Evaluation of DOE Nuclear Energy Programs

NERAC Evaluation Subcommittee
September 10, 2004

I. Introduction

The Subcommittee on Evaluations (SCoE) of the Nuclear Energy Research Advisory Committee (NERAC) was asked to evaluate the programs of the Department of Energy's (DOE) Office of Nuclear Energy, Science and Technology (NE). The purpose of the evaluation is to assist NE, DOE, and the Office of Management and Budget (OMB) by providing an independent assessment of NE programs which would be of value in the budget process. After consultation with NE, the Subcommittee decided to focus its initial evaluation on three separate but related programs based on their common or related missions and goals. These programs, comprising separate budget line items, are a) Nuclear Power 2010 (NP2010), b) Generation IV Nuclear Energy Systems Initiative (Gen IV), and c) the Advanced Fuel Cycle Initiative (AFCI). Together these three program areas share the mission of securing nuclear energy as a viable, long-term commercial energy option to provide diversity in energy supply. To a much lesser extent the subcommittee examined the nuclear hydrogen initiative, based on one briefing. The programs will be evaluated separately, and then an overall assessment will be made.

The charge to the NERAC-SCoE is attached as Appendix A, and the members of the subcommittee are listed in Appendix B. While not all subcommittee members agreed on all points, the report was signed off on by all members so that this report represents a consensus of the committee. The Subcommittee was briefed by the staff of NE on four occasions, listed in Appendix C. The Subcommittee also was provided with many supporting documents.

The activities of NE are an important contributor to the fulfillment of the energy mission of the Department. Nuclear energy is an important component to current electrical supply. If new nuclear plants are able to compete economically with gas- and coal-fired plants, nuclear energy could become a more important component of future energy supply because nuclear power does not have the emissions and climate-change risks that are associated with fossil fuels – nuclear's principal competitors
The Subcommittee is impressed by the competence and commitment of the NE staff. However, it appears that some NE activities are significantly understaffed and underfunded relative to the importance of the fundamental mission and the emphasis that the Department has placed on those activities. All of the NE programs that we evaluated have established current programs that are designed to provide the foundation for much larger programs in future years. It is highly unlikely that the presumed large growth in funding in future years will in fact occur. DOE management and OMB should provide clear guidance as to realistic future funding trajectories so that the focus and emphasis in current-year activities is appropriate. The gap between program goals and provided funding was striking. Even with the hard work of the competent staff it will be impossible to come close to these goals with the funding paths that these programs appear to be on.

II. Nuclear Power 2010 Program (NP2010)

The mission of the Nuclear Power 2010 Program is to:

> Resolve the regulatory, technical, and institutional uncertainties associated with the licensing and construction of new nuclear power plants.

The current program goal is to:

> Enable an industry decision in 2005 to proceed with obtaining an NRC license to construct and operate at least one new nuclear power plant in the United States.

Without comment on their merits, we find the mission and goal to be sufficiently clear and specific.

This program is largely not a nuclear energy R&D program. Rather, it is intended to enhance the likelihood that a new nuclear plant will be constructed and operated by having the federal government bear some of the costs associated with new, first-of-its-kind construction. The energy companies are receiving from the Federal government one-half the cost associated with obtaining Early Site Permits (ESP) for three plant sites from the Nuclear Regulatory Commission (NRC). Under the same program, DOE also proposes to fund one-half the cost of an NRC Construction and Operating License (COL) for at least one plant. The NE historical and planned funding levels (in $ millions) for Nuclear Power 2010 for FY 2002-10 are:

[---------actual----------]				[OMB]	[------Proposed by the program-------]			
FY 2002	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
7.9	16.6	19.4	10.2	65	75	70	55	55

The Administration's budget requests for FY 2003 and FY 2004 were about $38M. DOE made a similar request to OMB for FY05, but only $10.2M was included in the budget request to Congress. OMB stated in its FY 2005 Pass back to DOE "[n]o funds are provided for efforts associated with finalization and certification of an advanced reactor design, the cost of which should be assumed by the private sector." The OMB passback appears to be inconsistent with the guidance provided by the Administration in the President's Energy Plan. There is a significant disagreement between OMB and the Department as to the appropriate focus of this program that should be resolved.

The FY2005 budget has been further reduced to $5M in the House appropriations bill.[1]

In spite of limited funding, we find that the NP2010 program has made good progress on its mission. A business-case analysis was completed in July 2002, several commercial

[1] In explanation of this reduction, the House committee stated, "in the absence of a licensed repository for spent nuclear fuel, the Committee does not believe the Nuclear Regulatory Commission should license any new reactor plants in this country."

and federal sites were evaluated during FY 2002, and a risk-mitigation and incentive analysis was completed in July 2003. Several consortia of vendors and power companies have been formed, and three ESP applications have been filed. An economic policy study was completed this summer.

In November 2003, DOE issued a solicitation for licensing demonstration projects that would lead to successful COLs. Two consortia responded with substantial plans: Dominion Energy with Atomic Energy of Canada, Ltd., Bechtel, and Hitachi proposed a twin-unit ACR-700 plant at the North Anna site. The program cost, to be cost-shared, was estimated to be $500M over 6 years. The second consortium, called NuStart Energy, includes Exelon, Entergy, Constellation Energy, Southern Co., Duke, TVA, Florida Power and Light, Progress, Electricité de France International with General Electric, and Westinghouse. The site and technology (AP 1000 or ESBWR) will be selected as part of this project, estimated to cost $800M over 7 years. In addition, TVA with General Electric, Toshiba, Bechtel, Global Nuclear Fuels-America, and USEC have a $40-50M cost and feasibility study under way for a two unit ABWR at TVA's Bellefonte site.

As the name indicates, the initial objective was to have a new nuclear plant in operation by 2010. However, due to budget limitations and changes in DOE policy, this date has slipped by several years. Indeed, the 2005 goal for an industry decision is now expected by 2009 at the earliest, following NRC decisions on ESPs and progress on the COLs. The earliest time a plant could operate is 2014, and might well slip even further. None of the consortia members has indicated a willingness to commit to constructing a new plant even if a COL is granted. While industry appears to be willing to participate to keep the option available, their willingness or ability to commit to new nuclear power plants is uncertain.

The focus of the program is to address and reduce the barrier to new construction that is presented by licensing uncertainty. There are other barriers to new construction that warrant careful evaluation – most prominently, an economic barrier that can arise from high capital costs, long construction times, overbuilt generating capacity in some areas, and uncertain prices for future electrical power. It is appropriate for DOE to assess all the barriers to new construction and to consider whether there is an appropriate federal role for addressing all of them.

The magnitude of the requested cost sharing sought by the various consortia is larger than the staff's projections of future budgets. Also, the staff's projections may be quite optimistic. A careful evaluation is necessary to define the appropriate scope of the program and necessary magnitude of federal involvement. The project is managed by two very dedicated DOE employees. Considering the large cost shares that are likely to be needed over the next several years, we find that the downward funding trend is not compatible with the Department's expressed interest in the program. The future suggested budget levels will not allow the program to stay on schedule, and the staffing level is inadequate for a program of the expected size. Public words and the budget are not in harmony.

III. Generation IV Nuclear Energy Systems Initiative (Gen IV)

The origin of Gen IV can be traced to a speech given by the Director of NE in 1999. In FY 2001, the Gen IV International Forum (GIF) was organized. This group, initially comprised of ten countries, agreed on a framework for international cooperation in research for a future generation of nuclear energy systems. In December 2002, the GIF and a subcommittee of the NERAC jointly issued *A Technology Roadmap for Generation IV Nuclear Energy Systems* (GIF-002-00) [hereafter *Technology Roadmap for Gen IV*]. This report recommended that the GIF members focus research on six Gen IV systems: the Very High Temperature [Gas-Cooled Thermal] Reactor (VHTR), the Super-Critical Water-Cooled Reactor (SCWR), the Sodium-Cooled Fast Reactor (SFR), the Gas-Cooled Fast Reactor (GFR), the Lead Fast Reactor (LFR) and the Molten Salt Reactor (MSR).

In FY 2002 DOE-NE decided that the focus of the U.S. Gen IV research and development activities would be on the VHTR and it would be the source of heat for hydrogen production. NE proposes to construct a 300 MWe VHTR at Idaho National Laboratory (INL). In planning and budget documents, this reactor is synonymous with the New Generation Nuclear Plant (NGNP). In September 2003, NE issued *The U.S. Generation IV Implementation Strategy.*

On 27 February 2004, NE developed a draft *Generation IV Nuclear Energy Systems Ten Year Program Plan: Fiscal Year 2004* [hereafter *Gen IV Ten Year Plan*].

The mission of Gen IV can be found in the *Gen IV Ten Year Plan:*

- Developing and demonstrating advanced nuclear energy systems that meet future needs for safe, sustainable, environmentally responsible, economical, proliferation-resistant, and physically secure energy, and
- Developing and demonstrating technologies that enable the transition to a stable, long-term, environmentally, economically, and politically acceptable advanced fuel cycle.

This mission statement represents an abbreviated summary of the eight goals for Gen IV systems articulated in the *Technology Roadmap for Gen IV:* two sustainability goals, two economic goals, three safety and reliability goals, and one related to proliferation resistance and physical protection.

Along with the mission, DOE stated a strategy that included two priorities:

- Develop a Next Generation Nuclear Plant (NGNP) to achieve economically competitive hydrogen and electricity production in the mid-term.
- Develop a fast reactor to achieve significant advances in sustainability for the long term.

The VHTR is to be the basis for the NGNP[2]. For the second priority, the Gen IV program "gives the highest priority to advancing the LFR and GFR, while monitoring the progress of the SFR." However, another NERAC subcommittee chaired by Burt Richter has concluded that fast reactors are not given sufficient priority in the Gen IV program to support the AFCI mission.

Without comment on their merits, we find the mission and goals to be sufficiently clear and specific.

The NE historical and planned funding levels (in $ millions) for the entire Gen IV program and the NGNP portion for FY 2002-10 are:

	[-----actual------]			[OMB]	[-----Proposed by the program---------]			
	FY 2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Gen IV	16.9	27.7	30.5	148	159	196	201	180
NGNP	3.0	14.4	19.3	101	108	142	146	126

The NGNP numbers for the outlying years were provided to the SCoE in April, and are said to be the "required" levels. They are considerably smaller than those given in the appendices to the *Gen IV Ten Year Plan* only two months earlier. The SCoE was also provided with a list of "target" numbers for the outlying years. They are about 20-25 percent of the numbers in the table above, and possibly reflect the belief that the budgets "required" to meet the time scales of the program cannot be obtained. As an example of severe shortfall between request and receipt, the program requested nearly $140M for 2005. At the level of funding being received, the program cannot meet its goals. The House appropriations bill has added $10M to the total Gen IV budget, but timely progress will require very large boosts in FY 2006 and beyond.

The long-term budget plans apparently include the cost of the Gen IV demonstration reactor. However, we did not find clear information on whether the budget also includes other large capital projects required for the R&D program (e.g., laboratories).

It is clear that most of the current and projected funding is for the NGNP project, which involves the VHTR. Table 6.1 of the *Gen IV Ten Year Plan* shows breakdowns of the remaining part of the budget for the other reactor systems. The largest funding levels for FY 2008-2012 are for the SCWR, which is not listed as one of the systems under Priority 2. Furthermore, amounts only slightly less than those for the Priority 2 systems are listed for the MSR, in which NE has said it will have only "exploratory collaborations." We find that the Gen IV budget profile is not commensurate with NE's stated priorities, a situation that is made worse when actual budgets fall well below "required" levels.

The program is a large, long-term, and complex program interwoven with the NHI and AFCI programs. There has been very little technical progress to date. Activities instead have focused on assessing the state of knowledge and developing annual goals for each component of the program along with cross-cut relationships among them, developing

[2] The VHTR may not be the final choice. We note that NE is soliciting interest among several companies to fill the “integrator” role for the NGNP. One of the integrator’s responsibilities will be to determine what type of Gen IV plant should be built.

budgets, developing very extensive management systems with monthly evaluations and adjustments across the program, communication methods between component areas, and quality control and quality assurance measures. Because actual budgets have not corresponded to the stated needs, and have not been provided until well into the fiscal year, the planning work has had to be redone several times. The reports produced for the Gen IV program are voluminous. The SCoE expresses concern about the appearance, if not the reality, that the actual research and development work will be swamped and inhibited by these administrative activities.

The current roster of Gen IV reactor concepts was selected by the GIF in 2002, by considering a number of goals such as sustainability, economics, and proliferation resistance. However, we find that there is no sustained or scheduled episodic effort to evaluate the concepts against these goals to ensure that new technical information or decisions do not obviate the original basis for selection. One potential example of this was a French decision to eliminate passive safety features from the gas-cooled fast reactor despite the fact that this feature was pivotal in the decision to include the reactor concept in the final list.

Each of the reactor concepts has challenges and risks, but they may well be much larger for the VHTR that has become the heart of the US Gen IV program efforts. The very high temperatures raise issues about the performance of materials, perhaps even new materials, in such a hostile thermal and radiation environment. The high temperatures are needed for some chemical methods of producing hydrogen, but there are also other methods that do not require such extremes.

There appears to have been little attention paid to the back-end of the fuel cycle for VHTR fuel. NE staff indicated that spent nuclear fuel from the VHTR (exact design not yet determined) would be stored for an extended time. Given that one of the basic goals of the advanced nuclear program is to reduce impacts on the repository by reprocessing so as to not send actinides and intermediate-lived fission products to the repository, the potential for VHTR fuel to be disposed intact would not appear to be desirable. However, despite the difficulties involved in reprocessing graphite-based fuels, there is apparently no plan for even a minimal program to examine methods for reprocessing graphite-based fuels to assure that it is both feasible and practical.

We suggest that the challenges and risks of the various design concepts should be examined again from a strictly technical, economic, and non-political viewpoint.

An extremely important issue during the past few years for NERAC and NE has been support for university researchers to ensure that the U.S. continues to have top-quality people skilled in nuclear energy. We find that the Gen IV documents acknowledge this educational need, but only extremely briefly and with very limited plans for incorporating university researchers into the project, mainly by contracts from the national laboratories for specific tasks. Such projects can train some people, but generally not the Ph.D.-level people who will provide the core of the university educational system.

Although Gen IV is advertised as an international program, the actual work appears to be largely undertaken by the United States on its own or pursuant to bilateral arrangements

with some of the Gen IV participants. On the basis of the information provided to us, we find little in the way of multilateral coordination of efforts as well as little comprehensive understanding of what other countries are doing or planning. NE needs to establish firm understandings with all the Gen IV participants for cooperation and sharing of research results, as well as for appropriate commitments as to intellectual property rights.

IV. Advanced Fuel Cycle Initiative (AFCI)

In the "Advanced Fuel Cycle Initiative (AFCI) Program Plan," January 30, 2004 (hereafter, "AFCI 2004 Program Plan"), Generation IV and AFCI are referred to as an "Integrated Program " with the same mission statement as given for the Gen IV program in Section III above, except the first bullet is followed by "(Gen IV)" and the second bullet is followed by "(AFCI)". Thus restated, the mission of AFCI is:

- Developing and demonstrating technologies that enable the transition to a stable, long-term, environmentally, economically, and politically acceptable advanced fuel cycle.

The AFCI 2004 Program Plan also sets forth the following five near-term objectives:

- In FY 2008 provide preliminary engineering data and analysis to support the secretarial recommendation to Congress on the need for a second repository.
- By 2010, qualitatively define the most technically feasible and desirable nuclear fuel cycle option and validate new technologies necessary for implementation during transition to a stable long-term fuel cycle.
- By 2012, complete the qualification program for the Next Generation Nuclear Plant (NGNP).
- By 2015, develop engineering data to recommend the best option for transitioning nuclear waste management toward the future and obtain sufficient information to begin near-term implementation.
- By 2015, quantitatively define the most technically feasible and desirable long-term Gen IV nuclear fuel cycle option and validate new technologies necessary for its implementation.

The four major program elements of the AFCI Program are separations, fuels, transmutation science and engineering, and systems analysis.

The NE historical and planned funding levels (in $ millions) for the AFCI program for FY 2002-10 are:

[-----actual------]			[OMB]	[-----Proposed by the program---------]			
FY 2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
57.3	66.7	46.3	94.5	96.5	96.5	96.5	100

Although the NE program plan had called for $75M in FY 2005, the request was sharply reduced by OMB. The House appropriations bill has added $20M back into the program.

The AFCI program has the benefit of a reasonably substantial staff, as compared to the other NE programs, and this staff is competent and knowledgeable. AFCI has been comparatively well funded for a sustained period in comparison to the other NE initiatives. Again, however, the available budget in the out years is likely to fall well below the levels planned by the program.

The AFCI program has had the challenge of adapting to the constant evolution of mission. Although the name has changed several times, its core research activities of developing separation processes for spent fuel, i.e., reprocessing, and transmutation technologies have continued throughout. AFCI has shifted from a program for deployment to one for R&D.

The justification for pursuing separations technologies is that fuel recycle and transmutation of selected actinides and fission products isotopes could reduce the high-level waste management burden. Economic considerations, while part of the mission, have not been incorporated sufficiently by the AFCI program. The advanced fuel separations technologies that have been and currently are the focus of the AFCI research and development effort—UREX+ and pyroprocessing—may be less economical than PUREX reprocessing/MOX recycle. Fuel cycle cost modeling indicates that conventional PUREX reprocessing/MOX recycle *fuel* costs are several times greater than the cost of the open fuel cycle used in the United States today.[3] A reduction in high-level waste management requirements will require deployment of technologies that are uneconomical today in terms of fuel costs and may remain uneconomical in the foreseeable future. Similarly, transmutation of selected isotopes is more efficient in fast reactors, but these have proven to be more costly to construct than conventional light water-cooled thermal reactors. Thus, fast reactors can be justified on economic grounds only if the costs of the total fuel cycle are reduced in comparison with the once-through fuel cycle or if they are seen to provide other societal benefits. Moreover, even the advanced separations technologies carry proliferation risks that appear higher, at least in the near-term, compared to the open fuel cycle in use today. The research program is seen by some as having proliferation risks since it can encourage other countries to develop means of separating out plutonium.[4] Thus, whether the AFCI program will ever be able to develop and demonstrate separations and technologies that will fulfill the AFCI mission—"enable the transition to a stable, long-term, environmentally, economically, and politically acceptable advanced fuel cycle"—is a contentious issue and the members of NERAC-SCoE are not of one view regarding the value of this research.

Regardless of our individual views on what is an appropriate level of research on separations and transmutation technologies, we agree that there is no urgency to reduce the high-level radioactive waste burden if there are no or only a few additional nuclear

[3] "The Future of Nuclear Power," An Interdisciplinary MIT Study, 2003, pp. 146-148, gives $2,040 for the total (ore purchase through disposal) for 1 kgIHM of fresh UOX fuel and $8890 for 1 kgIHM of fresh MOX fuel. Although this is a substantial difference in fuel cost, the MIT study estimates that the incremental cost of electricity for use of a MOX/UOX cycle compared to a once through UOX cycle would be 0.28 cents/kWe-hr.

[4] The US should review all cooperative agreements to insure they do not advance proliferation. For example, the US is inviting representatives from South Korea to study pyroprocessing while the IAEA just learned that a South Korean facility was developing laser enrichment techniques to produce HEU.

plants built in the United States. Therefore, the NP2010 and the Gen IV programs should be of greater priority than AFCI, although AFCI work should proceed at an appropriate level so that results are available when and if needed. . The current DOE budget does not reflect this.

Aspects of the program require coordination with other parts of DOE. For example, AFCI's work concerning nuclear waste could focus on volume reduction, on separation of actinides, or on separation of fission products to minimize repository short-term heat loads. Guidance from other parts of DOE is necessary to define sharply the technical challenges on which AFCI should focus. We find that such guidance is often lacking and AFCI has sought instead to pursue multiple avenues of work, some of which ultimately may not be of particular interest. Greater efforts should be made to develop integrated guidance across DOE programs that would focus AFCI efforts more productively.

Because AFCI has already begun to mature, it can point to a long list of technical research accomplishments. Although the results were expressed in considerable detail, we often could not judge how well they fit into the goals of the program. The AFCI has developed a variety of metrics that are intended to establish a baseline for judging the success of the program. However, we find that these metrics tend to be so narrow that they encompass only an imperfect measure of the scope of AFCI's work. Success or failure in meeting these metrics does not provide much information about the overall effort. Moreover, success or failure in the metrics can be the result of matters that are outside AFCI's control. Better evaluation tools are needed.

We find that the AFCI program has done a reasonably good job within budget constraints of incorporating university researchers into its activities. It has ongoing scholarship and fellowship programs. There is a strong intent to provide more funding. The original NERI program now has been incorporated into the overall Gen IV funding, with a goal of establishing a base level of $15M. A request for proposals under this new initiative has had an excellent response, with projects totaling more than twice the available funds.

In terms of fuel development activities that are important to the nation, we find one significant omission. The U.S. nationally and internationally has been actively working to reduce the amount of HEU fuel in research and test reactors for nonproliferation reasons. The development of alternative fuels that have comparable power capabilities as HEU fuel should be a high priority of the U.S. government. Secretary Abraham's recently announced Global Threat Reduction Initiative focuses on reducing the worldwide stock of HEU. The AFCI is the logical program for managing this alternative fuels research and development effort. Conversion of HEU-fueled U.S. research and test reactors, including several university research reactors, also should be accelerated to demonstrate to other countries the seriousness of the U.S. commitment to this global security effort.

V. Nuclear Hydrogen Initiative (NHI)

The President announced the Administration's Hydrogen Initiative in his State of the Union address in February 2002. In December 2003 a technology roadmap for the Nuclear Hydrogen Initiative was issued.

As stated in the *Nuclear Hydrogen R&D Plan* of March 2004, the mission of the NHI program is to undertake R&D "to accelerate the development of hydrogen technology" to "enable industry to make an investment decision by 2015 regarding the commercial viability of hydrogen for fuel cell vehicles."

The NE historical and planned funding levels (in $ millions) for the NHI program for FY 2002-10 are:

[--actual--]		[OMB]	[-----Proposed by the program-------]			
FY 2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
6.4	9.0	20.0	25.0	25.0	25.5	30.0

NE is making R&D investments in technologies to generate hydrogen from water, including high-temperature electrolysis and thermochemical cycles. In some instances, this effort is deemed to be an integral part of the Gen IV program, while in other instances it is a separate program. In any case, the goal to produce hydrogen economically is clearly a driving force in the selection (or at least justification for the selection) of the VHTR. However, the principal focus on thermochemical methods is well outside the historical role and skills of NE. In view of the pervasive budget shortfalls for the NE programs, we find that NE is investing in hydrogen production technologies in lieu of its core nuclear mission. We believe that NE should improve its collaboration in this area with other DOE offices, in particular, OS, EE, and FE.

VI Overall Program Integration and Assessment

In part, because the energy issues are so important to the country, NE's vision seems to be much larger than its stomach – or rather the amount of food provided to it. All of the NE programs that we evaluated are designed to provide the foundation for much larger programs in future years. From the evidence of recent years, it is easy to anticipate that the presumed large growth in funding in future years is very unlikely to occur. The fluctuations in funding, sometimes quite large, often in the wrong direction, and typically well away from fiscal-year boundaries, has resulted in turmoil and much wasted effort for some of the programs. NP2010, Gen IV, and AFCI are not responsible for these disruptions, but must respond to them. Due to the long-term nature of the R&D activities, it is critical that funding be stabilized. DOE senior management, OMB, and Congress should join together in establishing a consistent set of priorities and ensuring that the programs can count on proper and stable funding.

It is clear from both documents and discussions that Gen IV (including NGNP and NHI) and AFCI are inextricably intertwined if the overall objectives of the Gen IV roadmap are to be achieved. Despite this linkage, the only clear evidence that these programs are being considered in concert is a GPRA document that was withdrawn from formal consideration by SCoE because of its draft status.

Recently the Director of OMB and the Director of OSTP wrote "[t]he combination of finite resources and a multitude of new research opportunities requires careful attention to funding priorities and wise choices by agency managers." [5]In the likely event that funding can not be provided to cover the "required" needs of the programs, the observations made here may have a bearing on how the priorities are set. We are concerned that aspects of the evaluation and rating schemes applied in the budgeting process are inherently flawed when applied to long-term research programs. DOE/NE has generally claimed exemplary performance in meeting the annual performance measures such as milestones. However, SCoE finds that such performance is deceptive. In particular, the annual performance measures are established each year after the final budget is known. While this adjustment may be fair in the sense that DOE/NE cannot be expected to provide results that have not been funded, it is deceptive in that it camouflages the impact of budget shortfalls on the ability to achieve the long-term goals and mission of the various departments. These practices in performance measures can also be applied monthly in the subcomponents of the programs. R&D, and especially long-term R&D, can have short-term setbacks (in many cases not under its control) and dead ends, and yet come together at the end to meet the original goals. The SCoE prefers that DOE/NE and other federal agencies that have similar R&D activities be required to report the impact of annual budget shortfalls on the ability of the program to achieve their long-term goals and mission. In that regard, we find that, while the programs evaluated here have not yet derailed, some are perilously close to it unless the "required" levels of funding are provided in the very near future.

Overall, we find that attention has been paid to program description and planning, but resources (people and dollars) have not been provided consistent with the descriptions and plans. DOE and the Administration have given strong support to nuclear energy – but primarily only in words. Without resources to match the rhetoric, these programs will fail.

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[5] Memo for the heads of executive departments and agencies, "Updated Administration Research and Development Budget Priorities", from John H. Marburger, III, and Joshua B. Bolton, 12 August 2004.

Appendix A

In a letter of 31 December 2003 from William D. Magwood IV, Director Office of Nuclear Energy, Science and Technology to William Martin, NERAC Chair:

"[W]e request that NERAC establish new subcommittees ….."

"Subcommittee on Evaluations

The Office of Management and Budget (OMB) increasingly requires programs to rely on independent evaluations of their directions and progress. The full NERAC and its subcommittees have provided independent evaluations in the past, but these evaluations have never comprehensively covered the entire Nuclear Energy program. The subcommittee would engage appropriate experts to:

- Monitor on a continuing basis, designated Nuclear Energy programs, and
- Evaluate the progress of these programs against:
  - Direction and guidance provided by the full NERAC or any of its appropriate sub-organizations; and
  - Any program plans and performance measures developed by the program under evaluation.

We request this subcommittee engage with other appropriate NERAC sub-groups in carrying out its work but avoid including members of program-specific subgroups in its membership to preserve the independence of its review. We also request that the subcommittee report formally on Nuclear Energy programs no less than annually – on a schedule that would enable the subcommittee's conclusions to be relevant to OMB's review process."

Appendix B

Membership of NERAC Subcommittee on Evaluations

John Ahearne, subcommittee chair and NERAC vice-chair

Thomas Cochran, Director Nuclear Program, NRDC

Joseph Comfort, professor of physics, Arizona State University

Allen Croff, ORNL (retired)

Marvin Fertel, vice-president, NEI

Richard Meserve, President, Carnegie Institution of Washington

Michael Sellman, President and CEO Nuclear Management Company

Appendix C

Meetings of the NERAC Evaluations Subcommittee in 2004, all at the DOE Forestall building.

15 April: general overview of many NE programs

10 June: Gen IV

7 July: NP2010

13 August: AFCI