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Review of DOE's Nuclear Energy Research and Development Program

BOARD ON ENERGY AND ENVIRONMENTAL SYSTEMS

Background

There has been a substantial resurgence of interest in nuclear power in the United States over the past few years. One consequence has been a rapid growth in the research budget of DOE's Office of Nuclear Energy (NE). In light of this growth, the Office of Management and Budget included within the FY2006 budget request a study by the National Academy of Sciences to review the NE research programs and recommend priorities among those programs. The programs to be evaluated were: Nuclear Power 2010 (NP 2010), Generation IV (GEN IV), the Nuclear Hydrogen Initiative (NHI), the Global Nuclear Energy Partnership (GNEP)/Advanced Fuel Cycle Initiative (AFCI), and the Idaho National Laboratory (INL) facilities. This report presents a description and analysis of each program along with specific findings and recommendations. It also provides an assessment of program priorities and oversight. Appendix A offers alternative views on the GNEP program by two of the study committee members.

Findings and Recommendations

NP 2010 This program is a joint DOE-industry effort to support the near-term deployment of new nuclear power plants. The program has good relations with its contractors, is funding appropriate projects, and has a strong focus on many essential front end activities. Overall progress is far slower than proposed, however, and successful completion of the NP 2010 program should be DOE's NE highest priority.

The planned pace for combined construction and operating license (COL) reviews needs improvement. DOE should support a high-level group with industry and the U.S. Nuclear Regulatory Commission to focus on this goal. In addition, the effort to standardize the COL application may not be incorporating safety and licensing issues common to families of designs. DOE should work with industry on addressing this concern.

Critical deployment issues are receiving insufficient attention and DOE should initiate a cooperative project with industry to identify problems that can arise during construction and startup and to define best practices for industry. Also, little effort has been devoted

to improving the infrastructure that would be required to support a major expansion of nuclear electric generation capacity, and DOE should support a workshop with industry focusing on efforts to revitalize this infrastructure.

GEN IV and NHI The primary focus of this program is the Next Generation Nuclear Plant (NGNP) that would produce high-temperature process heat and other energy products, such as hydrogen. While the long-term goal of the NGNP project is hydrogen production through the NHI, there are shorter-term benefits of high-temperature reactors that are likely to result in more industry support for the program.

The base NGNP program is not coordinated with the public/private partnership initiative needed to commission this reactor, and the required 50 percent private funding may not be forthcoming. NE should take steps that would enhance design flexibility, develop needed technologies, and improve hydrogen-production performance.

DOE should expand NHI interactions with industrial and international research efforts and include additional performance metrics—safety and sustainability. Finally, there are inadequate resources in DOE to go much beyond the current NGNP and very-high-temperature reactor concepts. Other long-term base technology options should be modestly supported.

GNEP/AFCI The GNEP R&D program's goals are to develop and deploy recycling technologies that do not separate plutonium and advanced reactors that consume transuranic elements from recycled fuel. The GNEP R&D program should not go forward and that it should be replaced by a less aggressive research program. Domestic waste management, security, and fuel supply needs are not adequate to justify commercial-scale reprocessing facilities, and there is no economic justification to proceed.

Instead, a majority of the study committee members favors a research program similar to the original AFCI; two members recommend against such research. In any case, NE should not commit to the construction of a major demonstration or facility unless there is a clear economic, national security, or environmental policy reason for doing so.

INL Facilities The Idaho National Laboratory is the principal DOE facility for nuclear energy research. INL provides important capabilities in support of the NE's mission. It needs new or rejuvenated facilities, however, to continue in this role and attract the high caliber researchers needed by the NE program. In addition, INL needs to reduce its deferred maintenance backlog.

To plan in accordance with budget realities, INL should evaluate alternatives for achieving its goals and construct major user facilities to attract researchers and industrial users. In this context, a more transparent, structured, and jointly supported planning and budgeting process is needed. Finally, NE has limited experience being the lead Program Secretarial Office (PSO) of a national lab and needs to develop these capabilities.

Program Priorities and Oversight The NE program should put its highest priorities on NP 2010, research in support of the commercial fleet, and university research. Medium-level priority should be placed on GEN IV, NGNP, NHI, and AFCI, and on reducing deferred maintenance and building capacity for INL. Major facility deployment in the GNEP R&D program should have low priority.

Budget actions to meet these priority recommendations include: full support for NP 2010; evaluation of the public benefit of commercial reactor fleet research; adequate funding of university programs; steady funding for GEN IV R&D, but with more modest goals; a more modest and longer term applied research and engineering program for AFCI; funding of major fuel cycle facilities only when clearly needed; and reasonable and predictable funding to support the PSO responsibility for INL.

The NE budget process creates a bias towards shorter-term needs at the expense of the long-term activities that are more characteristic of the program. Consistent resource allocation over time is needed. NE should adopt an oversight process for the NE program for evaluating program plans and progress against those plans, and for adjusting resource allocations as planned decision points are reached. The oversight body should encourage objectivity, avoid conflict of interest, and ensure transparency.

For further information; Copies of *Review of DOE's Nuclear Energy Research and Development Program* are available from the National Academy Press; call (800) 624-6242 or (202) 334-3314 (in the Washington metropolitan area), or visit the NAP Web site at <<http://www.nap.edu/>>. Support for this project was provided by the U.S. Department of Energy. Any opinions, findings, conclusions, or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the sponsors. More information about the Board on Energy and Environmental Systems can be found at <<http://www7.nationalacademies.org/bees/>>.

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