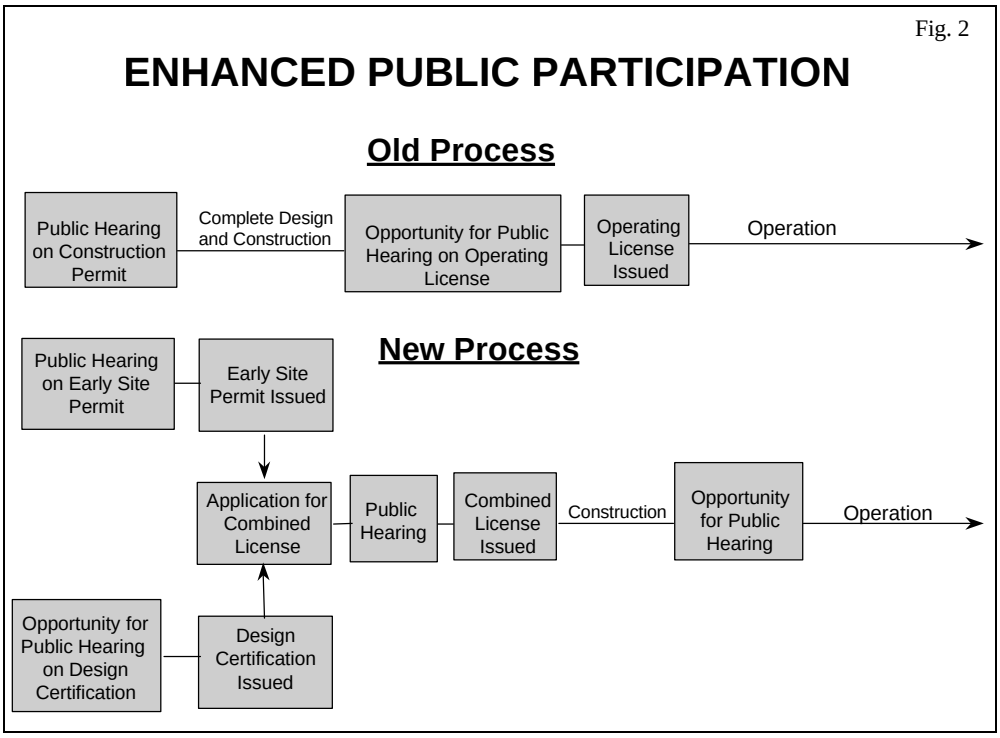

ENHANCED PROJECT PREDICTABILITY
Old Process
Construction Permit
Application
Operating License
Application
Operation
Construction
New Process
Design Certification
Early Site Permit
Construction Permit/ Operating License
Application
Operation
Construction
Project Decision

Fig. 2


ENHANCED PUBLIC PARTICIPATION
Old Process
Public Hearing on Construction Permit
Complete Design and Construction
Opportunity for Public Hearing on Operating License
Operating License Issued
Operation
New Process
Public Hearing on Early Site Permit
Early Site Permit Issued
Application for Combined License
Public Hearing
Combined License Issued
Construction
Opportunity for Public Hearing
Operation
Opportunity for Public Hearing on Design Certification
Design Certification Issued