Time for Next-Generation Nuclear Plants in U.S.A.

Other nations are forging ahead, while the U.S. budget for nuclear R&D is only 11% of what it was in 1980! What's needed is a crash program, as Marsha Freeman reports.

While dozens of nations start building their first nuclear power plants, a parallel effort is under way to deploy more advanced, next-generation nuclear technology to supplement, and then replace, today's light-water fission reactors. The United States is decades behind in this effort, upon which future economic survival depends. While there is an acknowledged lack of skilled manpower, and industrial infrastructure, the greatest obstacle to moving forward has been the lack of political will.

Next-generation nuclear reactors include an array of technologies. The most immediately necessary, as detailed in the accompanying article, is a family of high-temperature reactors. Through the production of outlet temperatures up to three times that of today's power plants, high-quality heat can be applied to create desperately needed freshwater, through desalination, and the production of synthetic fuels, such as hydrogen.

Efforts in Russia, China, India, Japan, and South Africa to carry out research, build prototypes, and deploy fourth-generation nuclear technologies, are under way. In the United States, although there are small-scale concept development and design activities, there is no plan to *build* anything for more than a decade. How could there be? Adjusted for inflation, the budget for nuclear energy R&D today is *11%* what it was in 1980.

Congress has recently taken a small step to reorient the Bush Administration's nuclear R&D program, which is geared, not toward economic development, but toward "nonproliferation," in order to get the next-generation reactor program moving. A crash effort, with massive infusion of resources, which characterized President Eisenhower's Atoms for Peace program, is what is needed.

In 2002, the Department of Energy started a new program to design and demonstrate a Next-Generation (also referred to as a fourth-generation) Nuclear Plant project. In 2004, the Department approved the development of a full-scale nuclear plant that would be combined with a facility for producing hydrogen. The very-high-temperature reactor was chosen as the power source, to operate at about 950°C, or 1,742°F, nearly three times that of today's commercial nuclear power plants. Recognizing that it was years behind other nations in nuclear R&D, a Generation IV International Forum was initiated by the United States, to "cooperate" with other nations already engaged in advanced nuclear R&D.

But from the beginning, the program had no sense of urgency, too little funding, and a schedule that was determined not by the pace of technical progress, but mainly by the budget-driven strategy of spending smaller amounts of money, over a longer period of time.

The roadmap for a $2.4 billion demonstration program has construction on the very-high-temperature reactor scheduled to begin in 2016, and the plant to be operational by 2021. The Department of Energy proposes commercial introduction by 2030! Even were this a revolutionary new technology, never before engineered, this schedule might appear to be a bit conservative.

But consider the following: The United States operated two higher-temperature gas-cooled reactors in the past—the Peach Bottom Unit One reactor (1969-74), and the Fort St. Vrain reactor (1979-89); Japan and China have operated small high-temperature gas-cooled reactors, demonstrating the feasibility of the concept; and South Africa is building a fuel fabrication facility, and completing the R&D to begin mass producing small, modular, high-temperature gas-cooled reactors, using the pebble bed design, in the next decade.

To make matters worse, in February 2006, President Bush announced his Global Nuclear Energy Partnership (GNEP). This program is a *25-year* effort to engage other nuclear-

Idaho National Laboratory

This artist's rendition of the Next Generation Nuclear Plant is reminiscent of the 1960s designs done at Oak Ridge National Laboratory for nuplexes, or Nuclear-Centered Agro-Industrial Comlexes. The high-temperature reactor will be used to produce electricity, and high-quality heat for the production of synthetic fuels, such as hydrogen, and for process heat applications in industry.

energy nations to develop "proliferation-proof" nuclear designs. The purpose of the program is to limit access by the new nuclear energy nations to the full nuclear fuel cycle, including uranium enrichment to produce fuel, and reprocessing of spent fuel. When GNEP became the Administration's focus, the Next-Generation Nuclear Reactor became a lower priority.

Concerned that this next-generation nuclear program was floundering, Rep. Darrell Issa (D-Calif.), chairman of the Subcommittee on Energy and Resources of the Government Reform Committee, asked the General Accountability Office (GAO) to examine the progress of the program.

Moving Forward, Faster

In its September 2006 report, "Status of DOE's Effort to Develop the Next Generation Nuclear Plant," the GAO reviewed the progress made, and the recommendations by two independent advisory groups. A group of experts gathered by Idaho National Laboratory, where the next-generation reactor will be built, and the DOE's Nuclear Energy Research Advisory Committee (NERAC), both recommended that the DOE accelerate its schedule for completing the plant. As the GAO notes, what good will an "even more advanced" reactor be in 2030, when other countries already have high-temperature systems for sale?

The Idaho group suggested that three years could be trimmed off the schedule, by scaling back some of the technology advances planned for the project, and taking a more incremental approach. The reactor could be designed to incorporate more advanced fuels and materials as they are developed, rather than waiting for the "best" to be ready before building anything.

NERAC pointed out that accelerating the schedule will make the project more "attractive to industry," which is supposed to pay a share of its development. In testimony before the Senate Committee on Energy and Natural Resources on June 12, 2006, NERAC member Dr. Douglas Chapin stated that a "completion date of 2021 greatly decreases the chances of substantial industry and international contributions." NERAC recommended that a reactor facility "that can be built soon, to gain experience, and then upgraded as the technology advances," would be preferable. It could be a "technology demonstrator," and a smaller machine.

As it now stands, the very-high-temperature reactor needed to meet the DOE's design criteria would require a pressure vessel, which houses the nuclear reactor core, more than twice the size of that of a conventional nuclear power plant. There is only one company, Japan Steel, that could even scale up production to manufacture such a vessel, the GAO notes.

In Senate testimony on June 12, 2006, Dr. Regis Matzie, senior vice president of Westinghouse, stressed that the U.S. program could also be accelerated by leveraging the large-scale testing facilities developed in South Africa, enabling the progam here to be "demonstrated within a ten-year period."

The GAO states that in addition to the efforts in China, South Africa, and Japan, the General Atomics company in the United States, and the French nuclear giant Areva, are advancing their own designs. General Atomics has started activities with the Nuclear Regulatory Commission (NRC), that could lead to an application for design certification, and has a research reactor design that could lead to a commercial prototype.

South Africa's Eskom, in partnership with Westinghouse, has also started pre-design-certification activities with the NRC. If the U.S. program stays on its current track, one or both of these fourth-generation nuclear reactors could be on sale to U.S. utilities, years before the U.S. demonstration reactor is up and running.

The Idaho National Lab group estimated that completing the plant three years earlier would reduce the total cost, but would require more funding in the near term. In FY2007, the Lab states, funding for design work would need to be increased from $23 million, the Administration request submitted to Congress, to $100 million. DOE's response was that although the current design work "could support doubling the department's FY07 request of $23 million ... DOE has limited funding for nuclear energy R&D and has given other projects ... priority over the Next Generation Nuclear Plant."

Congress was not satisifed with this response.

In a June 11, 2007 report on the FY2008 Department of Energy budget, the House Committee on Appropriations states that its bill includes an increase to $70 million for the Next-Generation program. The money for the increase was taken from the ill-conceived GNEP program. The Committee directed the Department of Energy to make the Next-Generation program a higher priority than GNEP.

Highest priority and sufficent resources would put the next-generation nuclear reactor on the right pathway.