

**(GE's FAST REACTOR AS PROPOSED FOR THE GNEP
PROGRAM)**

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Prepared Testimony
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Mr. Chairman, Senator Reid, and Members of the Committee, it is a pleasure to be here today to discuss General Electric Company's potential contribution to the Global Nuclear Energy Partnership (GNEP) program with the Power Reactor Innovative Small Module or "PRISM" reactor technology. In my previous role as GE's General Manager of Nuclear Technology, I had the opportunity to establish the foundation for utilizing this fast reactor technology. My testimony will provide a detailed summary of this technology and its potential role in meeting the objectives of the GNEP program.

This is a significant period for our country as we advance into a possible nuclear energy renaissance. GE supports the GNEP concept and is very interested in working with this Committee and the Department of Energy to realize the goals of GNEP. In so doing, we can make real and significant contributions to U.S. and international energy security needs. GE is especially interested in GNEP because it provides the policy framework for solving two of the more serious challenges impacting the nuclear industry today: waste and proliferation. The Advanced Recycling Center concept put forth in our response to the Department of Energy's request for Expressions of Interest for the Advanced Burner Reactor (ABR) and the Consolidated Fuel Treatment Center (CFTC) proposes our solution-based approach.

The Department of Energy has developed a broad implementation strategy for GNEP comprised of seven key elements. GE sees these elements grouped into two broad categories: technical and programmatic.

GNEP Technical Elements:

- Demonstrate proliferation-resistant recycling
- Develop advanced burner reactors
- Demonstrate small-scale reactors
- Minimize nuclear waste

GNEP Programmatic Elements:

- Expand the use of nuclear power
- Develop enhanced nuclear safeguards
- Establish reliable fuel services

While demonstration of proliferation-resistant fuel recycling is the crux of GNEP, we believe the first three technical elements can be best accomplished through a partnership between private industry and the government. The fourth follows with success in advancing the fuel cycle and ABR deployment. Accomplishment of the GNEP technical elements will "pull" the programmatic elements to success.

I have been asked to focus my remarks on the advanced reactor GE has developed – PRISM. That PRISM technology directly supports two key technical elements critical to GNEP success:

- Demonstrate an advanced burner reactor, and
- Demonstrate a small-scale reactor.

The PRISM can provide the energy to generate electricity while "burning" spent fuel from our nation's 103 operating light water reactors (LWR) as well as future LWRs. Because of its relative small size and its inherently safe encapsulated design, PRISM can be factory built and transported to the site.

To assist the Committee in fully understanding this technology, my testimony will cover three areas:

- A historical overview of the origins of PRISM;
- The PRISM technology itself, developed with the support of funding provided by the Committee; and,
- A PRISM (or SuperPRISM) deployment roadmap for the Committee's consideration.

Historical Overview

A preliminary safety information document referencing the PRISM design was released by the U.S. Nuclear Regulatory Commission (NRC) in February 1994. NUREG-1368 noted that "...the staff, with the [Advisory Committee on Reactor Safeguards] in agreement, concludes that no obvious impediments to licensing the PRISM ([Advanced Liquid Metal Reactor]) design have been identified."

In the early 1980s, the Liquid Metal Fast Breeder Reactor program focused on deployment of the Clinch River Breeder Reactor (CRBR) in Tennessee. The program encountered difficulties because of cost escalations and schedule delays. The LMR program faced challenges because uranium was not becoming scarce and prohibitively expensive as earlier had been predicted.

While the CRBR project was being debated, a small group at GE's Advanced Reactors program pursued a technology other than large loop sodium reactors. At the time, the 1,000 MWt CRBR was envisioned as the stepping-stone to 3,000 MWt "commercial" plants - the scale thought necessary to be economically competitive with the large light water reactors. GE questioned the economics of large fast reactors, and conducted internal work based on alternative small modular reactor. This small reactor, with rated power in the range of 400 to 1,000 MWt could provide stair step plant power levels by adding reactor modules at a site to reach economic and power generation goals. This was the genesis of GE's Power Reactor Innovative Small Module - PRISM.

In August 1981, representatives from the Argonne National Laboratory's Special Project Office visited the Advanced Reactor team. We explained the idea that our relatively small PRISM reactor vessel could be transported to a refueling center about every 18 months. ANL explained their in-core refueling machine process for the Experimental Breeder Reactor II. It became apparent that rather than moving an entire reactor, technology was available to move just the fuel. From this synergistic meeting with the national laboratory, the concept of PRISM matured.

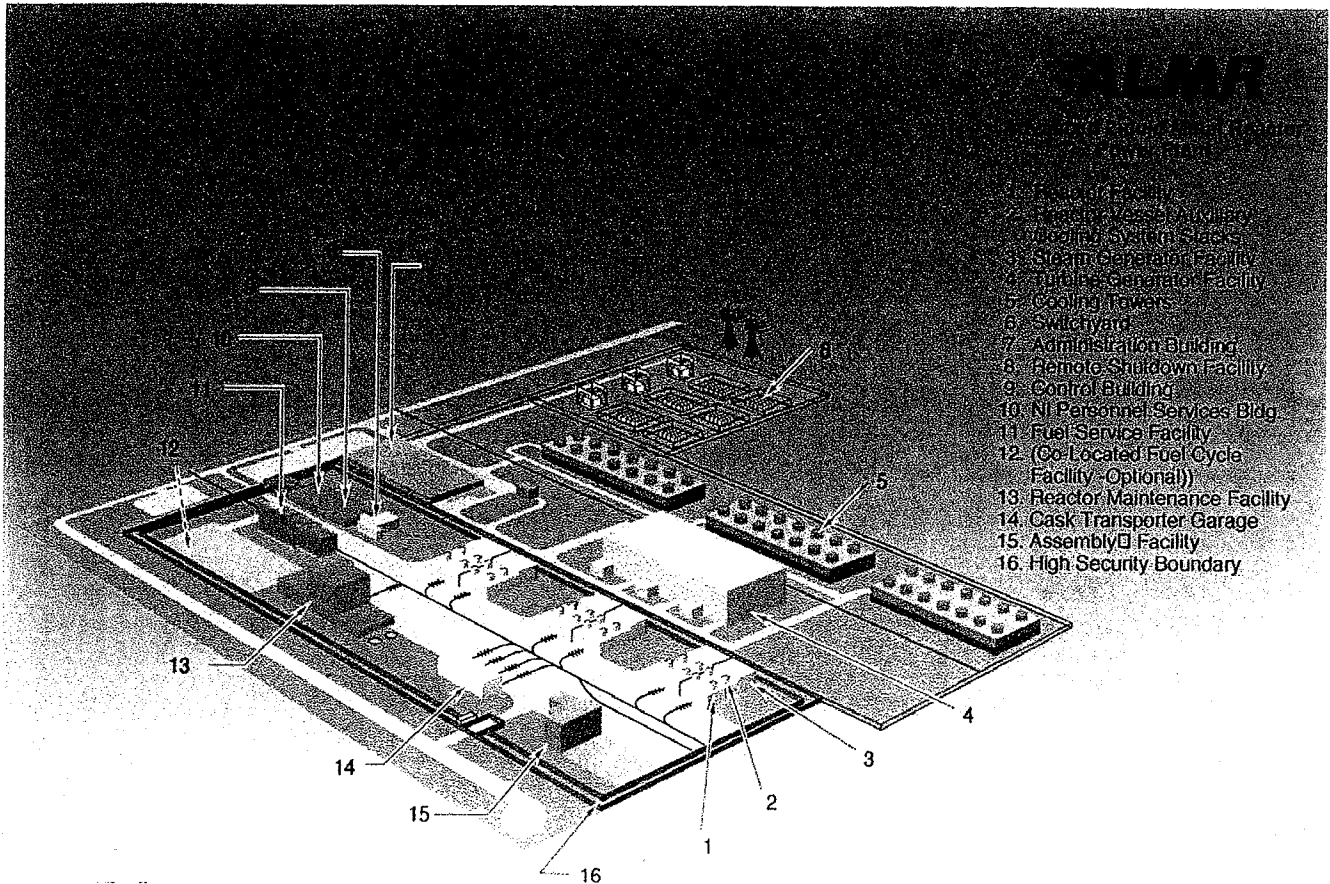
When Congress terminated the CRBR project in 1983, DOE began the Advanced Liquid Metal Reactor program. The goal of the ALMR program was to increase the efficiency of uranium usage by breeding plutonium and create the condition wherein transuranic isotopes would never leave the site. The ALMR was designed to allow any transuranic isotope to be consumed as fuel, and is the forerunner to the GNEP framework we have today.

GE competed for leadership of the ALMR program against another fast reactor technology. GE won the competition and joined the ALMR program with its two key elements: reactor design and fuel cycle development. GE led seven industry partners to refine the conceptual design of the PRISM reactor. The national laboratories, led principally by ANL, tackled the fuel cycle development and waste characterization with 80% of the ALMR funding.

The ALMR program was funded from 1984 to 1994. Two products emerged from the expenditure of approximately \$100 million in government funds: the advanced conceptual PRISM reactor design and the highly proliferation resistant pyroprocess for spent fuel recycle. At the point at which the ALMR program was terminated, the

PRISM design was less than five years from construction contracting. Figure 1 shows the typical power plant site design developed as a part of the ALMR program.

Figure 1: Typical Advanced Liquid Metal Reactor Power Plant Site Layout



A major outcome from this early work on PRISM, focused on safety and economics, was the possibility of deploying a small reactor competitive with large light water reactors. The PRISM designers evaluated light water reactor systems such as defense in depth, active intervention system, and active emergency backups, and developed a passive, inherently safe design that did not depend upon control rods to SCRAM (immediate shut down of the reactor), back up emergency systems, etc.

The passive safety philosophy developed with PRISM has been transferred to advanced light water reactor designs. DOE designates these reactor designs as GENERATION III+. At GE, we call ours the ESBWR. For example GE's ESBWR relies on gravity for both core and containment cooling, therefore providing passive safety.

Following the discontinuation of DOE's ALMR program, GE continued to develop a more advanced modular fast reactor design called SuperPRISM, or S-PRISM. The thermal rating of each reactor module was increased to 1,000MWt from the PRISM's original 840 MWt. The SuperPRISM design sought to further improve upon the commercial potential of PRISM with:

- increased power output;
- compact reactor building on single seismically isolated base pad;
- multi-cell containment system; and
- improved steam cycle efficiency.

These improvements enabled an estimated capital cost of \$1,335/kWe, with a busbar cost of 29.0 mills/kWh for the two-power-block plant with a net plant output of 1520 MWe (capital cost and busbar cost in 1998 dollars).

This history demonstrates that the national laboratories and private industry learned a great deal from the Clinch River Breeder Reactor project and the follow-on Advanced Liquid Metal Reactor project. GE was privileged to lead a very talented industrial team.

PRISM is an important technology that America has already largely developed. I will now describe the details of the technology.

PRISM Technology

PRISM is an advanced fast neutron spectrum reactor plant design with passive reactor shutdown, passive shutdown heat removal, and passive reactor cavity cooling. PRISM supports a sustainable and flexible fuel cycle to consume transuranic elements within the fuel as it generates electricity. The essence of the reactor technology is a reactor core housed within a 316 stainless steel reactor vessel. Liquid