FUTURE NUCLEAR ENERGY RESEARCH & DEVELOPMENT

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Chairman Jeff Bingaman

Good morning, Mr. Chairman and members of the committee. Thank you for inviting me here today. I am currently chair of the Nuclear Engineering and Engineering Physics program at the University of Wisconsin, Madison. I am also involved in a number of national activities in nuclear energy for the National Academies, the Department of Energy and the Nuclear Regulatory Commission. In 2007, I was a member of the National Academies review of the DOE Office of Nuclear Energy and recommendations for future R&D activities in nuclear energy. Today, I would like to address the Committee on this particular issue of nuclear energy R&D as well as human resources related to nuclear science & engineering.

Growing energy demands, emerging concerns about carbon-dioxide emissions from fossil fuel combustion, and a sustained period of successful operation of the existing fleet of nuclear power plants have resulted in a renewal of interest in nuclear power in the United States. Clearly, nuclear energy can be an important component in addressing these issues. However, we must ensure that our nuclear R&D investments are aligned to the technological challenges associated with deploying new plants and developing a nuclear fuel cycle that is sustainable as well as proliferation-resistant.

The Office of Nuclear Energy (NE) of the U.S. Department of Energy (DOE) has been the major agent of the government's responsibility for advancing nuclear power. One consequence of the renewed interest in nuclear power has been rapid growth in the NE research budget. NE R&D funding has increased from less than $5 million in Fiscal Year 1998 to almost $400 million in the pending FY 2009 Omnibus Appropriations Bill.

In FY 2006 the President's Budget requested that funds be set aside for a study by the National Academy of Sciences to conduct a review of the Nuclear Energy research programs and budget, and to recommend priorities among the programs given the likelihood of constrained budget levels in the future. The programs to be evaluated were Nuclear Power 2010, the Generation IV reactor development program, the Nuclear Hydrogen Initiative, the Advanced Fuel Cycle Initiative (which temporarily evolved into the Global Nuclear Energy Partnership - GNEP), and the Idaho National Laboratory facilities program. I served as a member of this Committee and I believe its recommendations are still very relevant in the prioritization and phasing of our future nuclear R&D investments.

NP 2010 PROGRAM

The Nuclear Power 2010 (NP 2010) program was established by the U.S. Department of Energy (DOE) in 2002 to support the near term deployment of new nuclear plants. NP 2010 is a joint government – industry 50/50 cost-shared effort with clear objectives. A good working relationship exists between DOE and industry. The selection of the projects funded is appropriately market driven and there is strong focus on demonstrating the regulatory processes, finalizing and standardizing the advanced reactor designs, and implementing the 2005 EPACT standby support provisions, all of which are essential activities and have led to a large number of Combined License submittals to the NRC. Our Committee concluded that successful completion of the NP 2010 program should be the Office of Nuclear Energy's highest priority. DOE should also immediately initiate a cooperative project with industry to identify problems that experience shows can arise in actual construction and startup of new plants and define best practices for use by the industry.

DOE has also begun to evaluate the need for a reinvigorated R&D program to improve the performance of existing nuclear plants. The NAS study supports such an R&D program in a cost-shared effort separate from NP 2010; e.g., "Life After 60" focus on plant life extension.

GENERATION IV PROGRAM

DOE has engaged other governments, in a wide-ranging effort for the development of advanced next generation nuclear energy systems, known collectively as "Generation IV" (or Gen IV). The goals of Gen IV are to widen the applications of nuclear energy; enhance the economics, safety and physical protection of new reactors; and improve the fuel cycle waste management capability and proliferation resistance in the coming decades.

During the 2002 to 2005 time period, the Gen IV program's primary goal was to develop the Next Generation Nuclear Reactor (NGNP) focusing on high-temperature process heat and innovative approaches to produce energy products that might benefit the transportation and chemical industry, such as hydrogen. The current design focuses on a gas-cooled and graphite-moderated reactor. (Figure 1)

The NGNP program has well-established goals, decision points and technical alternatives. The 2005 EPACT identified two key decision NGNP points; licensing by the NRC and plant operation no later than 2021. A major risk in this program is that the current business plan does not match government funding. The program requires predictable and steady funding, and its goals and timetable should be in harmony with available funding. Our committee also recommend that NE sustain a balanced R&D portfolio in new Gen IV advanced reactor development concepts; e.g., funding and prioritization for grid-appropriate reactors (Fig. 2).

ADVANCED FUEL CYCLE INITIATIVE and GNEP

Since 2002, the United States has been conducting a program of spent fuel reprocessing research and development in a program called the Advanced Fuel Cycle Initiative (AFCI). In March 2006, after the National Academies committee was established, DOE unveiled GNEP, a broad initiative intended to facilitate a worldwide expansion of nuclear energy while minimizing the risks of proliferation. GNEP would require the US to be an active participant in the community of nations that recycle fuel in order to meet the fuel and waste disposal needs of other "user" nations. The AFCI research program was absorbed in GNEP along with rapid deployment of commercial reprocessing, recycle facilities and fast reactors.

The overall concept has many positive features, especially in the international arena. At a time when many countries are actively expanding their nuclear energy portfolio, there are strong energy and national security arguments for continued U.S. leadership in the field.

However, the committee was not persuaded that the GNEP program was worth pursuing, as presented to the committee by DOE. We felt the program was premised on an accelerated deployment strategy, creating large technical and financial risk, and premature narrowing of technical options. Also, there was insufficient external input and independent peer review.

Nonetheless, the committee believes that a program, similar to the original AFCI research program, is worth pursuing. Such a program should be paced by national needs, including economics, technological readiness, national security, energy security, and other factors. It should not include construction of large demonstration or commercial scale facilities. Rather, the committee recommended a more modest and longer term program of applied research and engineering effort including new research-scale experimental capabilities that reveal innovative approaches for fuels, materials, modeling, power systems and reprocessing.

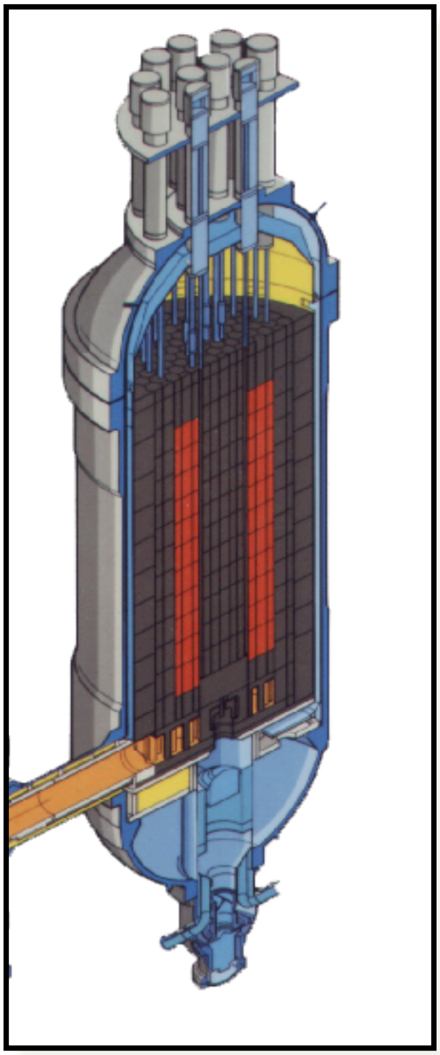
UNIVERSITY NUCLEAR SCIENCE and ENGINEERING INFRASTRUCTURE
Our success in addressing U.S. nuclear R&D challenges -- whether its nuclear energy, nonproliferation, or detection --- will ultimately be predicated on our ability to educate and train the next generation of nuclear scientist, engineers and related nuclear specialists.

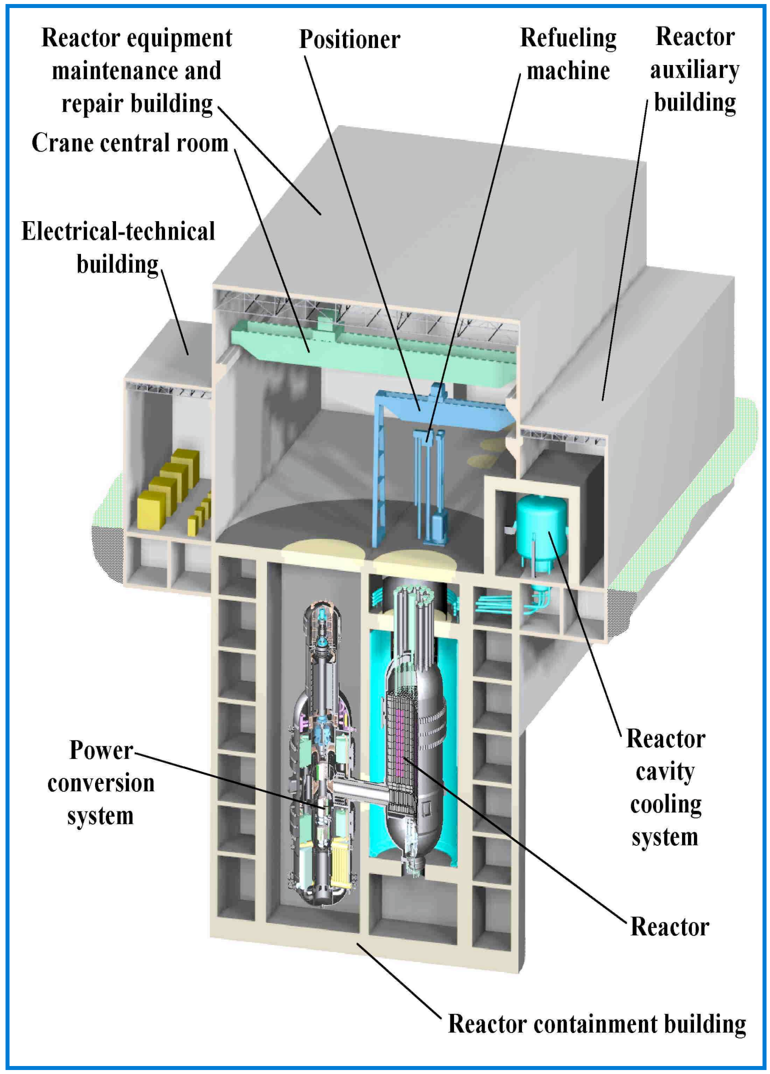
There is good news - undergraduate enrollments continue to increase and several new programs have been created (Figure 3). However, from a federal funding standpoint, the last few years have been a period of significant uncertainty. In 2006, DOE proposed the complete elimination of nuclear university programs. Since that time, Congress has added back funding in the appropriations process (with the support of many members of this Committee, including you, Mr. Chairman), and ultimately shifted a significant portion of the program to NRC. Last year, DOE committed to allocate 20 percent of its R&D funding for work to be performed at universities. Most recently, in the pending Omnibus Appropriations Bill, an Integrated University Program structure has been created, which provides DOE, NNSA, and NRC with funding to support both mission-directed research, and a jointly coordinated program that supports the overall discipline and infrastructure such as research reactors. The Omnibus language, combined with the "20% Solution," is a strong package of on-going stewardship. Congress should continue this structure, with stable funding portfolio.

OVERSIGHT: To counterbalance the short-term nature of the budget process, we also recommended that DOE adopt an oversight process for evaluating the adequacy of program plans, evaluating progress against these plans, and adjusting resource allocations as planned decision points are reached. The senior advisory body for NE was the Nuclear Energy Advisory Committee, and a modified committee seems the obvious starting point for reestablishing proper oversight; to ensure its independence, transparency, strategic issues.

In closing, the programmatic building blocks already exist for a strong, relevant portfolio of federal investment in nuclear R&D. Congress should build on these existing programs in a stable and predictable manner, avoiding precipitous changes in focus or funding.

FIG. 1: CONCEPTUAL PICTURE OF GAS-COOLED NUCLEAR REACTOR and FUEL





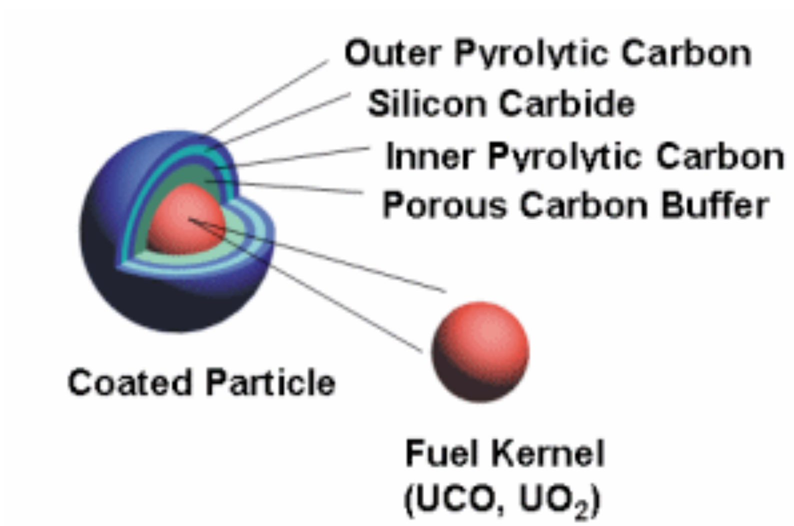
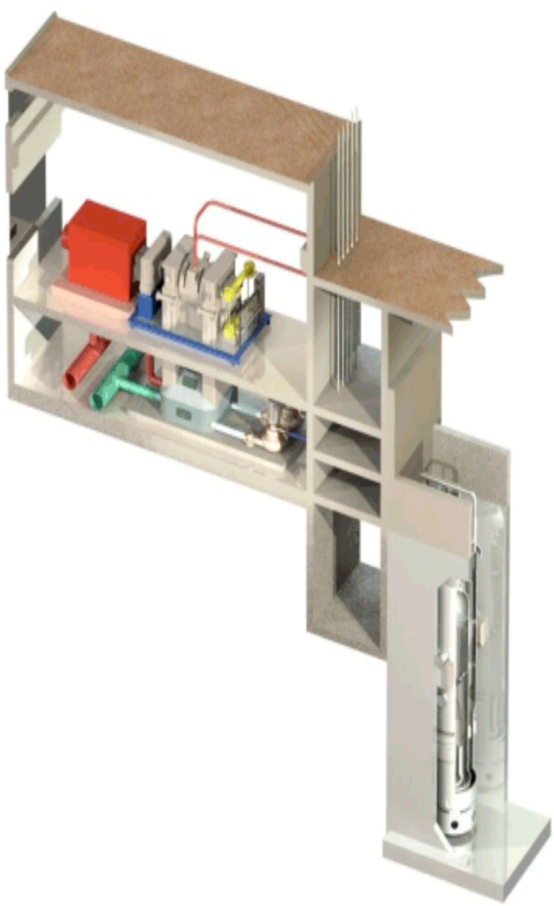


FIG. 2: NuSCALE PRESSURIZE WATER REACTOR POWER PLANT MODULE



Single-unit side view of the NuScale system design

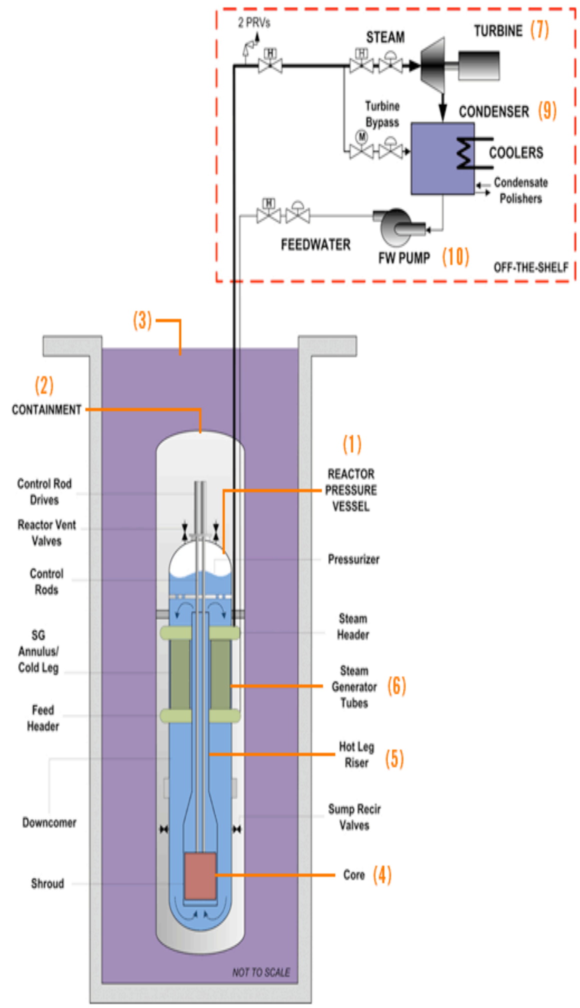


FIG. 3a: NUCLEAR ENGINEERING ENROLLMENTS OVER THE LAST DECADE

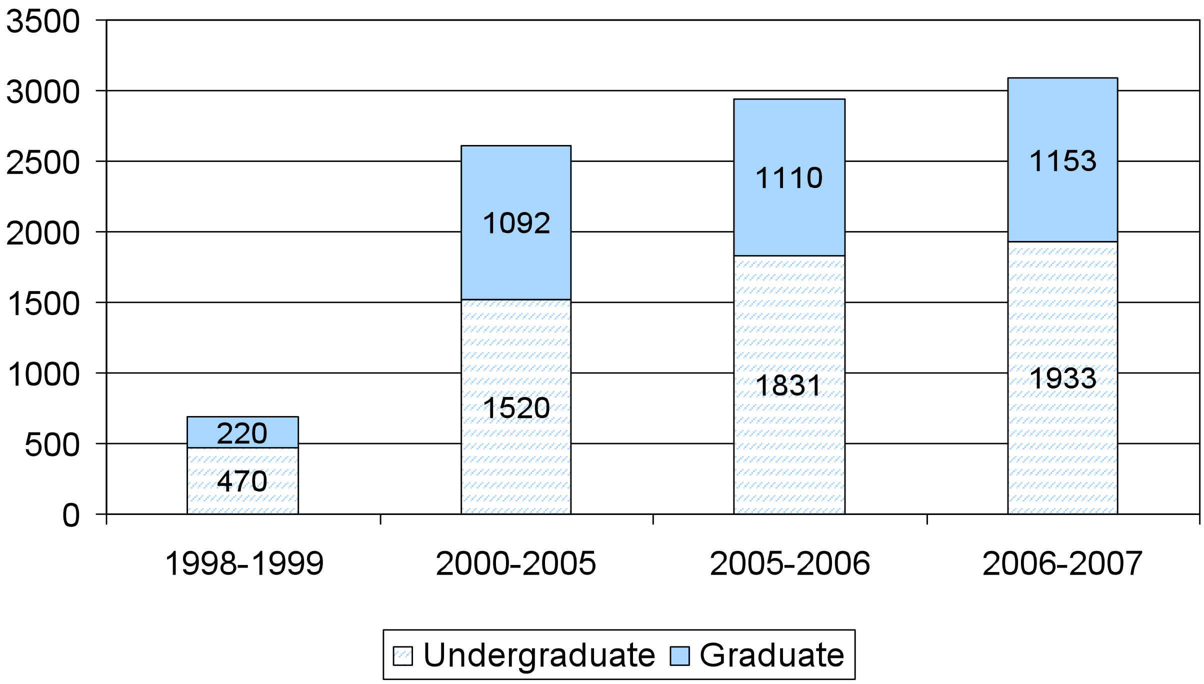


FIG. 3b: NEW NUCLEAR ENGINEERING PROGRAMS IN LAST FIVE YEARS

- **COLORADO STATE UNIVERSITY**
- **SOUTH CAROLINA STATE UNIVERSITY**
- **UNIVERSITY of SOUTH CAROLINA**
- **TEXAS TECH UNIVERSITY**
- **UNIVERSITY of CALIFORNIA, LOS ANGELES**
- **VIRGINIA COMMONWEALTH UNIVERSITY**

(plus others that are under active consideration)