# *The Department of Energy's Use of Merit Reviews*

## Report of the External Members of the Laboratory Operations Board

**March 17, 1999**

**Laboratory Operations Board**
U.S. Department of Energy

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# Findings and Conclusions

In their evaluation of the Department of Energy's use of merit reviews, the external members of the Laboratory Operations Board reached several findings and conclusions. To fully understand and appreciate the work of the external members, the entire report should be read. However, for convenience, the findings and conclusions are summarized in the following:

## Findings

- The perception that the Department of Energy does not use merit reviews to evaluate its programs and projects is *incorrect*. The external members found extensive use of reviews throughout the Department, including its laboratories. There are no major programs or projects that escape some form of merit review. Significantly, evidence that the results of the reviews influence decisions was found.

- The type of merit review conducted for any given program or project is matched to the objectives of the research. The external members found this alignment of the assessment approach to the nature of the research to be a sound and appropriate management practice.

- There is no shared definition of what is meant by merit or peer reviews in the Department and no centralized point where program offices or laboratories can go to receive guidance on use of reviews.

- In its Strategic Plan published in 1997, the Department made a commitment to strengthen its management of the review process but never followed up on that commitment.
- A working group of the Research and Development Council has been established to coordinate the use of merit reviews across the Department's research and development programs.

## Conclusions

The Department should follow through on the commitments made in 1997 to strengthen its management of the review process. Any reform undertaken should respect the value of tailoring merit reviews to the nature of the research. These commitments included:

- Establishment of guidelines for conducting peer review at various levels of management.
- Periodic and random sampling of the use and effectiveness of peer reviews.
- Development of a process for linking peer review principles and methods to other evaluation activities.
- Development of ways to reward effective use of peer reviews.
- Research on improved methods for peer reviews.
- Expanded use of peer reviews as part of the Work Authorization Process.
- Utilization of enhanced quality Field Task Proposals.

Reestablishment of the Office of Program Analysis within the Under Secretary's Office would help institutionalize these commitments and serve as a resource for program offices and laboratories.

General agreement should be reached on how to characterize the different types of peer and merit reviews. Having an agreed to lexicon will help the Department better explain its extensive use of reviews.

# The Department of Energy's Use of Merit Reviews

## I. Introduction

In early 1994, Secretary of Energy Hazel O'Leary asked that a Secretary of Energy Advisory Board subcommittee be established to consider alternatives for the future of the Department's laboratories. The subcommittee, formally called The Task Force on Alternative Futures for the Department of Energy National Laboratories, is commonly referred as the Galvin Committee after its Chair, Robert Galvin, Chairman of the Executive Committee of Motorola, Inc.

The Galvin Committee issued its report in February, 1995. Among its findings was a recommendation that the Department strengthen the research and development it funds at its laboratories and at universities. Among the Department's responses to this recommendation was to task the external members of the Laboratory Operations Board with evaluating the use of merit reviews[1] by the Department. This document presents the results of the evaluation by the external members of the Laboratory Operations Board.

In conducting their evaluation, the external members of the Laboratory Operations Board looked broadly at the Department's use of merit reviews rather than evaluating the review of individual projects. The scope of work included a survey of 505 individuals from outside the Department who either currently serve or have recently served on Departmental or laboratory advisory committees, boards, or research proposal review groups, to determine their view of the effectiveness of the Department's use of merit reviews.

[1] While the original charge used the term peer review, the external members chose to enlarge the scope of their work to include all forms of merit reviews including peer reviews.

# II. Background

The Department of Energy and its predecessor agencies have a history of using merit reviews to judge the relevance and quality of programs and projects. Part of the practice has been the national laboratories' system of advisory boards and review panels (almost always composed of independent members) providing merit reviews (including peer reviews). Today, the Department, including its laboratories, uses merit reviews as an integral part of the procurement process, to evaluate programs and to guide funding decisions.

In keeping with the Galvin Committee's recommendations, the Department's September 1997 Strategic Plan committed the Department to improvements in its use of merit reviews to ensure the high quality and relevance of the Department's science. The Plan also calls to increase the coverage and improve the quality of merit reviews in FY 1999 and for a review of the merit and program review processes to be conducted. Consistent with this commitment a working group of the Research and Development Council has been established to coordinate the use of the merit reviews across the Department.

# III. Use of Merit Reviews

Merit reviews, as used in this report, encompass the full range of processes used to evaluate research and development activities at the Department of Energy. They are characterized by the use of technically competent experts who perform reviews utilizing objective criteria.

Merit reviews can be conducted either prospectively or retrospectively depending on the purpose. In many cases programs and projects receive both prospective and retrospective scrutiny. In addition to evaluating the quality and relevance of a program or projects, merit reviews can be used to help establish program priorities and future program directions. This type of review can guide the direction of work as well as the selection of performers.

The Department's merit review practices are guided by a variety of laws and regulations. The Federal Acquisition Regulation, the Department's Acquisition Regulation, and the Competition in Contracting Act guide the review requirements for research and

development contracts. When awarding both competitive and non-competitive contracts for financial assistance, including grants and cooperative agreements, the Department's procurement regulations require that it follow an approach analogous to merit reviews. The Office of Science's guidelines as promulgated in the Financial Assistance Regulations require that "... any financial assistance be awarded through a merit-based selection process. Objective merit reviews means a thorough, consistent and independent examination of applications based on preestablished criteria by persons knowledgeable in the field of endeavor for which support is requested." (10CFR 600.13 (a)) Evaluation teams assess the quality, business viability, and cost of each proposal.

The absence of consistent definitions for merit and peer reviews within the Department is a source of confusion. For the purposes of this report, the external members have chosen to differentiate between merit reviews and peer reviews in the following way. Merit reviews take the form of peer reviews when independent experts review research proposals and/or performer performance. Peers must be technically competent in the scientific or technical field under review and must be free from conflicts of interest. In some cases, however, independent peer review either is not feasible or appropriate. In these instances, there are other forms of review that offer valuable information and guidance for decision makers.

Within the Department of Energy, there are two categories of work where peer reviews are generally not used. The first area is national security. The uniqueness of the Department's mission to secure and maintain the Nation's nuclear stockpile severely limits the population of experts, with the required security clearances, who are sufficiently independent to qualify as peer reviewers. Instead, multiple merit reviews by knowledgeable experts are used to judge the technical merit and programmatic relevance of programs and projects. Organizations such as the JASONS and the National Research Council are often called on to conduct merit reviews of selected projects and programs in the area of national security.

The other programs and projects for which peer reviews typically are not used are those designed to move technology or processes into the marketplace. For example, the Office of Energy Efficiency and Renewal Energy supports research directed to developing energy efficient materials for use in building construction. For such programs and projects, the merit or relevance of any given effort is best judged by its acceptance or failure in the competitive environment. Before the ultimate market test, however, the Department engages experts from industry and the scientific and technical community in

program planning and merit reviews. These experts provide valuable judgements to program and project managers and influence the direction of work.

## Program Reviews

Throughout the Department merit reviews are used to examine the overall research priorities of the Department and its programs and to evaluate accomplishment of mission objectives. These types of evaluations are often provided by advisory committees associated with program offices, such as the Biology and Environmental Research Advisory Committee (BERAC), the High Energy Physics Advisory Committee (HEPAC), the Basic Energy Sciences Advisory Committee (BESAC), the Environmental Management Advisory Committee (EMAC), and the Nuclear Energy Research Advisory Council (NERAC).

These committees are made up of knowledgeable individuals from outside the Department, drawn mainly from a specific field of research, are formally chartered for a period of years, meet regularly, and report to the Assistant Secretary level or higher within the Department. The committees examine existing programs at their most highly aggregated level. Their scope includes reporting on the health, currency, and quality of the overall research that the Department is doing in a specific field.

The deliberations of these committees are both prospective and retrospective. Their reviews are prospective in that they often are called upon to recommend new directions for the Department (though not prospective in the sense of specific review of individual proposals). The reviews are retrospective in that they are often called upon to evaluate the quality of the research efforts across a wide range of program elements.

## Project Reviews

The use of merit reviews to evaluate projects is widespread across the Department. As a matter of Departmental policy, both unsolicited and solicited proposals for financial assistance are subjected to merit reviews as part of the procurement process. Prospective reviews using external independent peers are the norm for university-based research funded by the Department. University applicants generally submit unsolicited proposals for areas related to the Department's pursuit of national priorities in science and technology.

# IV. Use of Merit Review by the Department's Program Offices

A series of interviews with the Program Secretarial Officers responsible for the Department's major research and development programs is the basis for the following descriptions of how merit reviews are used by program offices. (The approach used in these interviews is described in a memorandum provided in Appendix A.) Subsequently, each program office was asked to review the section describing their office's use of merit review and update the information.

The varying objectives of the Department's programs call for different types of research. It follows that the forms of merit review appropriate to this range of research program also varies. The approach used by the Office of Science with its mission to support the basic research is distinctly different from that of the Offices of Energy Efficiency and Renewal Energy or Fossil Energy whose program emphasis is heavily influenced by the energy marketplace and where the emphasis is often on the *development* side of research and development.

In 1982, an Office of Program Analysis was established within what is now the Office of Science to arrange detailed peer reviews of specific projects and entire programs. It facilitated the more than 3,000 reviews in forty-two major research and development programs by 422 review panels. Though primarily retrospective in nature, there were instances where the panels were called upon to review research directions and proposals. A database of the results of these reviews was developed which can be used to benchmark new review results. The procedures used by the office and a sixteen-year summary of the programs reviewed are provided in Appendix B.

Recently, the peer review activities of the Office of Program Analysis were transferred to the Office of Planning and Analysis within the Office of Science. At the same time, adjustments in the review process were made to conform to the Federal Advisory Committee Act procedures. As a result, internal and external reports are now prepared. The "internal use only" report details the specific technical strengths, weaknesses, and potential improvements of individual projects. The external report provides the kind of nonproprietary and business-sensitive information appropriate for public disclosure.

Unlike the previous practice of the Office of Program Analysis, which was to cover the travel and per diem costs of reviewers and

meeting facilities, the Office of Science requires partial cost recovery for conducting peer reviews from the programs. The number of reviews being coordinated by this Office had been reduced to the point that it has an insignificant role in the merit review process in the Department.

A summary of current practice for each program office that funds research and development follows. The focus of each summary is on the program offices' approach and on the mechanisms that each uses to conduct its peer reviews.

## Office of Science

The largest part of the Department of Energy's research and development responsibilities falls under the Office of Science. Of the Department's total research and development budget of $7.5 billion, $2.8 is devoted to the programs supported by the Office of Science.

The Office's basic philosophy is to rely almost entirely on merit review, in one form or another, to evaluate day-to-day program activities, priorities, and directions. In fact, most of the Office's fundamental science and energy research programs are subjected routinely to such merit review to ensure scientific excellence and mission relevance. Peer evaluation is used extensively in these merit review processes.

Research conducted by performers other than the Department's laboratories (most often universities) constitute about one third of all Office of Science's research funds or approximately $900 million. Competitive selection of external research performers is governed by a formal processes of prospective and retrospective peer review using independent experts evaluating anonymous proposals. The approach is similar in all respects to processes employed by the National Science Foundation and the National Institutes of Health. These processes are codified under the Office of Science's Program Rule (10 CFR Part 605), which, with some exceptions for flexibility, requires each funded grant proposal to receive a minimum of three external peer reviews. Performance is also reviewed as part of all renewal proposals, typically on three-year cycles.

Approximately two thirds, or $1.8 billion, of the Office of Science's funds support research at the Department's laboratories. These programs also undergo merit review consisting of a mix of prospective and retrospective reviews. The reviews employ varying degrees of peer evaluation at both the laboratory and Departmental oversight

levels, including regular annual reviews of program management and onsite project reviews by Departmental staff. In addition, all laboratories, user facilities, and major research divisions have visiting committees of outside experts that provide annual peer review of research relevance and quality.

With the exception of some Congressionally mandated programs, almost 100 percent of all programs funded by the Office of Science are peer reviewed either prospectively or retrospectively, or both. But the frequency of the reviews varies across the programs. Some are scheduled for review once a year; others may be reviewed at shorter or longer intervals. This judgment is appropriately made at the Associate Director level.

The Office of Science also makes extensive use of a number of standing committees constituted under the Federal Advisory Committee Act. The Office routinely obtains advice on program content, quality, future direction, priorities, and proposed facilities from advisory committees to each of the major programs.

## Office of Defense Programs

The Office of Defense Programs utilizes merit reviews to ensure funding of the highest quality unclassified and classified scientific research while simultaneously providing maximum benefit in support of the Department's mission of maintaining a safe and reliable nuclear weapons stockpile. The reviews include both prospective and retrospective, involving both internal and external peers following standard peer review practices. These practices are applied to all levels of funding review from elements at the Program Office, to Operations Offices, to the three Defense Program's laboratories, and for university research.

The principal Defense Program research entities are Los Alamos, Lawrence Livermore, and Sandia National Laboratories. These laboratories, due to the heavy past federal investment in support of nuclear weapons development, are a unique source of expertise, facilities, and capabilities. The Office also supports unique laboratory facilities at the University of Rochester—Laser Energetics and at Washington State University—the Institute for Shock Physics.

At the macro level, the funding for the Defense Program laboratories is determined thorough an extended, iterative budget process. The laboratories, in turn, utilize peer review processes to ensure the quality and relevance of their research effort to the Department's mission. The laboratories use a variety of advisory committees, both

standing and ad hoc, to review proposed research and development activities as well as to assess the quality and status of ongoing projects and programs.

For new research and development activities, committees that have reviewed proposed work include standing national committees such as the JASONS, special panels chartered by the National Academy of Sciences, committees impaneled by the Department or other federal agencies, and advisory committees established by the laboratories. A similar spectrum of committees has engaged in reviews of a cross section of ongoing projects and programs.

The laboratories' nuclear weapons program has historically been scrutinized through many layers of review. This approach has been continued as the laboratories have moved into the era of nuclear stockpile stewardship in the absence of nuclear testing. If anything, the need to certify the safety, reliability, and performance of the nuclear weapons stockpile without testing has led to enhanced review to ensure confidence in the scientific principles and methods being applied to maintaining the stockpile.

Over the past several years, the JASONS—a group of senior scientists from outside the Department with security clearances—have reviewed a number of areas related to efforts in stockpile stewardship. Examples of these reviews include examining the experimental and analytical basis for understanding the performance of each weapon type planned to remain in the enduring stockpile, assessment of inertial confinement fusion and its relation to stockpile stewardship, and the application of proton radiography to hydrodynamic testing.

The Nuclear Weapons Council, made up of representatives from the Departments of Energy and Defense, provides advice on and reviews all matters relating to nuclear weapons research, development, and production, surety and maintenance, dismantlement, and the allocation of nuclear material. Defense Programs also calls on the Senior Advisory Group, and its various subcommittees advise the CINCSTRAT on scientific, technical, and policy issues during the development of the nation's strategic war plans.

Additionally, the Joint Advisory Committee provides advice to the Secretary of Defense and the Secretary of Energy about all aspects of nuclear weapons safety, security, use control, and operations; and the Project Officers Group reviews and assesses the reliability, effectiveness, and surety for each warhead type in the stockpile. They review upgrades, limited life component replacement activities, life extension plans, and revalidation processes.

As described in the section on the laboratories' use of merit reviews, the President of the University of California created a President's Council National Security Panel to review the scientific and technical quality of the work undertaken at three Department of Energy laboratories, Lawrence Berkeley, Lawrence Livermore, and Los Alamos. The Council provides the President an annual report of its findings and recommendations. Within the President's Council the National Security Panel biannually reviews the quality of the research funded by the Department of Energy's Offices of Defense Programs and Nonproliferation and National Security and the Department of Defense programs funded at Livermore and Los Alamos National Laboratories.

Unclassified Defense Programs research undergoes a merit review process similar to research funded by other parts of the Department. For instance, projects are first subjected to a prospective review by internal laboratory peers and managers to ensure the projects support the Department's mission of maintaining a safe and reliable nuclear weapons stockpile in a non-testing environment as well as being on the leading edge of science or technology. These projects also undergo both prospective and retrospective review by outside panels of experts from academia, government, and industry. As in the academic world, the results of unclassified research are published in open, peer-reviewed journals that in turn provide a final level of merit review. Finally, where research involves large appropriation of funds for user facilities, the Office uses a number of different types of reviews. These include internal and external prospective reviews, contractor reviews, and public comment sessions.

With regard to university research, Inertial Confinement Research at the University of Rochester supported by the Office of Defense Programs is subjected to continuing peer reviews. Also, the Office has been supporting research at Washington State University since the late 1960s. Starting in 1997, the Institute of Shock Physics at Washington State became a significant part of the Office's research program based on its leadership in the field and its state of the art facilities.

Research efforts funded directly by the Office of Defense Programs is subject to peer review with heavy involvement of the laboratories. For example, the Inertial Confinement Fusion program has used both a prospective review of independent proposers as well as retrospective review by the Inertial Confinement Fusion Advisory Committee, a committee chartered under the Federal Advisory Committee Act.

## Office of Fossil Energy

The Office of Fossil Energy sponsors research that ranges from fundamental, to applied, to developmental in nature. Each phase of the research requires different approaches to merit review. Research supported by the Office of Fossil Energy that investigates basic scientific issues is subject to merit reviews very similar to those conducted by the Office of Science. For the developmental part of the Fossil Energy research and development program, however, the measure of success is market penetration. Market penetration is defined as the degree to which the Fossil Energy sponsored technologies and processes are adopted by industry.

In FY 1999, Fossil Energy's appropriation for research and development is $287 million. Merit reviews, using several different approaches, are used for over 90 percent of the research funded by Fossil Energy. For reviews of large parts of the Fossil Energy program, such as the entire Petroleum and Natural Gas Research and Development Program, or the entire Coal Research and Development program, Fossil Energy looks to industry through such bodies as the National Petroleum Council and the National Coal Council to provide technical reviews and evaluations of market relevance. The National Research Council, part of the National Academy of Sciences and the National Academy of Engineering, and the President's Committee of Advisors on Science and Technology (PCAST) have also reviewed major portions of the Fossil Energy Research & Development program. Additionally, the Assistant Secretary for Fossil Energy uses a program called the Executive Seminar Program to provide opportunities to engage senior executives from the fossil fuel industry in discussions regarding the program's direction and priorities.

At the individual project level, Fossil Energy has several review mechanisms. All Fossil Energy sponsored research at the national laboratories, universities, and industry facilities is subjected to review during annual contractor reviews. At these public meetings, generally each principal investigator presents and defends the project's yearly progress before peers and the federal technical program managers from the Office of Fossil Energy.

Some programs have steering committees to guide the reviews. In the Advanced Turbine Program, for example, a Government-Industry Steering Group meets annually to coordinate program reviews. Additionally, a consortium of 50 universities, headed by Clemson University, provides selected panel reviews of the university-based portion of the Advanced Turbine Program.

Prospective merit reviews take place prior to selection of projects for Fossil Energy funding. In the Clean Coal Technology Demonstration Program, for example, the procurement process involved multiple rounds of review with increasing selectivity. The determination of awardees through this process typically involved over 100 experts who judged the proposals on the basis of a set of predetermined criteria. This process was followed by an executive review at the Assistant Secretary level before selection.

## Office of Energy Efficiency and Renewable Energy

The basic philosophy of the Office of Energy Efficiency and Renewable Energy is that conventional, prospective peer review is appropriate for the science side of the program and is used extensively. However, the Office has found that peer reviews are less appropriate for the technology development side of the program where success is determined by market acceptability. In this latter area, the alternative to conventional peer review is the "technology road map" developed with industry to guide program decisions on an ongoing basis and supplemented by a variety of evaluation mechanisms that range from advisory boards to industry evaluations that stress market-applicability of the programs.

The Energy Efficiency and Renewable program's total research and development budget is approximately $550 million. Of the research and development funds, $350 million is used to support research and development at the laboratories. Of this amount, 80 percent is merit reviewed, either pre- or post-award. Of the non-laboratory research and development, which comprises grants, contracts, and cooperative agreements, approximately 30 percent is merit reviewed by external reviewers with the remaining 70 percent reviewed using a variety of approaches. The Office of Energy Efficiency and Renewable Energy has recently instituted a new initiative and expects that in the future 90 percent of its research will be merit reviewed.

## Office of Environmental Management

The Office of Environmental Management's basic research and technology development programs are run by the Environmental Management Science Program and its applied technology development work is done under the Technology Development Program. Each program follows different merit review processes.

The Office of Environmental Management and the Office of Science jointly manage the Environmental Management Science Program. The Science Program's budget of $50 million annually supports basic research to develop processes and technologies that will lead to reduced costs and risks associated with cleaning up the Department's nuclear complex. All proposals submitted to the Science Program for contracts and financial assistance are subject to peer reviews using an approach similar to that used by the National Science Foundation, National Institutes of Health, and the Department's Science Office. This represents approximately 25 percent of the total research and development of the Office of Science and Technology's budget. In FY97 and FY 98, the value of research peer reviewed was $76 million.

All Science Program solicitations are published in the Federal Register to ensure wide participation. The solicitations are based on pre-identified research needs related to intractable cleanup problems or those needing more effective solutions. Proposals received in response to the solicitation are subjected to two levels of review. First, peer review panels of scientific experts evaluate proposals for scientific excellence. Second, panels of scientists and engineers from the Department's sites evaluate proposals for relevance to the Department's identified cleanup problems. Final selection of projects is recommended only for proposals that score well in both reviews.

The Technology Development Program, uses a dual merit review system to ensure all projects meet the highest technical and scientific standards, and are relevant to solving existing Environmental Management remediation problems. Technical peer reviews are conducted by the American Society of Mechanical Engineers (ASME), and annual programmatic reviews, conducted by the program area leads, ensure projects meet relevancy requirements of end-users of the technologies or processes.

Under ASME management, technical peer reviews are conducted using panels to provide independent, external evaluation of technical and scientific merit of a technology. These technical peer reviews are done at various stages of development from late stage basic research through pilot demonstration and deployment and those conducted in FY97 and FY98 represent over $265 million invested in technologies.

Annual programmatic reviews within each program provide program level evaluations. Projects within each technology area are evaluated with respect to other technologies being developed. Evaluation criteria include linkage to Environmental Management's

customer needs; relative degree of technical maturity; technical, regulatory, and stakeholder review and approval; and deployment schedule.

The Office of Science and Technology also engages in formal interactions with the National Academy of Sciences' Board on Radioactive Waste Management. The Board has reviewed various aspects of the Office of Science and Technology's programs, including its approach to merit review, priority setting, and decision making; decontamination and decommissioning; high level waste tank remediation; mixed waste processing; subsurface contamination; vadose zone problems; and the program structure and research agendas for the Environmental Management Program.

## Office of Nuclear Energy, Science and Technology

The Office of Nuclear Energy, Science and Technology has undertaken a new approach to peer reviews for its nuclear energy research and development programs, some of which are expected to begin in FY 1999. As with other Departmental offices, the specific form of peer review varies according to the research element involved.

For example, for the Nuclear Energy Research Initiative, the Office plans to implement a peer review process under 10CFR 600 and generally modeled after programs conducted by the Office of Science. The Office will employ an independent peer review process to evaluate the scientific and technical quality of investigator-initiated research proposals from universities, national laboratories, and industry. Using this process to competitively select research will help to address long-term issues affecting the future of nuclear energy and the application of nuclear technology. Upon completion of the technical evaluation of the proposals, a second step in the merit review process will be to evaluate the relevancy of the proposed work to the objectives of the program. This second steps may involve a different group of reviewers as well as the Federal program managers of the work.

Another example of the new approach involves the research jointly funded by the Department and industry. For the Nuclear Energy Optimization Program, the Office and the Electric Power Research Institute (EPRI) conducted a detailed analysis and established a comprehensive, seven-year *Joint DOE/EPRI Strategic Research and Development Plan* to guide research needed to address the critical issues affecting existing nuclear power plants. This plan was reviewed by more than 200 utility, university, and laboratory experts. Further, the Nuclear Regulatory Commission and the EPRI Nuclear

Power Council have endorsed this research plan. Finally, to define annual program activities, the Office and EPRI are establishing a coordinating peer review group consisting of representatives from the commercial nuclear industry, Nuclear Regulatory Commission, and universities.

All of the Office of Nuclear Energy, Science and Technology's future research activities will be overseen on a strategic level by the new Nuclear Energy Research Advisory Committee (NERAC). The NERAC, chartered under the Federal Advisory Committee Act, will evaluate all current and future research programs, the effectiveness of their peer review mechanisms, and their progress. The NERAC will also provide strategic advice to the Office on the general direction of its research programs as well as their relative priority and funding requirements.

## Office of Civilian Radioactive Waste Management

The Office of Civilian Radioactive Waste Management employs merit reviews in the form of peer review and expert elicitation to evaluate its work related to the Yucca Mountain site for disposal of nuclear waste. The form and approach of the peer reviews used by the Office are in compliance with guidance from the Nuclear Regulatory Commission, which has regulatory oversight for the Yucca Mountain construction and operating license. Merit reviews are conducted to focus and address technical issues and inherent uncertainties associated with characterizing and predicting the performance of the natural and engineered components of a potential geologic disposal system at Yucca Mountain for the unprecedented period of 10,000 years.

The bulk of the work supported by the Office is research for development of a potential repository. External peer review is used to assure technical credibility and adequacy of scientific work, and external validation of the adequacy of the data collection methodologies and predictive performance models. When used internally, the review panels work in an iterative relationship to provide continuous feedback to improve the quality of the work. When external validation is the primary purpose of the review, the external credibility of the panel is a primary selection criterion, and the reviewers do not become involved in the development of the product, but perform a closed peer review, and results of the panel review are final when issued.

Following Nuclear Regulatory Commission guidance, peer review is used by the Office in several areas important to the credibility of our

scientific work. The Total System Performance Assessment Peer Review was initiated in January 1997 and continued through January 1999. Panel members were chosen for their international experience or direct experience with the WIPP performance assessment review. Their review was to assure the technical soundness of the performance assessment, and thus its credibility is to be used in deciding on site suitability as part of the adjudicatory licensing proceeding. In addition, the Office formed a peer review panel to evaluate the sampling, analytical, and interpretation aspects of chlorine-36 and other environmental isotope data which are important to evaluating the site's hydrogeologic characteristics in developing a predictive model for groundwater flux and distribution in a potential repository. This review was completed in January 1998 and considered in the preparation of the Viability Assessment published in December 1998.

The Office also uses formal elicitation of expert judgment to focus and quantify the range of information and informed technical opinion that lead to an understanding of a technical issue. This is particularly applied in areas of technical uncertainty which have a potentially significant impact on the performance of the site. Expert elicitations have been held in five technical areas for the development of the Viability Assessment. However, the Office does not rely on expert judgement as a substitute for objective quantitative analyses.

The use of expert judgment also has been important in developing a common understanding of issues to be addressed and technical data sets available for assessing issues. For example,the Office formed a panel of experts to review the issues and data for the probability of a volcanic event disrupting the potential repository at Yucca Mountain. The panel completed its study and submitted a final report in June 1996, which formed part of the basis for work reported in the December 1998 Viability Assessment.

In addition, the Office has formed the Mined Geologic Disposal System Consulting Board as an ongoing, independent, multi-disciplinary panel to provide feedback on the design of repository surface and subsurface designs, and on waste package design and fabrication. This form of review has resulted in substantial design improvement.

In addition to merit reviews performed by the Office, there are two oversight groups which are consulted by the Office, or which provide their review or opinion at their own initiative. These two organizations are the Nuclear Regulatory Commission, and the Nuclear

Waste Technical Review Board. Further, the National Academy of Sciences Board on Radioactive Waste Management has been requested by the Office to perform reviews; and the State of Nevada performs an oversight role, under the Nuclear Waste Policy Act, as the potential host state for a geologic repository.

## Office of Fissile Materials Disposition

The Office of Fissile Materials Disposition has used an external advisor review process for independent views on key decisions regarding technical initiatives and in the initial assessment of the scope of work for the plutonium disposition technologies. As a rule, the program's work scope, tasks and activities are defined and the candidate performers for the work limited to organizations with experience with handling plutonium or highly enriched uranium, along with the infrastructure to conduct work with these materials. The formal assessment on the initial scope of work was conducted by participants from the Office of Fissile Materials Disposition and from the national laboratories involved in the program.

The program has used the JASONS, the National Academy of Sciences, and a senior technical review group to provide reviews on initiatives and decisions.

## Office of Nonproliferation and National Security

The Office of Nonproliferation and National Security's research and development activities support priorities established by Presidential direction and the operational needs of other national security organizations with which it works. The Office's philosophy is that merit review is appropriate for the science portion of its program, but for the larger portion of its program that supplies prototype or operational systems to its customers, other forms of reviews are more appropriate.

As with research and development funded by the Office of Defense Programs, the activities within the Office of Nonproliferation and National Security involve high-level, classified information. People with the scientific credentials to qualify as reviewers not only have to be cleared, but generally are required to have a "need to know." Given this requirement, truly independent reviewers are rare. This results in the use of merit reviews rather than peer review.

Merit reviews are conducted through a variety of mechanisms. For the Office, annual program reviews are conducted with participa-

tion from other government agencies conducting similar research and development. On a case-by-case basis, the quality of the research and the relevance of the work to mission requirements is reviewed by organizations such as the JASONS and the National Research Council. Organizations such as these are also asked for advice on future program directions and emerging technologies to meet national security objectives. Two years ago the overall program also was reviewed by a panel of distinguished scientists, and the Director of the Office is establishing another independent panel to provide for routine, scheduled reviews.

Typically, about 80 percent of the program is reviewed prospectively and about 90 percent is reviewed retrospectively by internal and external experts. Usually the reviews are conducted annually, but occasionally special reviews of large development programs are conducted by representatives from other government agencies, industry, other national laboratories, and academia who have relevant expertise and appropriate clearances.

# V. The Use of Merit Reviews by the Department's National Laboratories

Merit reviews of research are used by all the Department's national laboratories. Two examples are the University of California and the University of Chicago. Other laboratory management contractors have processes that may differ; however, their overall purpose is similar.

The University of California manages three laboratories, Lawrence Berkeley National Laboratory, Lawrence Livermore National Laboratory, and Los Alamos National Laboratory. The University has review committees for each of its divisions. In the case of Los Alamos National Laboratory there are 15 divisions. The members of these committees are appointed by the laboratory director and report to the director. They are almost exclusively individuals from industry or academic research institutions. They hold annual meetings and report to the director on their assessment of the divisions' technical and scientific quality.

The director of the laboratory reviews the reports of the divisional review committees and submits a self-assessment to a Council established by the President of the University of California (this is

known formally as the President's Council on National Laboratories). Members of a subpanel of the President's Council (the Subpanel on Science and Technology), using the reports of the divisional review committees and the lab directors' self-assessments, then independently review the divisions in the three labs for which they have expertise. They compare and contrast the different divisions and not only assess the individual technical and scientific capabilities, but also evaluate the laboratory's performance in contributing to the programmatic goals of the Department.

The various reports are integrated and the Office of the President of the University of California submits the findings to the Department. The Department in turn asks the program offices that fund research at the laboratories to review the reports and evaluate how the laboratories have contributed to the programmatic goals of the Department. It should be noted that the performance of research is generally the major factor in determining management rewards for the contractor.

The more direct review structure used by University of Chicago at Argonne National Laboratory is typical of those used by contractors that manage only one laboratory. The Board of Trustees of the University appoints a Board of Governors which acts for the University in managing Argonne. The Board, chaired by the university president, divides oversight responsibilities across committees. The Scientific and Technical Advisory Committee is responsible for programmatic oversight and is made up of representative from the scientific, engineering, and business communities.

Included among the Scientific and Technical Advisory Committee's responsibilities is evaluating and maintaining the quality of the research conducted at the Laboratory. It accomplishes this through separate review committees whose members are drawn from academia, science, engineering, and business.

# VI. The Department's Use of Merit Reviews from the Perspective of Participants in the Reviews

A survey was initiated to solicit views on the Department's use of merit review from those who serve or have served on merit review panels or other advisory bodies for the Department. Names of re-

viewers and advisors were collected from Program Offices and laboratories. A questionnaire was prepared and electronically sent to the individuals on the lists. Care was taken to eliminate those individuals such as laboratory personnel who might have direct ties to the Department. The affiliation of those receiving the questionnaire was as follows:

| | |
|---|---|
| University | 63.0% |
| Industry | 13.5% |
| Other research laboratories (non DOE) | 9.5% |
| Associations | 3.2% |
| Independent Consultants | 2.8% |
| Other | 8.0% |

The questionnaire, a list of those asked to complete the questionnaire, and comments received are provided in Appendix C.

Figure 1 summarizes the percentage of respondents who provided characterizations of the quality of the research they reviewed.

Out of 207 respondents, 110 were on panels that met on a regular basis. The panels had a variety of purposes: 113 served on panels that provided retrospective analyses of scientific work; 155 served on panels that provided prospective guidance on strategic goals and/or research initiatives; 131 served on panels that evaluated specific research proposals or projects; and 127 served on panels that provided evaluation of previous research. Eighty-one percent felt that

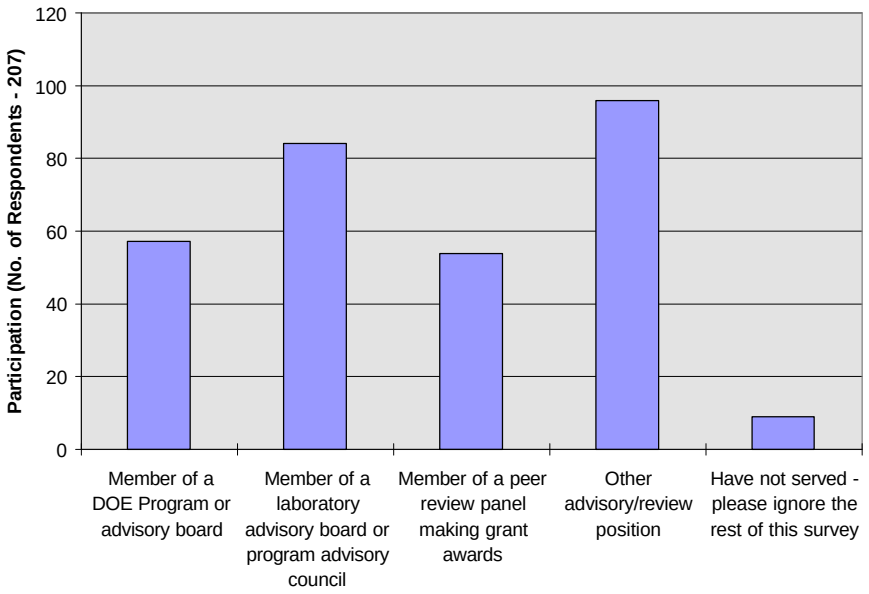


**Figure 1.** *Distribution of respondents to the survey by participation.*

the Department or the Laboratory was responsive to the panel's input while 10 percent did not. The remaining 9 percent did not respond.

Of particular interest were the respondents' views on the quality of research supported by the Department. Figure 2 is a summary of these responses. To determine whether the type of panel might influence the response to this question, further analysis was performed. This is summarized in figures 3 through 6.

# VII. Conclusions

On the basis of this qualitative review of the application of the Department's merit review processes it is clear that such mechanisms are in broad use. The Department appropriately uses review mechanisms that match the specific objectives of individual programs and projects. The relevance and quality of the review outcomes are enhanced because the style of review is determined by nature of the research. A one-size-fits-all approach would undermine the legitimacy of the evaluation. For example, the predominately basic research programs funded by the Office of Science are appropriately peer reviewed often using outside independent reviewers. In contrast, the Office of Defense Programs, which funds more applied research, uses outside experts to assist in its mostly retrospectively reviewed programs.

While program offices and laboratories need to have the flexibility to select the appropriate type of review mechanisms for their programs and projects, the Department does need to issue definitional guidance so that across the Department consistent terminology is used for review of the same type.

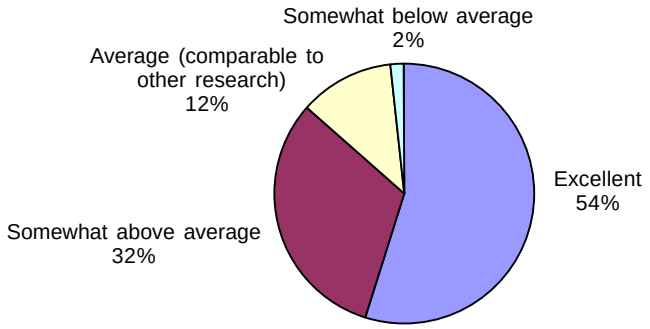


**Figure 2.** *Quality of research supported by the Department of Energy.*

There are no major programs or projects that escape some form of merit review. Indeed, there generally are several layers of review both within the Department and at the laboratories.

Analysis of the results of the survey of external participants in merit reviews for the Department, including the laboratories, indicates that they believe the Department and its laboratories are responsive to the input they receive from these reviews. Nevertheless, the Department should issue a set of guidelines for the operation merit review panels which incorporate the best practices presently in effect among the many parts of the Department responsible for managing or performing research activities.

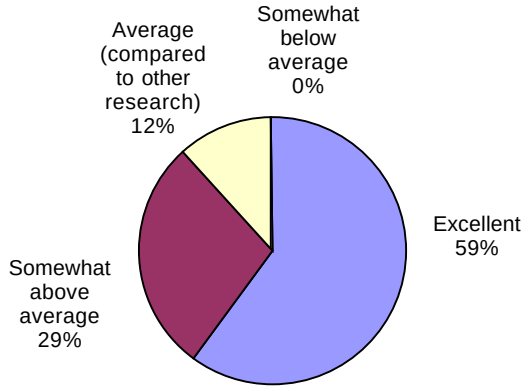


**Figure 3.** *Quality of research performed by Department of Energy as rated by members of DOE Program Advisory Boards.*

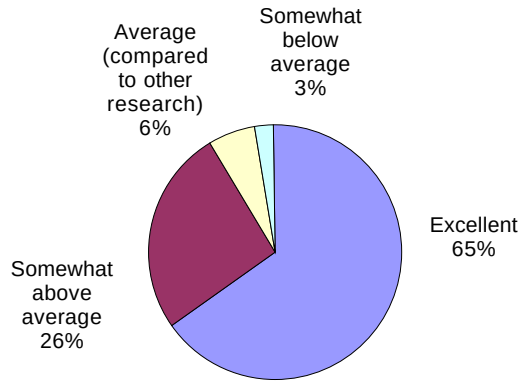


**Figure 4.** *Quality of research performed by Department of Energy as rated by members of DOE Lab Advisory Boards.*

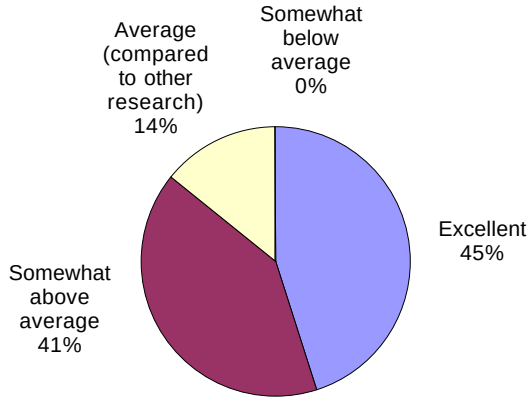


**Figure 5.** *Quality of research performed by Department of Energy as rated by members of peer review panels.*

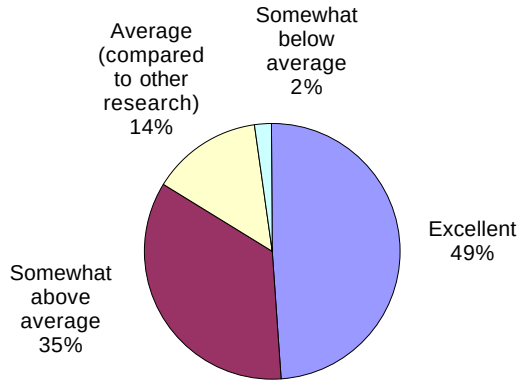


**Figure 6.** *Quality of research performed by Department of Energy as rated by members of other advisory or review panels.*

The external members found that the application of peer review processes is delegated to the program offices with no overall guidance given on which programs should undergo peer review prior to funding (prospective) or periodic merit review (retrospective) and in what detail. In Appendix D "Peer Review at the Department of Energy," the Department committed to the strengthening of its management of the peer review process through a variety of mechanisms, including

- Establishment of guidelines for conducting peer review at various levels of management
- Periodic and random sampling of the use and effectiveness of the peer reviews
- Development of a process for linking peer review principles and methods to other evaluative activities
- Development of ways to reward effective use of peer reviews
- Research on improved methods for peer review
- Expanded use of peer reviews as part of the Work Authorization Process
- Utilization of enhanced quality Field Task Proposals.

These commitments should be honored. Reestablishment of the Office of Program Analysis within the Under Secretary's Office would help institutionalize this ongoing self-improvement of the system of merit review. It also would be useful in demonstrating to a sometimes skeptical scientific community and public that the Department of Energy's merit review process is as effective in meeting its need for high-quality research as those of other research agencies are in meeting their needs.

Note: While the external members of the Laboratory Operations Board were conducting their study, the Department's Office of Inspector General completed an audit of the practices of three of the Department's laboratories—the National Renewable Energy Laboratory, the Pacific Northwest National Laboratory, and Los Alamos National Laboratory. The Inspector General's report, "The Department of Energy's Peer Review Practices" (April 1998), concluded that the three laboratories had established adequate peer review programs that conformed to the requirements of the Government Performance and Results Act and performance-based contracting. No recommendations were included in the audit report, which is provided in Appendix E.

# Appendices

# Appendix A
# Memorandum from Paul Gilman, External Member, Laboratory Operations Board

Memorandum to Distribution

From: Paul Gilman

Subject: External Members LOB Review Of Mechanisms For Evaluating Technical Merit Of Laboratory Programs

As you know, one of the reviews committed to by the Laboratory Operations Board in the *Strategic Laboratory Mission Plan- Phase 1* is that "the external members of the Board will document and review the mechanisms used throughout the Department for evaluating the scientific and technical merit of the work at the laboratories." As the external member of the Board who was asked to lead this effort, I would like to meet with you to discuss how I propose to conduct the review and to receive information from you how on the mechanisms used to evaluate technical merit in the programs under your jurisdiction. I shall contact your office to set up an appointment in this coming week. It is my intention to have the report ready for presentation to the LOB by May 15, so that means that we are on a very fast track.

The purpose of the report is to provide the basis for external members to comment on the mechanisms used by the Department to assure the quality of the research it funds. As you know, the Department is often criticized for "not using peer review" by people who do not understand the mechanisms the Department uses to evaluate the quality of its work. The first part of the report will describe the detailed processes used by the elements of the Department that fund research. During our meeting, I would like to get information for this part of the report. The specific information I would like is contained in the Attachment.

The second part of the study will attempt to validate how well the system is working. This would entail a survey of individuals, primarily from outside the Department, who have participated in the evaluation and review process to get their perspective on the quality of the programs they have reviewed, and how well their advice has been used.

Bennett Miller of the Office of Science is assisting me in this effort. He can be reached at (202)586-7172; fax: (202)586-7152; e-mail: bennett.miller@oer.doe.gov. I would appreciate it if you could confirm the person designated below as a point-of-contact who can work with Bennett and me as we begin collecting the data that we need.

## Distribution

Martha Krebs, ER-1
Victor Reis, DP-1
Alan Alm, EM-1
Christine Ervin, EE-1
Patricia Godley, FE-1
Terry Lash, NE-1
Ken Baker, NN-1

cc:

## Lab Directors

Thomas Barton, Ames
Dean Eastman, ANL
N. P. Samios, BNL
John Peoples, FNAL
Bart Krawetz, INEL
Charles V. Shank, LBNL
C. Bruce Tarter, LLNL
Siegfried S. Hecker, LANL
Charles Gay, NREL
Alvin W. Trivelpiece, ORNL
William J. Madia, PNNL
John Schmidt, PPPL
Paul C. Robinson, SNL
Burton Richter, SLAC
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Richard F. Celeste
Paul Fleury
Edward A. Frieman
M.R.C. Greenwood
Maxine L. Savitz
Robert Werthheim

## Points-of-Contact

Clyde Frank, EM-50
Mauri Katz, DP-15
Robert Knipp, NE-20
Bob San Martin, EE-1
Marvin Singer, FE-70
Phil Stone, ER-5
Bob Waldorn, NN-20

Other
Al MacLachlan
Frank Peters, FM-1
Toni Joseph, ER-7
David Cheney, SEAB
David Goldman, SEAB

# Attachment

The following are questions we would like to address in the review. They will form the basis for describing the structure (the "taxonomy") of the Department of Energy technical review mechanism that will be included in the first part of the report:

## Description

What mechanisms are used to evaluate the quality of the research either prospectively, i.e., prior to the selection of research performer, or retrospectively, i.e., during the performance of the work, or upon its completion? Since research evaluation is performed both by the funding agency and by the performing organization, it is important that we capture both parts of the process. For ease in presentation, I suggest that a Table, such as the one given below, be used to present this information. The Table should include a description of the size and composition of review committees, and a description of their output.

## Utilization

How are the reviews used in your decision making process? What impact can be ascribed to them, either budgetary impact or programmatic impact? Do the reviews result in a change in performers or a restructuring of programs? How do you measure whether a review has been satisfactory?

Chosen for illustration are some ER programs with which I am familiar. To answer the questions I posed above would clearly require a great deal more detail than is presently contained in the Table below.

***Table A–1. Sample table for reporting review mechanisms***

| Program | Program Review | Contractor/Laboratory Review |
|---|---|---|
| Program A | Review Mechanism<br>*Prospective*<br>—Peer and outside for extramural grant requests (dollars)<br>*Retrospective*<br>—Review of overall laboratory programs on an annual basis | Laboratory A<br>*Prospective*<br>—Using merit with outside reviewers (dollars)<br>*Retrospective*<br>—Using outside advisory committees and DOE program office annual review<br><br>Laboratory B<br>... |
| Program B | *Prospective*<br>—Extramural: peer with outside participants; intramural: merit (dollars)<br>*Retrospective*<br>—Advisory Committee annual review | Laboratory A<br>—Merit with other lab researchers (dollars)<br><br>... |

# Appendix B
# Office of Program Analysis Procedures for Peer Review Assessments

## Introduction

These assessment procedures provide the methodology used by the Office of Energy Research (OER) for independently assessing the quality and relevance of research and development within the Department of Energy (DOE). The assessments are performed by scientific and technical experts (Reviewers) who examine individual projects which comprise a program and evaluate each project's quality of research and relevance against the project's objectives and program goals. Analysis of the Reviewers' evaluations given individual projects can contribute to the evaluation of a program.

## Methodology

From its staff, OER designates an Executive Secretary to lead the assessment. With the assistance of the DOE Program Manager, the OER Executive Secretary schedules two to three day assessment meetings where sets of technically related research projects from the program are evaluated. OER also designates a Facilitator for each set of projects. Facilitators assist the Reviewers in completing their required tasks. They also ensure that the Reviewers strictly adhere to the assessment procedures, including limiting project discussions among Reviewers to exchanges of information.

OER selects Reviewers after obtaining recommendations from the DOE Program Manager and the Principal Investigators, and by an independent search for qualified candidates. Because many of the projects are broad and multidisciplinary, input from a broad range of experts is often necessary for their evaluation. Every effort is made so that at least two of the Reviewers are expert in the princi-

pal scientific disciplines or technical areas for any research project. Reviewers are drawn from academic institutions, industry, Government laboratories, and other sources, as appropriate.

Prior to the assessment meeting, information summarizing each project is requested from the Principal Investigators. Copies of the information are furnished to the Reviewers to prepare them for the Principal Investigators' oral presentations. An outline for this information is provided in Appendix A.

At the assessment meeting, the reviewers' evaluations focus on the scientific and technological aspects and the mission relevance of the projects, and not on program budgetary or management issues. Reviewers evaluate the scientific and technical merit and quality of the research being performed under the current contract or grant. In the case of a recent extension or continuation of the project, they review the immediately preceding contract or grant, i.e., the reviewers evaluate the most recent project performance, results, and products.

## Assessment of Projects

To begin the assessment meeting, the Reviewers meet in a plenary session. After welcoming remarks, a summary of the assessment process is presented, key staff personnel are introduced, and questions are answered. Reviewers then reconvene in separate breakout rooms for the sets of projects to be evaluated. There, Facilitators brief the Reviewers on their respective activities and responsibilities.

Prior to the appearance of the first Principal Investigator, the DOE Program Manager briefs each group of Reviewers for approximately 15 minutes on the set of projects they will evaluate. This overview orients the Reviewers on the history, specific objectives, context within the DOE program area, and context within the field of the program area of that set of projects. The DOE Program Manager provides 10 copies of this overview to the Facilitator as a resource for the Reviewers in their evaluations. The first Principal Investigator is then invited into the breakout room.

The Principal Investigators' oral briefings supply the Reviewers with sufficient information to evaluate the projects using the factors, criteria, and formats given in Appendix B, Form 1. These 30

minute briefings emphasize the scientific and technical aspects of the projects, namely:

- Specific project objectives and how they relate to the DOE program's mission
- Resources, special talents, and facilities used
- Scientific and technical content of the project, including issues being addressed and their significance and importance to the DOE program
- Experimental and theoretical approaches employed
- Major recent accomplishments of the project together with supporting data
- Remaining planned activities.

Principal Investigators also inform Reviewers of the identity of project staff and any collaborators, including their education, expertise, and role in the project, and the project's history showing DOE and non-DOE funding broken down by the periods of time in which the funding was received. A list of topics to be included in the oral presentation is provided in Appendix A, "Information to be Provided and Presented by the Project Principal Investigator."

Reviewers individually assess each project for the following evaluation factors

- Scientific or technical merit of the project objectives
- Importance of the project objectives to the program mission
- Quality of the project team to perform its objectives
- Scientific or technical approach
- Productivity
- Probability of successfully accomplishing the project's objectives
- Overall project evaluation based on the above factors.

These factors and their respective written and numerical rating criteria are provided in Appendix B, Form 1. Each Reviewer also

completes a Self-Rating Form (Appendix B, Form 2) for the project being rated. The self-rating form assists the OER Executive Secretary in preparing the draft assessment report.

The assessment forms are followed precisely in performing the evaluations to ensure consistency of review for all projects. Any issues that arise regarding the meanings of the factors or criteria on the forms, or other matters requiring interpretation of these procedures, are resolved by the Executive Secretary.

## Identification of Research Needs and Opportunities

After all projects in the set have been evaluated and a draft assessment report completed, Reviewers are asked to individually identify research needs and opportunities with respect to the DOE research program in the specific topic area of the set of projects evaluated. These would be based on their expertise and knowledge of the needs of the program area, together with the newly acquired information pertaining to the nature and quality of projects evaluated.

## Assessment Summary

The Executive Secretary, drawing upon individual contributions from Reviewers, prepares a draft assessment report for the sets of projects evaluated. These contributions include all the numerical scores for each project accompanied by evaluation narratives. Future needs for supporting research are also provided as a narrative. An outline for the Assessment Reports is provided in Appendix D. Copies of the Assessment Reports are provided to the DOE Program Manager requesting the assessment. Further distribution of information in the Assessment Reports is by the DOE Program Manager. Principal Investigators are provided evaluation results only on their respective projects.

# Instructions for Completing Project Rating Forms

*Peer Review Questionnaire (see Appendix B, Form 1)*

Reviewers individually rate the project using seven factors, including an overall project evaluation. Rating criteria for each factor use a scale composed of integer values from zero to ten, with the ends of the scale representing seriously deficient and outstanding attributes, respectively.

For the first factor (or question to address), Q1, "Scientific or Technical Merit of the Project Objectives," Reviewers assess the importance of the scientific or technical question or problem addressed, including the potential importance or value to science (technology) of meeting the project objectives. These judgments are based primarily on the Reviewers' knowledge of the scientific or technical field. These judgements should *not* consider who is performing the research or how well the research is being conducted.

For Q2, "Importance of Project Objectives to Mission," Reviewers assess the importance of the project's objectives in terms of contributing to the program's mission. Again, these judgments should *not* consider who is performing the research or how well the research is being conducted.

For Q3, "Quality of Project Team," Reviewers assess the composition and quality of the team through examination of contributions by individual and associated team members relevant to the project's objectives. Also considered are the team members' honors and awards, their experience relevant to the project area, and the balance of appropriate skills (including collaborators) for accomplishing the project's objectives.

***Table B–1. Peer review summary data (1982–1997)***

| Program Reviewed | No. of Panels | No. of Reviewers | No. of Projects |
|---|---|---|---|
| 42. Lighting Research Program *(November 1997)* | 8 | 2 | 14 |
| 41. Laboratory Technology Research *(August, September, October, November 1996; January 1997)* | 87 | 15 | 95 |
| 40. Beryllium Health Effects Research *(July 1996)* | 6 | 1 | 7 |
| 39. Fossil Advanced Research *(June, July 1995)* | 40 | 6 | 43 |
| 38. Fossil Advanced Research *(January, February 1995)* | 50 | 8 | 58 |
| 37. Photovoltaic *(August, October, November, December 199 **[?]**)* | 115 | 15 | 123 |
| 36. Large Computational Projects *(June, July 1994)* | 61 | 10 | 78 |
| 35. Structural Biology *(May 1994)* | 31 | 5 | 8 |
| 34. Fossil Advanced Research *(January, February 1994)* | 52 | 8 | 60 |
| 33. Engineering Research *(November 1993)* | 28 | 4 | 30 |
| 32. Radiation Chemistry *(October 1993)* | 22 | 3 | 23 |
| 31. Heavy Element Chemistry *(October 1993)* | 14 | 2 | 14 |
| 30. Bioscience *(July, September 1993)* | 55 | 8 | 60 |
| 29. Applied Math *(March, April 1993)* | 64 | 8 | 9 |
| 28. Solar Photochemistry (BES) *(January, February 1993)* | 62 | 8 | 5 |
| 27. Geosciences (BES) *(January, May, July, September 1993)* | 126 | 16 | 136 |
| 26. Combustion (BES) *(October, November, December 1992)* | 94 | 13 | 100 |
| 25. Materials (BES & CE) *(June, July, September, October, November, 1992; February, March, May, June, October 1993)* | 299 | 44 | 332 |
| 24. Catalysis (BES) *(May, June, July 1992)* | 78 | 11 | 81 |
| 23. Nuclear Medicine (OHER) *(April, May, August 1992)* | 118 | 14 | 120 |
| 22. Geothermal Energy (CE) *(April 1992)* | 44 | 5 | 42 |

***Table B–1. Peer review summary data (1982–1997) (contd.)***

| Program Reviewed | No. of Panels | No. of Reviewers | No. of Projects |
|---|---|---|---|
| 21. Solar Thermal Electric *(March 1992)* | 26 | 3 | 24 |
| 20. Fusion Energy *(January 1992)* | 25 | 3 | 25 |
| 19. Wind Energy Program *(June 1991)* | 52 | 7 | 48 |
| 18. Subsurface Science Program (OHER) *(July 1991)* | 61 | 8 | 59 |
| 17. FE Advance Research Programs *(March 1991)* | 258 | 31 | 228 |
| 16. Molecular and Cellular Biology Research *(October, November 1990)* | 69 | 9 | 65 |
| 15. Radiation Biology Research *(June 1990)* | 37 | 4 | 27 |
| 14. Radon Research Program *(March 1990)* | 65 | 8 | 53 |
| 13. Photovoltaic Energy Technology *(January 1990)* | 129 | 17 | 105 |
| 12. Flue Gas Cleanup *(December 1989)* | 30 | 4 | 26 |
| 11. OVER Chemical Toxicology *(June 1989)* | 44 | 5 | 39 |
| 10. Oil Shale, Tar Sands Western Tight Gas Hydrates *(October 1988)* | 51 | 5 | 37 |
| 9. Building & Community Systems *(July 1988)* | 118 | 15 | 101 |
| 8. Small Business Innovation Research (*November 1988)* | 119 | 17 | 106 |
| 7. Nuclear Medicine *(January 1988)* | 63 | 7 | 48 |
| 6. FE Advance Process Technology *(August 1987)* | 25 | 3 | 21 |
| 5. FE Advanced Research and Technology Development (ARTD) (N/A) | 110 | 11 | 70 |
| 4. Geothermal Technology Development *(June 1987)* | 31 | 4 | 24 |
| 3. ARTD *(May 1984)* | 101 | 10 | 58 |
| 2. Enhanced Oil Recovery *(July 1983)* | 38 | 5 | 29 |
| 1. Basic Energy Sciences *(March 1982)* | 129 | 40 | 180 |

# Appendix C
# Survey of Members of Advisory Boards for the Department of Energy Programs and National Laboratories

Please start answering the survey below.

Instructions:

The external members of the Department's Laboratory Operations Board (LOB) are in the process of documenting and reviewing the mechanisms used throughout the Department for evaluating the scientific and technical merit of the work at the laboratories. As part of this effort, we are asking those persons who have participated in the advisory and review process to provide input for the evaluation. We hope to get your perspective on the quality of the programs you have reviewed, and whether your advice has been used.

Please take a moment to answer the questions that follow. This survey is voluntary and your responses will be treated as confidential.

Thank you. If you have any questions, please contact:

David Goldman, AB-1
(202) 586-0464
david.goldman@oer.doe.gov
Department of Energy
Secretary of Energy Advisory Board
1000 Independence Avenue, SW
Washington, DC 20585

According to the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number. The time required to complete this information collection is estimated to average 10 minutes per response. If you have any comments concerning the accuracy of the time estimate or suggestions for improving this form, please write to: U.S. Department of Energy, Energy Information Administration, EI-70, 1000 Independence Avenue, SW, Washington, DC 20585.

Question 1: In what capacity have you served as an advisor/reviewer to DOE or its laboratories? (mark all that apply)

Member of a DOE program advisory board (e.g., EMAB, HEPAP, BESAC)

Member of a laboratory advisory board or program advisory council (e.g., Argonne's ATLAS Program Advisory Council, Los Alamos National Laboratory's National Security Council)

Member of a peer review panel making grant awards

Other advisory/review position

Have not served – please ignore the rest of this survey

Question 2: As a member of a Departmental advisory group or a laboratory advisory/program review panel, did you: (mark all that apply)

Meet on a regular basis.

Provide retrospective analysis of the scientific work under your group's purview.

Provide prospective guidance on strategic goals and/or research initiatives.

Evaluate specific research proposals/projects.

Provide evaluations on the quality of past research.

Question 3: Did you feel the Department or laboratory was responsive to your input?

YES

NO – Please explain

Comments:

Question 4: Based on your experience in the field, how would you judge the quality of research you reviewed in your capacity as an advisor/reviewer for the Department or laboratory (you may answer more than once)?

Excellent

Somewhat above average

Average (comparable to other research in the field)

Somewhat below average

Poor

Comments:

Question 5: Please provide any suggested changes or improvements for the Department's Advisory Board program.

*Table C–1. People receiving survey*

| Name | Title | Organization |
|---|---|---|
| Mr. H. N. Abramson | Retired Executive VP | Southwest Research Institute |
| Dr. Gabriel Aeppli | Senior Research Scientist | NEC Research Institute, Inc. |
| Mr. John F. Ahearne | Director, Sigma Xi Center | Duke University |
| Ms. Jane A. Alexander | | |
| Mr. James Allen | Professor | University of California at Santa Barbara |
| Mr. Lew Allen, Jr. | | |
| Dr. Jens Als-Nielse | Professor | H.C. Orsted Laboratory, Niels Bohr Institute |
| Dr. Jeanne Altmann | Professor, Ecology and Evolution Department | The University of Chicago |
| Dr. Harlan U. Anderson | Curators Professor of Ceramics Engineering | University of Missouri – Rolla |
| Mr. Roy A. Anderson | Senior VP, Nuclear Operations | Florida Power Corporation |
| Mr. Scott Anderson | | Northern Arizona University |
| Mr. D. J. Andrews | | U.S. Geological Survey |
| Dr. Richard Anthes | | University Corp. for Atmosphere Release (UCAR) |
| Dr. Albert Arking | Research Scientist | Johns Hopkins University |
| Mr. Joseph Armato | | |
| Mr. John Armstrong | | |
| Mr. W. D. Arnett | | University of Arizona |
| Mr. Robert Asaro | | UC Davis |
| Mr. Neil W. Ashcroft | | Cornell University |
| Dr. Allen R. Atkins | VP Technology and Define Processes | Boeing Company |
| Mr. David H. Auston | | Rice University |
| Mr. Albert Baciocco | | National Academy of Sciences |
| Mr. Sam Bader | | Argonne National University |
| Dr. Gregory B. Baecher | Professor and Chairman | University of Maryland |
| Mr. Jonathan Bagger | Professor, Department of Physics and Astronomy | Johns Hopkins University |
| Mr. Mike Bailey | Senior Principal Scientist | Scientific Visualization SD Supercomputer Center |
| Mr. Oliver Baker | | Hampton University |
| Mr. A. Balch | | UC Davis |
| Dr. Wendy Baldwin | Director for Extramural Affairs | National Institutes of Health |
| Dr. Richard Balzhiser | President Emeritus | Electric Power Research Institute |
| Dr. Sherif Barakat | | NRC-CNRC |
| Mr. David M.Barnett | | Stanford University |
| Mr. Allen Barnett | | Astropower Corporation |
| Dr. J. C. Barrett | Scientific Director | National Institute of Environmental Health Science |
| Dr. Keith D. Bartle | Professor, Physical Chemistry | School of Chemistry |
| Mr. Richard Barvainis | | MIT Haystack Laboratory |
| Mr. Floyd Barwig | AIA Director | Iowa Energy Center |
| Dr. Boris W. Batterman | Prof., Applied and Engineering Physics Dir., C | Cornell University |
| Mr. Jeffrey A. Baxter | | |
| Dr. Fakhri Bazzaz | Mallinckrodt Professor of Biology | Harvard University |
| Dr. Earl R. Beaver | Director, Waste Elimination | Monsanto Company |
| Ms. Susan L Beck | | University of Arizona |
| Mr. Robert H. Becker | | UC Davis |
| Ms. Gretchen Beers | | |
| Mr. Wallace B. Behnke, Jr. | | Consulting Engineer |

*Table C–1. People receiving survey (contd.)*

| Name | Title | Organization |
|---|---|---|
| Ms. Betsy Beise | University of Maryland | |
| Dr. Arden L. Bement, Jr. | Professor of Engineering | Purdue University School of Materials Engineering |
| Dr. Stephen J. Benkovic | Evan Pugh Professor and Eberly Chair in Chemistry | The Pennsylvania State University |
| Mr. Larry Benson | | U.S. Geological Survey |
| Mr. George Bergantz | | University of Washington |
| Dr. Ed Berkey | Vice President and Chief Science Officer | Concurrent Technologies Corp. |
| Mr. Alan Berman | | |
| Mr. Alan Berry | | Bio-Technical Resources |
| Dr. John Best | | IBM |
| Dr. Eugene W. Bierly | Director for Education and Research | American Geophysical Union |
| Mr. Roger G. Bilham | Professor | University of Colorado – Denver |
| Dr. John H. Birely | | |
| Dr. Robert J. Birgeneau | Dean, School of Science | Massachusetts Institute of Technology |
| Dr. Howard K. Birnbaum | Director, Materials Research Laboratory | University of Illinois at Urbana-Champaign |
| Mr. James P. Blanchard | | University of Wisconsin |
| Ms. Leslie Bland | | Indiana University |
| Mr. Erich Bloch | | Council on Competitiveness |
| Ms. Andrew Bocarsly | | Princeton University |
| Mr. David F. Bocian | Professor of Chemistry, Department of Chemistry | University of California |
| Mr. J. Bokor | | UC Berkeley |
| Dr. Allen H. Boozer | | Columbia University |
| Mr. Emano F. Borra | | Universite Laval |
| Mr. James B. Boyce | | Xerox Palo Alto Research Center |
| Mr. Carl-Ivar Branden | Professor, Microbiology and Tumor Biology | Karolinska Institutet |
| Mr. John C.Bravman | | Stanford University |
| Mr. Adrian Brearley | | University of New Mexico |
| Dr. John Bredehoef | | The Hydrodyanics Group |
| Dr. Steve Brenner | Senior Director, Physical Sciences | The DuPont Merek Pharmaceutical Company |
| Mr. Leo Brewer | | UC Berkeley |
| Dr. Robert M. Briber | Assoc. Prof. Dept. of Materials and Nuclear Engineering | University of Maryland |
| Mr. Norman Brinkman | | General Motors Corporation |
| Mr. Cate Brinson | | Northwestern University |
| Dr. George S. Brown | Committee Chair, Professor of Physics | University of California |
| Dr. Gordon E. Brown | Daniel Wm. Kirby Professor of Earth Sciences | Stanford University |
| Mr. Douglas Brown | | Ben Holt Co. |
| Mr. Lou Browning | | Acurex Environmental Corporation |
| Mr. Oscar P. Bruno | | California Institute of Technology |
| Mr. Richard O. Buckius | | University of Illinois |
| Dr. Robert J. Budnitz | President | Future Resources Associates, Inc. |
| Dr. Franklin Bunn | | Harvard University |
| Ms. Patricia R. Burchat | Professor, Physics Department | Stanford University |
| Majg. Leslie M. Burger | Commander, North Atlantic Regional | Medical Command and Walter Reed Army Medical Center |
| Mr. George Burliarelli | Chancellor | Polytechnic University |

*Table C–1. People receiving survey (contd.)*

| Name | Title | Organization |
|---|---|---|
| Mr. Adam Burrows | | University of Arizona |
| Mr. Robert L. Byer | | Stanford University |
| Dr. James D. Callen | | University of Wisconsin – Madison |
| Dr. John V. Carlis | Associate Professor | University of Minnesota Computer Science Department |
| Dr. Tom Carlson | | Corps of Engineers |
| Mr. James Casey | | UC Berkeley |
| Mr. Richard Casten | | Yale University |
| Ms. E. A. Cecchetti | | |
| Mr. Thure E. Cerling | | University of Utah |
| Mr. Bulbul Chakrabo | | Brandeis University |
| Mr. David Chambliss | | International Business Machines, Inc. |
| Dr. Tony F. Chan | | UCLA |
| Mr. Jamie Chapman | | OEM Development |
| Mr. Daniel S. Chemla | | Lawrence Berkeley Laboratory |
| Dr. I-Wei Chen | Skiranich Prof. of Materials and Innovation | University of Pennsylvania |
| Mr. Roger A. Chevalier | | University of Virginia |
| Mr. Malcolm Chisholm | Professor of Chemistry | Indiana University |
| Dr. Gregory R. Choppin | Lawton Distinguished Prof. of Chemistry | Florida State University |
| Dr. Richard L. Church | Staff Member, Dept. of Geography | University of California |
| Mr. Ralph Cicerone | Professor of Geosciences Dept. | UC Irvine |
| Ms. Wendy Clark | | Automotive Testing Laboratories, Inc. |
| Ms. Bunny Clark | | Ohio State University |
| Mr. Christopher Clayton | | UCLA |
| Mr. L. D. Clements | | University of Nebraska |
| Mr. Marvin Cohen | | UC Berkeley |
| Mr. Phillip Colella | | Lawrence Berkeley Laboratory |
| Mr. Lawrence Coleman | | UC Davis |
| Mr. Joseph Colucci | Consultant | |
| Dr. Rita R. Colwell | President | University of Maryland Biotechnology Institute |
| Mr. Manoel Conde | | Argonne National Laboratory |
| Mr. Robert W. Conn | | UC San Diego |
| Mr. Harold Connolly | | California Institute of Technology |
| Mr. Bruno Coppi | | Massachusetts Institute of Technology |
| Dr. Robert Costanza | Prof., Ctr. for Environment and Estaurine Studies | University of Maryland |
| Mr. James B. Cowart | | Florida State University |
| Dr. Michael K. Craddock | Professor of Physics | University of British Columbia |
| Mr. Ken Creager | | University of Washington |
| Dr. Jack Crow | Director, National High Magnetic Field Laboratory | Florida State University |
| Mr. Keith Custer | | |
| Mr. William B. Daniels | | University of Delaware |
| Mr. Ed Demeo | | Electric Power Research Institute |
| Mr. Steven Denbaars | | UC Santa Barbara |
| Mr. Richard S. Denning | Senior Research Leader, Consultant | Battelle |
| Dr. Denice D. Denton | Dean, College of Engineering | University of Washington |
| Mr. Donald DePaolo | Professor, Dept. of Geology and Geophysics | UC Berkeley |
| Mr. Enzo DeSanctis | | Italy |

*Table C–1. People receiving survey (contd.)*

| Name | Title | Organization |
|---|---|---|
| Mr. Rob DeSoto | | Colorado Office of Energy Conservation |
| Mr. John M. Deutch | | Massachusetts Institute of Technology |
| Mr. William E. Dietrich | | UC Berkeley |
| Mr. Paul Dimotakis | | California Institute of Technology |
| Mr. Frank DiSalvo | | Cornell University |
| Mr. Stanislav G. Djorgovsk | | California Institute of Technology |
| Ms. Dana Dlott | | University of Illinois – Urbana |
| Mr. Jack Dongarra | | University of Tennessee |
| Mr. Sidney D. Drell | Deputy Director | Stanford Linear Accelerator Center |
| Mr. Scott Duvall | | |
| Ms. Christine Dwyer | Senior VP | RMC Research Corporation |
| Dr. Robert C. Dynes | Chancellor | UC San Diego |
| Mr. Paul Ekman | | UC San Francisco |
| Dr. Alan W. Elzerman | Professor and Chair | Clemson University |
| Dr. Iraj Ershaghi | | University of Southern California |
| Mr. Eric Esary | | Naval Research Lab |
| Mr. Ronald W. Ewing | Independent Consultant | Ewing Consultants |
| Ms. Gracio Fabris | | FAS Engineering, Inc. |
| Mr. Roger Falcone | | |
| Mr. Chet Farris | | Siemens Solar Industries |
| Mr. Joel Ferziger | | Stanford University |
| Mr. Daniel W. Fessler | Of Counsel | LeBoeuf, Lamb, Greene & MacRae, L.L.P. |
| Mr. Paul Fieury | | University of New Mexico |
| Mr. Brad Fillipone | Kellogg Radiation Laboratory | California Institute of Technology |
| Dr. Barbara Filner | Grants Program Officer | Howard Hughes Medical Institute |
| Mr. Bradley Flippone | Kellogg Radiation Laboratory | California Institute of Technology |
| Dr. Lorenzo Foa | | European Organization for Nuclear Research |
| Mr. M. G. Forest | | University of North Carolina –Chapel Hill |
| Mr. Harvey Forest | | Solarex Corporation |
| Dr. Marye A. Fox | Vice Chair and Vice President for Research | University of Texas |
| Dr. Uta Francke | | Stanford University School of Medicine |
| Dr. John E. Frederick | Professor of the Geophysical Sciences | The University of Chicago |
| Mr. William L. Friend | Director | Bechtel Group, Inc. |
| Mr. Bernard Frois | | CEA, France |
| Mr. Darrell Gallup | | Unocal Corporation |
| Dr. Barbara Garrison | | The Pennsylvania State University |
| Mr. George Gehrels | | University of Arizona |
| Mr. Claus-Konr Gelbke | | Michigan State University |
| Mr. Michael A. Gelman | | Carnegie Mellon University |
| Ms. Mary B. Genter | | University of Cincinnati |
| Dr. Raymond F. Gesteland | Investigator, Howard Hughes Medical Institute | University of Utah |
| Mr. Nasr Ghoniem | | UCLA |
| Mr. Bernie Gittelman | | Cornell University |
| Mr. John Gland | | University of Michigan – Ann Arbor |
| Dr. James A. Glaze | Vice President | Semiconductor Industry Association |
| Mr. William A. Goddard II | Charles and Mary Ferkel Professor of Chemistry | Beekman Institute, California Institute of Technology |
| Mr. Andrew J. Goodpaste | | |

*Table C–1. People receiving survey (contd.)*

| Name | Title | Organization |
|---|---|---|
| Ms. Susan L. Graham | Professor, Computer Science Division | University of California |
| Mr. Murray Grande | | Northern California Power Agency |
| Mr. Harry Green | | UC Riverside |
| Dr. Anne Greenbau | | University of Washington |
| Dr. Robert A. Greenkorn | Vice President of Special Programs | Purdue Research Foundation |
| Dr. Jonathan Greer | | Abbott Laboratories |
| Ms. Joanna Groza | | UC Davis |
| Mr. Patrick Gruber | | Cargill Dow Products |
| Mr. Ray Gunner | | IBM |
| Mr. Yogi Gupta | | Washington State University |
| Mr. Miklos Gyulassy | | Columbia University |
| Mr. Karl Hagen | | Emory University |
| Mr. Michael Haley | | University of Oregon |
| Dr. Richard E. Hallgren | Executive Director | American Meteorological Society |
| Mr. William Happer | Professor | Princeton University |
| Dr. Jerry M. Harris | | Stanford University |
| Dr. W. F. Harris | Director and Professor, Division of Biology | University of Tennessee |
| Dr. Willard W. Harrison | Dean, College of Liberal Arts and Sciences | University of Florida |
| Dr. Robert Haselkorn | Director, Center of Photochemistry and Photobiology | The University of Chicago |
| Mr. Wick Haxton | | University of Washington |
| Ms. Victoria Haynes | | |
| Dr. Alan Hedge | | Cornell University |
| Mr. John Hedges | | University of Washington |
| Mr. Russell Hemley | | Carnegie Institution of Washington |
| Mr. John Hemminger | UC Irvine | |
| Mr. Tom Henyey | | University of Southern California |
| Dr. Jan F. Herbst | | General Motors Corporation |
| Mr. Jonathan Heritage | | UC Davis |
| Mr. David Hertzog | | University of Illinois |
| Mr. DavidHibbitt | | |
| Dr. James E. Hill | Chief of the Building Environment Division | National Institute of Standards and Technology |
| Mr. William N. Hitchon | | University of Wisconsin – Madison |
| Mr. David M. Hitz | | |
| Mr. Mike Hochella | Professor of Geochemistry | Virginia Polytechnic Institute |
| Dr. Jeffrey Hodgson | | University of Tennessee |
| Mr. Timothy Hollingsh | | Pacific Gas & Electric |
| Mr. Roy Holt | | University of Illinois |
| Dr. Dewey Holten | Professor | Washington University |
| Dr. Leroy E. Hood | Gates Prof. and Chair, Molecular Bio-Tech | University of Washington |
| Mr. C. F. Hooper | | University of Florida |
| Dr. Robert Horsch | | Agracetus |
| Dr. Linda Horton | | Oak Ridge National Laboratory |
| Mr. William G. Howard, Jr. | | National Academy of Sciences |
| Dr. Fern Y. Hunt | | National Institute of Standards and Technology |
| Dr. Louis Ianniello | | |
| Dr. Ettore F. Infante | Dean, College of Arts and Science | Vanderbilt University |
| Ms. Barbara Jacak | | SUNY Stony Brook |

***Table C–1. People receiving survey (contd.)***

| Name | Title | Organization |
|---|---|---|
| Mr. Thomas R. Jarboe | | University of Washington |
| Dr. David A. L. Jenkins | Director, Technology | The British Petroleum Company, P.L.C. |
| Mr. Alexander Jenkins | | California Energy Commission |
| Mr. Donald Johnson | | Grain Processing Corporation |
| Mr. Tudor Johnston | | INRS – Energie et Materiaux |
| Mr. Jiri Jonas | | University of Illinois – Urbana |
| Mr. Tim Jull | | University of Arizona |
| Mr. Douglas Jung | | Two-Phase Engineering |
| Mr. Tuneyoshi Kamae | | University of Tokyo |
| Mr. Prashant V. Kamat | | University of Notre Dame |
| Mr. David Kaplan | | University of Washington |
| Dr. Sid Karin | | UC San Diego |
| Mr. Dave Kasik | | Boeing Commercial Airplanes |
| Dr. William E. Kastenber | Professor and Chairman, Nuclear Engineering | UC Berkeley |
| Mr. Tom Katsoulea | | University of Southern California |
| Ms. Karen Kavanagh | | UC San Diego |
| Mr. M. L. Kavvas | | UC Davis |
| Mr. Henry W. Kendall | | Massachusetts Institute of Technology |
| Dr. Lawrence A. Kennedy | Dean, College of Engineering | The University of Illinois at Chicago |
| Mr. Arthur K. Kerman | | Massachusetts Institute of Technology |
| Dr. David Keyes | | Old Dominion University |
| Dr. Joseph K. Kielman | Chief Scientist | Information Resources Division, FBI |
| Dr. Jeff Kimpel | | National Severe Storm Laboratory |
| Dr. David T. Kingsbury | Vice President and Chief Information Officer | Chiron Corporation |
| Mr. V. K. Kinra | | Texas A&M University |
| Mr. Malcolm Kirby | | Xerox |
| Dr. Janos Kirz | Professor of Physics | SUNY Stony Brook |
| Dr. Edward H. Klevans | Prof. and Dept. Head, Nuclear Engineering Dept. | The Pennsylvania State University |
| Mr. Andre Knoesen | | UC Davis |
| Dr. Mel Koch | Center for Process Analytical Chemistry | University of Washington |
| Dr. Martha H. Kohler | Principal | M.H. Kohler & Associates |
| Dr. Kenneth E. Kolm | Associate Professor of Environmental Science | Colorado School of Mines |
| Mr. Steven Koonin | Vice President and Provost | California Institute of Technology |
| Mr. Steven E. Koonin | | |
| Mr. Doug Kosar | | Gas Research Institute |
| Mr. Stanley Kowalski | | Massachusetts Institute of Technology |
| Mr. George Kozmetsky | | University of Texas |
| Dr. Alvin Kwiram | Vice Provost for Research | University of Washington |
| Mr. Stephen Laderman | | Hewlitt Packard |
| Ms. Jean-Marc Laget | | |
| Mr. Martin Lampe | | Naval Research Lab |
| Mr. Phil Lampert | | National Ethanol Vehicle Coalition |
| Dr. Gerard H. Lander | Professor | EITU |
| Dr. Margaret A. Lemone | Senior Scientist | National Center of Atmospheric Research |
| Dr. Stephen Leone | | JILA |
| Dr. Daniel Leroy | | CERN |
| Dr. Marsha Lester | | University of Pennsylvania |

*Table C–1. People receiving survey (contd.)*

| Name | Title | Organization |
|---|---|---|
| Dr. Susan Lindquist | Dept. of Molecular Genetics and Cell Biology | The University of Chicago |
| Mr. Roger Little | | Spire Corporation |
| Mr. John R. Longenecker | President | Longenecker & Associates |
| Mr. Robert Lourie | | |
| Mr. Glen E. Lucas | | UC Santa Barbara |
| Dr. Martha L. Ludiwig | Professor, Biological Chem., Biophysics Res. | University of Michigan |
| Mr. Peter T. Lyman | | |
| Mr. Kelvin G. Lynn | | Washington State University |
| Mr. John C. Macdonald | | Northern Arizona University |
| Ms. Krishnan Mahesh | | Stanford University |
| Dr. Shirley M. Malcom | Head, Directorate for Education and HR Programs | AAAS |
| Mr. Kenneth Malley | | |
| Mr. David Mao | | Carnegie Institution of Washington |
| Mr. Brian Maple | Professor, Physics Department | UC San Diego |
| Dr. Emanuel Margolias | Professor, Dept. of Biological Sciences | University of Illinois at Chicago |
| Dr. Earl S. Marmar | | Massachusetts Institute of Technology |
| Dr. Cora B. Marrett | Provost and Vice Chancellor for Academic Affairs | University of Massachusetts |
| Dr. George M. Martin | | University of Washington |
| Dr. Brian W. Matthews | Professor, Molecular Biology, Dept. of Physics | Institute of Molcular Biology, University of Oregon |
| Mr. Michael Mauel | | Columbia University |
| Mr. James McCarthy | | University of Virginia |
| Ms. Rose McKinney | | Corporation for Solar Technology and Renewable Resources |
| Ms. Joanna McKittrick | | UC San Diego |
| Mr. William McLean | | Sandia National Laboratory |
| Dr. Larry McLerran | Professor | University of Minnesota |
| Mr. Patrick McMurty | | University of Utah |
| Mr. Adrian C. Melissinos | | University of Rochester |
| Mr. Dan Merion | | California Institute of Technology |
| Dr. Jill P. Mesirov | | Center for Genome Research, Massachusetts Institute of Technology |
| Dr. Barbara J. Meyer | Professor and Head, Molecular and Cell Biology Dept. | University of California |
| Mr. David D. Meyerhofe | | University of Rochester |
| Dr. Carolyn Meyers | | National Science Foundation |
| Mr. Al Mezzina | Consultant | |
| Ms. Alice Mignerey | | The University of Chicago |
| Mr. Howard M. Milchberg | | University of Maryland |
| Mr. George Miley | | University of Illinois |
| Dr. Carl Miller | Manager, Technology Assessment | Delphi Energy and Engine Management Systems |
| Dr. Ronald A. Milligan | | The Scripps Research Institute |
| Mr. Bernard J. Minster | | UC San Diego |
| Dr. James W. Mitchell | Director, Materials and Ecology Research | Lucent Technologies |
| Dr. Dade W. Moeller | President | Dade Moeller & Associates, Inc. |
| Mr. Cameron M. Moore | | BP Solar |
| Mr. Berndt Mueller | | Duke University |

***Table C–1. People receiving survey (contd.)***

| Name | Title | Organization |
|---|---|---|
| Mr. Gottfried Muenzenbe | | Institute of Kernphysik |
| Mr. Jesper Munch | | University of Adelaide |
| Mr. Jim Napalitan | | |
| Ms. Diana S. Natalicio | | University of Texas – El Paso |
| Dr. John A. Nation | Professor | Cornell University |
| Mr. Alan Needleman | | Brown University |
| Mr. Ulrich Neumann | | University of Southern California |
| Dr. Kenneth W. Neves | | Boeing Corporation |
| Mr. Jeffrey Nguyen | | UC Berkeley |
| Mr. Malcolm Nichol | | UCLA |
| Dr. Ralph W. Nicholas | Professor and Director, International House | The University of Chicago |
| Mr. Kenneth Nichols | | Barber Nichols, Inc. |
| Mr. Guust Nolet | | Princeton University |
| Mr. Andrew Norris | | Rutgers University |
| Ms. Anita Oberbauer | | UC Davis |
| Ms. Z. M. Oden | | Beth Israel Hospital |
| Mr. J. T. Oden | | University of Texas |
| Mr. Rich Orr | | |
| Dr. Franklin M. Orr, Jr. | Dean, School of Earth Sciences | Stanford University |
| Mr. Steven A. Orszag | | Princeton University |
| Mr. Michael Ortiz | | California Institute of Technology |
| Dr. Robert A. Osteryoun | Research Prof. and Dept. Head, Department of Chemistry | North Carolina State University |
| Mr. Thomas A. Page | Chairman and Chief Executive Officer | San Diego Gas & Electric |
| Mr. Dennis Palmer | | Stanford University |
| Mr. Vijay Pandharip | | University of Illinois |
| Mr. Scott Parker | | University of Colorado – Boulder |
| Mr. J. T. Parker | | Pentagon |
| Mr. David H. Pashley | | Medical College of Georgia |
| Mr. Merrel Patrick | | |
| Mr. Peter Paul | | SUNY Stony Brook |
| Mr. Stanton J. Peale | | UC Santa Barbara |
| Dr. Roberto D. Peccei | Dean, Physical Sciences Department | UCLA |
| Mr. Richard Peck | | University of New Mexico |
| Mr. Michael Pernice | | University of Utah |
| Mr. Robert Perry | | Ohio State University |
| Ms. Helen O. Petrauska | Vice President, Environmental and Safety Engineering | Ford Motor Company |
| Mr. Nasser Peyghamb | | University of Arizona |
| Dr. Joachim Pfluger | Senior Staff Scientist | HASYLAB |
| Mr. Warren Pickett | | UC Davis |
| Mr. Tony S. Pietro | | Indiana University |
| Mr. Larry Pinson | | |
| Gen. John L. Piotrowski | | U.S. Air Force (retired) |
| Mr. Karl Pister | Chancellor Emeritus | University of California |
| Dr. Louis F. Pitelka | Director and Professor | Center for Environmental Science, University of Maryland |
| Dr. Carl H. Poppe | Senior Arms Control Advisor | University of California, Lawrence Livermore National Lab. |
| Mr. Herman Postma | | |

*Table C–1. People receiving survey (contd.)*

| Name | Title | Organization |
|---|---|---|
| Ms. Jane Poths | | Los Alamos National Laboratory |
| Mr. Charles Powers | | St. Croix Research, Acurex Environmental Corp. |
| Mr. Roger Prince | | Exxon Research and Engineering |
| Mr. Dan Prober | | Yale University |
| Dr. Bill Pulleblan | Director of Mathematical Sciences | T.J. Watson Research Center |
| Mr. Jay Quade | | University of Arizona |
| Mr. Michael Quah | | DuPont |
| Dr. Richard K. Quisenber | Committee Chairman, Executive Director | AMTEX Partnership |
| Dr. Alan Rabson | | National Cancer Institute |
| Mr. Harry B. Radousky | | Columbia University |
| Mr. G. Ravichand | | California Institute of Technology |
| Mr. Robert Redwine | | Massachusetts Institute of Technology |
| Mr. W. J. Renton | | |
| Mr. William Reynolds | | Stanford University |
| Mr. Bernard Richards | | Catepillar, Inc. |
| Dr. Geraldine L. Richmond | Chair, Department of Chemistry | University of Oregon |
| Mr. Frank Richter | Professor | The University of Chicago |
| Dr. John Riganati | | David Sarnoff Lab |
| Mr. Rick Riman | | Rutgers University |
| Mr. Barrett H. Ripin | | The American Physical Society |
| Dr. Vernon P. Roan, Jr. | Department of Mechanical Engineering | University of Florida |
| Mr. Hamish Robertsib | | University of Washington |
| Mr. Donald Robson | | Florida State University |
| Mr. Marshall N. Rosenbaug | | |
| Dr. Herman S. Rosenbau | Committee Chair, Consultant | |
| Mr. Mendel Rosenbau | | Stanford University |
| Dr. Robert B. Rosenberg | President | RBR@Vision |
| Mr. Marshall N. Rosenblut | | U.S. – ITER |
| Mr. Lewis Rothberg | | University of Rochester |
| Mr. Lewis Rothberg | | |
| Mr. Michael Rubner | | Massachusetts Institute of Technology |
| Mr. John B. Rundle | | University of Colorado – Denver |
| Dr. Thomas P. Russell | | University of Massachusetts |
| Ms. Sara Russell | | Smithsonian Institution |
| Mr. Richard E. Russo | | Lawrence Berkeley Laboratory |
| Mr. Wolfgang Sachse | | Cornell University |
| Mr. Michael J. Sailor | | UC San Diego |
| Mr. Jack Salvador | | |
| Mr. Jack Sandweiss | | Yale University |
| Dr. Stephen L. Sass | Professor, Dept. of Materials Science and Eng. | Cornell University |
| Mr. James C. Savage | | U.S. Geological Survey |
| Dr. Gary S. Sayler | Director | University of Tennessee |
| Mr. Daniel Scherson | | Case Western Reserve University |
| Mr. Michael Schmidt | | Yale University |
| Mr. Donald Schneider | | The Pennsylvania State University |
| Mr. Berthold Schoch | | University of Bonn |
| Mr. Frank Schulli | | Columbia University |
| Dr. Jeffrey L. Schwartz | University of Washington | |

***Table C–1. People receiving survey (contd.)***

| Name | Title | Organization |
|---|---|---|
| Mr. Richard Schwartz | | Purdue University |
| Mr. J. C. Scott | | IBM |
| Mr. Lawrence T. Scott | Boston College | |
| Mr. Donald Scott | | University of Waterloo |
| Mr. Abraham Seiden | | UC Santa Cruz |
| Dr. Toshiyuki Seko | | Japan Automotive Research Institute, Inc. |
| Mr. Rajat Sen | | Sentech |
| Dr. Michael Shaevitz | Professor and Director, Nevis Laboratories | Columbia University |
| Mr. Mubarak Shah | | University of Central Florida |
| Mr. Lu Jeu Sham | Professor, Physics Department | UC San Diego |
| Ms. Marjorie D. Shapiro | | UC Berkeley |
| Mr. Kenneth J. Shea | | UC Irvine |
| Mr. Peter Shearer | | UC San Diego |
| Dr. Zhi-Xun Shen | | Stanford University |
| Mr. Manuchehr Shirmoham | | Material Integrity Solutions, Inc. |
| Dr. Jean'ne M. Shreeve | VP for Research/Graduate Studies and Prof. | University of Idaho |
| Mr. Bill Shugree | | |
| Mr. Gary Shulman | | Geothermal Power Co., Inc. |
| Mr. Edward Shuryak | | SUNY Stony Brook |
| Mr. Karin Sidney | Director, Office of Advanced Scientific Computing | UC San Diego |
| Mr. Issac Silvera | | Harvard University |
| Dr. William W. Simmons | | Systems Solutions |
| Dr. Melvin I. Simon | Biaggini Professor of Biology | California Institute of Technology |
| Mr. David J. Singh | | Naval Research Lab |
| Dr. Thomas J. Slaga | Chair, Center of Cancer Causation and Prevention | AMC Cancer Research Center |
| Dr. Richard Smalley | | Rice University |
| Dr. Susan Smialowsk | Professor, Dept. of Materials Science and Engineering | Ohio State University |
| Mr. Burton J. Smith | Chief Scientist | Tera Computer Company |
| Dr. Janet L. Smith | | Purdue University |
| Dr. Samuel Smith | President | Washington State University |
| Mr. Larry Smith | | UCLA |
| Mr. Petros Sofronis | | University of Illinois |
| Dr. Sean Solomon | | Carnegie Institute of Washington |
| Mr. Soroosh Sorooshia | | University of Arizona |
| Mr. James Spicer | | Johns Hopkins University |
| Dr. George R. St. Pierre | Presidential Professor and Chairman Emeritus | Ohio State University |
| Dr. Theodore L. Steck | Professor of Biochemistry and Molecular Biology | The University of Chicago |
| Dr. Donald F. Steiner | A.N. Pritzker Professor and Senior Investigator | Howard Hughes Medical Institute |
| Mr. Raymond Stevens | | UC Berkeley |
| Dr. Jerry E. Stoneking | Dean, College of Engineering | University of Tennessee |
| Dr. Herbert L. Strauss | Professor of Chemistry | University of California |
| Mr. Roger Strelow | Managing Principal | Dames & Moore |
| Mr. Andrew Stuart | | Electolyser Corporation |
| Mr. Walter Studhalte | | Douglas Energy |

*Table C–1. People receiving survey (contd.)*

| Name | Title | Organization |
|---|---|---|
| Mr. Nam P. Suh | Cross Professor and Department Head | Massachusetts Institute of Technology |
| Dr. Jeremiah D. Sullivan | Professor of Physics | University of Illinois – Urbana-Champaign |
| Mr. Charles J. Sullivan II | President | Alabama Public Service Commission |
| Mr. Jinji Suzuki | | General Motors Corporation |
| Ms. Linda M. Sweeting | | Towson University |
| Ms. Jan Talbot | | UC San Diego |
| Dr. Andrew D. Taylor | Director of Science and Head, ISIS Facility | Rutherford Appleton Laboratory |
| Mr. John Telle | | PL/LIG |
| Mr. Shanghua Teng | | University of Illinois |
| Dr. Dennis W. Thomson | | The Pennsylvania State University |
| Mr. William J. Thomson | Professor, Dept. of Chemical Engineering | Washington State University |
| Mr. Kevin Thorne | | University of Illinois |
| Dr. Maury Tigner | | |
| Dr. David Tirrell | | California Institute of Technology |
| Dr. Neil E. Todreas | Kepco Professor, Professor of Nuclear Engineering | Massachusetts Institute of Technology |
| Mr. Yitzhak Tor | | UC San Diego |
| Mr. Stan Trimble | | UCLA |
| Mr. John C. Tully | | Yale University |
| Dr. Karl K. Turekian | | Yale University |
| Mr. Bruce Turkingto | | University of Massachusetts – Amherst |
| Mr. John F. Turner | President and Chief Operating Office | The Conservation Fund |
| Mr. Cliff Tyree | | U.S. Environmental Protection Agency |
| Mr. Rizwan Uddin | | University of Illinois |
| Ms. Marjolean Van der Me | | Cornell University |
| Mr. Bob Voigt | | The College of William & Mary |
| Mr. James Waddington | | McMaster University |
| Dr. Henry N. Wagner, Jr. | Director, Division of Radiation Health Science | John Hopkins Medical Institutions |
| Mr. Mike Walker | | |
| Dr. Susan S. Wallace | Chair, Dept. of Microbiology and Molecular | University of Vermont |
| Mr. Yang Wang | | Florida State University |
| Dr. Warren M. Washington | Senior Scientist, Climate and Control Dynamics | National Center for Atmospheric Research |
| Dr. Edel Wasserman | Science Advisor | DuPont Central Research and Development |
| Mr. William Weis | | Stanford University |
| Mr. Richard L. Wells | | Duke University |
| Dr. Mary Wheeler | | University of Texas |
| Dr. Robert M. White | President Emeritus | National Academy of Engineering |
| Dr. Clive G. Whittenbu | | Erickson Group, Ltd. |
| Dr. John W. Wilkins | Ohio Eminent Scholar of Materials Research | Ohio State University |
| Dr. Conrad Williams | | Morgan State University |
| Mr. Jack Williamson | | |
| Dr. David Wilson | | University of Alberta |
| Ms. Deborah L. Wince-Smit | Senior Fellow | Council on Competitiveness |
| Mr. Steven Winter | | Steven Winter & Associates |
| Dr. Robert Withers | | ARCO Exploration and Production Technology |
| Mr. Andrew Wong | President | ETT Development Corporation |
| Mr. Stan Woosley | | UC Santa Cruz |

***Table C–1. People receiving survey (contd.)***

| Name | Title | Organization |
|---|---|---|
| Mr. Guy Worthey | | University of Michigan – Ann Arbor |
| Mr. Alan Wray | | |
| Mr. Alan Wray | | NASA |
| Mr. Fred Wuhl | | UCLA |
| Dr. Robert E. Wyatt | Professor of Chemistry, Dept. of Chemistry | University of Texas |
| Dr. James H. Wyche | Associate Provost | Brown University |
| Mr. Xianfan Xu | | Purdue University |
| Mr. Yoshi Yamamoto | Professor, Applied Physics Department | Stanford University |
| Mr. Grenville Yuill | | University of Nebraska |
| Mr. George Zandt | | University of Arizona |
| Mr. Paul Ziemer | Professor | Purdue University School of Health Sciences |
| Dr. Bruno Zotter | Senior Physicist | LEP Division, CERN |

# Responses to Question 5 of Survey (Comments on Improvements)

– Provide more of a connect between project allocation decisions and the peer review decisions.

– It was not clear to me that the board membership's expertise was as well matched to the program as it might have been.

– There has been some difficulty in maintaining on the Committee someone with deep technical knowledge in the fuel processing/materials area but also with a broad oversight capability. They tend to be short term members.

– I suggest the Department use their external advisors to help in framing the questions for the various advisory boards to address. Too often we are given specific questions to think about, but sometimes these do not really get to the heart of what many of..[1]

– I suggest a two step process: the lab personnel first shoot down the proposals that are irrelevant. Of the remaining proposals, the "outside" evaluators (in the second stage) should pick those that should be funded.

– Continue to include a variety of opinions from different types of real-world perspectives. Discourage lots of needless presentation/ creation of special material for review process —in other words, discourage the "justification" approach and encourage

– None—the program ran very smoothly.

– For strategic issues of a supradivisional nature; upperlevel management (lab director or AD) should be required to make significant response input to external advice. Research programs and projects should be justifiable as to why they uniquely qualify to...

– Periodic updates would be helpful so we don't have to wait a year and then get a cram course on progress—or lack thereof These updates should be very brief and executive oriented.

[1] Where there were limitations on the amount of text that could be recorded, these are indicated by "...".

– As a Member of the LLNL Engineering Advisory Committee, I have been generally pleased with the process, except for the fact that higher level committees have taken it upon themselves to "adjust" our committees' evaluations. They should not be allowed to...

– Assistant Secretary advisory boards need better coordination and communication. In ER for example there must be an overarching Board to help with cross program prioritization. Too much stovepiping persists.

– I have been a member of the external advisory panel for Sandia's Engineering Sciences Research Foundation. This panel has met twice so far, on an annual basis. Given the short time available for this activity, I think Sandia has done a good job of organizing...

– The entire review process was efficiently and clearly administrated. At this point in time, no obvious suggestions for improvements are apparent.

– I felt that the people who oversaw the project tended to have particular expectations and restricted the language we could use in the evaluations that we undertook. While I understand the need for uniformity in any review process, I felt too constrained.

– I think that the SLAC Scientific Policy Committee serves a useful role at SLAC.

– I think that—in general — the Office of Energy Research suffers from low visibility within the Department of Energy. A higher profile would increase the value of the advisory system. Perhaps this will change with the appointment of Dr. Moniz.

– From my perspective, it works well. Continue to include people with broad backgrounds.

– A review package with standardized project detail format and more information on the financials should be given to the reviewers at least a week before the review. Information on past performance should be given to the reviewers.

– From the options you gave in question 1, I assume that it may be unusual for a contractor to have an advisory committee (as the University of California does) rather than DOE or the individual laboratories. If this is so, then from my experience I would...

– While the process was fair and provided ample time for input, discussion, and feedback, more careful planning on the part of the organizers would have saved considerable time. The meetings actually adjourned 4 hours earlier than planned. DOE needs to...

– Onetime panels are less effective than panels with multi-year staggered terms. Among other values, this system allows more detailed review of part of an operation during each review cycle with all components reviewed at least every few years. UC's in...

– The Advisory Board I was on was very effective; I have no changes to suggest.

– I have no substantive recommendations to make based on my current experience. Have thoroughly enjoyed the open interchange of ideas, etc.

– From time to time, I have provided reviews of individual research proposals but most of these cases, the DOE did not provide any feedback on the final action taken on the proposal. When I review a paper for Phys. Rev. or Phys. Rev. Letters, I usually...

– My primary suggestion is avoid mixing conflicting functions of the advisory committees. For example, a committee charged to provide real critical analysis and suggestions for rectification of program activities or strategy to the program managers is...

– (1) For Peer Review meetings, reviewers should be provided with project costs, completed and proposed. Many programs are good values if the-cost can be minimized, but would not be justified at more costly levels. In short, the bottom line is whether DOE...

– For this relatively small research group with 5 or 6 ongoing projects, our 1 $^{1}/_{2}$ days of review was appropriate. Given more time, we could have learned more about the past projects (successes and failures) and perhaps would have had more to say regarding...

– I like the program as is.

– Avoid appointments which have conflict of interest (as in the fusion materials review panel, several members); rely on the general scientific community and not the specific specialty (to avoid self-preservation), and look for reviewers who are impartial.

- Difficult to answer without a specific example.
- I thought the meeting was effectively organized (by McGrory).
- Integrate the Advisory Panels more closely into the management process of the Lab instead of beating the Advisory Panel as something needed to fulfill contract requirements.
- Based on feedback I have heard from many other researchers, many reviews are usually of very poor quality, where the reviewers completely missed the print. This is not typical whining from someone who has not received funding, it is based on observation...
- Perhaps have some industrial scientists evaluate academics. That is, have several representatives from industry—not all just academics.
- I think the program advisory structure for BNL (and for the other high energy and/or nuclear labs) works well and I have no suggestions for improving it.
- My one criticism of the process is that lack of continuity. Participants should serve for three year terms, meet at least twice a year, and their role and mission should be clearly defined. Without a clear definition of what is expected of them, they...
- The tasks I have been involved with were well focused and should continue as is. No problem! DOE nuclear physics is well managed.
- I think the BESAC has sometimes not been focused as well on specific issues. Sometimes it has, but other times it ends up being meetings to just hear what is going on, without much advice going back from the committee.
- I believe the peer review process I have been involved with is quite useful and should be continued.
- I think the Advisory Board Program provides a unique and outstanding asset for DOE and the USG. It also furthers the goal of the further integrating the nation's R&D system by promoting linkages among the three sections of government, academia and industry...
- As of now, I have no specific suggestions. It is not clear how often our specific panel should meet and/or what will trigger another meeting.

– It often is difficult to evaluate a particular project or subprogram because we are provided with inadequate information on the budget and priority of that project or program relative to others. I feel we too often seem to be evaluating projects or program...

– More coordination with other Advisory Board's within a specific laboratory. Also be given the opportunity to participate in Advisory Board meetings of other government laboratories in order to gain a broader perspectives and identify best practices that...

# Appendix D
# Peer Review at the United States Department of Energy

## I. Introduction

Merit review with peer evaluation is a powerful and effective tool for enhancing relevance and productivity in Federal research and development (R&D). Despite some of its well-documented shortcomings[1], peer review stimulates competition, establishes high standards for quality, rewards productivity, and, on balance, fosters creativity and promotes fair play. When combined with energetic and visionary R&D program leadership, peer review can marshal highly competent R&D teams, focus scarce resources on the most important and potentially fruitful technical opportunities, and provide reasonable assurances to taxpayers that their Federal R&D dollars are being prudently invested.

On May 6, 1994, in a White House memorandum, the Office of Science and Technology Policy (OSTP) and the Office of Management and Budget (OMB) established merit review with peer evaluation as an "R&D policy principle" to be incorporated in all Federal agency R&D budgets for Fiscal Year 1996. Specifically, according to the memorandum, each Federal R&D agency is expected to

> "significantly enhance the utilization of merit review with peer evaluation and competitive selection in Federal R&D projects. Research not subject to merit review with peer evaluation is expected to decline and funding in these areas should be moved into areas of merit-reviewed research with peer evaluation."

Further, increasing concern about accountability for efficient and productive use of government funds, including funds for

[1]Chubin, Daryl E. and Hackett, Edward J., *Peerless Science: Peer Review and U.S. Science Policy*. (Albany, NY: State University of New York Press, 1990).

government-supported R&D, has been reflected in recent Federal legislation and executive direction. The Chief Financial Officers Act, the Government Performance and Results Act, the Competition in Contracting Act, the revision of the Federal Acquisition Regulation, the National Performance Review initiative, and a number of other program evaluation initiatives from OMB have all had a profound effect on Federal agency management, oversight, and conduct of R&D programs.

The Department of Energy (DOE) fully embraces these principles of accountability, competition, and objective merit review, including peer review. In fact, it has already put in place many new ways of doing business that are strengthening their application. This paper documents the Department's continuing and expanding commitment to these principles and, in particular, to peer review.

## II. Scope of Peer Review at the Department of Energy

At the Department of Energy, peer review means competent, qualified, objective, and formal evaluation using (1) specified criteria and (2) the review and advice of qualified peers. To be qualified, peers must be technically competent in the scientific and technical field under review. Peers may come from any source, including industry, academia, and government agencies and associated laboratories. To be objective, peers must be reasonably independent and free from conflict of interest. The results of peer reviews must be recorded and, under appropriate controls, accountable to further review.

Merit reviews meeting these criteria take on many and diverse forms. They are applied to R&D proposals, projects, and programs. They are applied, as well, to the design and acquisition of major research facilities and to the formulation of multiyear research plans and strategies. Appropriate forms of peer review are constructed and applied to activities at various organizational levels: the Department Secretary, Assistant Secretaries, program offices, National Laboratories, integrated laboratory R&D, research subcontractors (including universities), and laboratory user facilities. The nature of peer review at each level is tailored to the needs at that level.

Peer reviews are usually undertaken in the context of the allocation and use of scarce R&D resources. They may be used in conjunction with competitive selection processes, where peer reviews take place prior to the award or approval of a grant or contract, or where the research activities are chosen from a pool of qualified applicants following peer reviews. These types of peer review are called pre-award, or *prospective*, reviews. Peer reviews may also be used in conjunction with evaluations of ongoing or recently completed research. These in-progress or performance reviews are called post-award, or *retrospective*, reviews. These latter reviews also strongly influence the allocation of R&D resources by what is sometimes referred to as selection by competitive survival.

Although the terms *prospective* and *retrospective* are useful constructs to describe *when* merit reviews with peer evaluation take place, the substance of both types of reviews are quite similar. In both cases, the merit of an investigator's or research group's record of accomplishments (retrospective considerations) *and* the projected course of future research (prospective considerations) bear directly on the evaluation.

## Statutory and Regulatory Context

The Department of Energy, like other Federal R&D agencies, must carry out its scientific and technical missions within a larger context of statutory, regulatory, and procedural requirements governing the expenditure of R&D funds. This context varies for different programs, but in each case largely determines the way in which peer review principles and methods are applied.

The award of research contracts, for example, is governed by the Federal Acquisition Regulation and the Competition in Contracting Act, both of which require competition among bidders and formal selection processes. The Department employs peer review principles and methods, including the use of independent engineering and scientific reviewers, in the technical evaluation stage of all such selection processes related to R&D, except in relatively rare instances where sole-source selection may be justified.

Further, the award of research grants and cooperative agreements is governed by the Department's Financial Assistance Rules, as promulgated in the Code of Federal Regulations (10 CFR Part 600). The Department's major research organizations have promulgated formal rules in the CFR governing the merit review process for R&D financial assistance. These rules require the use of technical experts to perform credible merit reviews of all

applications, solicited and unsolicited. Such merit reviews may make use of standing committees, ad hoc committees, or field readers, and generally include, in the spirit of peer evaluation, at least three qualified persons from outside the awarding program office, in addition to the designated contracting officer's representative.

A combination of Federal and Departmental regulations also governs the award of contracts at the Department's laboratories. Under the Federal Acquisition Regulation, a management and operating (M&O) contract is recognized as an appropriate instrument, or agreement, under which the government

> "contracts for the operation, maintenance, or support, on its behalf, of a government-owned or controlled research, development, special production, or testing establishment wholly or principally devoted to one or more major programs of the contracting Federal agency."

Such M&O contracts permit the Department to draw upon, nurture, and maintain the special technical expertise and capabilities required for unique missions, such as those associated with nuclear weapons and large, multidisciplinary, integrated, non-weapons research. Over the years, the Department's missions and associated requirements for such specialized expertise and capabilities have given rise to the Department's laboratory system. Altogether, the replacement cost of the facilities of this system is currently estimated to exceed $30 billion. The laboratories employ about 50,000 people, representing a concentration of technical talent that includes more than 8,500 Ph.D.s and several Nobel laureates.

Examples of specialized research facilities located at these laboratories include accelerators for the study of high energy physics, the world's most powerful computers and lasers, synchrotron light sources for probing the structure of materials, facilities for producing medical isotopes, and instrumentation laboratories for characterizing the details of flame propagation and combustion. The Department owns and maintains these facilities and, with the exception of the classified facilities, makes them available to researchers from all sectors of the economy, public and private. The Department underwrites the operating costs for experimenters who openly share their data with the scientific community. Commercial users may also use the facilities to conduct proprietary research, but on the condition that they participate on a full-cost-recovery basis. Peer review is routinely employed to allocate available time and select the experiments conducted at the

major research facilities, with some facilities having waiting lists exceeding a year.

Under a DOE-initiated contract reform[2], the Department's M&O contracts now require, or will soon require, regular performance-based merit reviews to ensure accountability in M&O contractor performance. M&O contracts that do not now contain such requirements will incorporate them when the contracts come up for renewal or renegotiation. In addition, all laboratories have an array of outside advisory panels that periodically review and advise on the relevance and productivity of laboratory-conducted R&D.

Finally, one M&O contractor seldom performs all of its R&D tasking by itself. Whether under a lead-laboratory or other management arrangement with the Department, a portion of the R&D is typically subcontracted to universities, private laboratories, or other R&D performers. At the National Renewable Energy Laboratory, for example, one-half of the laboratory's total funding supports research subcontracted to outside R&D performers. At Argonne National Laboratory, Oak Ridge National Laboratory, and Pacific Northwest Laboratory, this figure varies between 10 and 20 percent. At other laboratories, this figure is less. All such subcontracts, likewise, are governed by contract provisions that generally require both competitive selection processes, which in the case of R&D generally involve merit reviews with peer evaluation, and periodic evaluations of contractor performance.

## R&D Programs Subject to Peer Review

The Department's overall R&D budget for Fiscal Year 1994 is estimated, depending upon one's precise definition of R&D, to be about $7.4 billion, as shown in Appendix A. This amount may be grouped into three broad, roughly equal, categories: fundamental science and energy research ($2.4 billion); civilian energy technology and related R&D ($2.8 billion); and national security R&D ($2.2 billion).

Of the $7.4 billion total, approximately 20 percent supports research carried out by R&D performers employed outside the Department and its laboratory system. Performers include industry, universities, public and private research institutions, and R&D

[2]U.S. Department of Energy, "Making Contracting Work Better and Cost Less; Report of the Contract Reform Team." (Washington, DC: U.S. Department of Energy, February 1994).

consortia. The instruments used to convey funding to these R&D performers include Department-awarded grants, cooperative agreements and contracts, and laboratory-awarded research subcontracts.

Of the remaining 80 percent, most supports research and related activities carried out by performers within the Department and its laboratory system. Of this, approximately 40 percent supports the operation, maintenance, construction, and modernization of the specialized research and related user facilities. Another 35 percent supports internal laboratory research programs. The remaining 25 percent supports other functions, including general infrastructure (for example, roads, utilities), overhead, and other indirect costs.

The mix of R&D activities calls for a variety of approaches to managing research and applying peer review principles and methods. For example, research by outside R&D performers, because of the nature of the procurement instruments used to convey funding, is governed by statutory and regulatory requirements that require, in one form or another, merit reviews, mostly with peer evaluation, in conjunction with pre-award competitive selection processes. The M&O contracts are, likewise, competed and regularly evaluated, with increasing emphasis on specific performance-based measurement criteria. Also, because experimental time on the special facilities is so highly valued and demand exceeds supply, virtually all access to the facilities is allocated through some means of merit review with peer evaluation.

Peer review coverage of the internal research programs at each laboratory is, likewise, varied. The greater portion is subject to retrospective merit reviews, called for by management and conducted most often by scientists who are independent of the laboratory, in conjunction with outside program reviews and advisory committee oversight. A lesser portion is subject to prospective peer review as exemplified somewhat narrowly by the highly successful laboratory directors' discretionary R&D program and more broadly by the many programs managed within Departmental headquarters that apply peer review principles and methods to the evaluation of laboratory Field Work Proposals. This latter process is illuminated later in this paper.

Even though the Department applies different peer review methods to guide its research programs, both outside and internal, a sampling of R&D projects, using retrospective merit review by independent experts, provides evidence that research quality and relevance of both types of research programs are comparable. For example, an organization within the Office of Energy Research

(the Office of Program Analysis) regularly conducts, at the invitation of R&D program managers, retrospective peer reviews of R&D programs throughout the Department. Using an interactive method with independent, outside expert reviewers, this organization has evaluated more than 2,700 research projects over 12 years, covering about 20 percent of the Department's civilian basic research and technology development programs. The most recent data, which includes 744 research projects in Basic Energy Sciences conducted at both national laboratories and universities, produced results showing that the research programs of both internal and outside R&D performers shared nearly identical statistical profiles on research quality and relevance. These retrospective peer reviews, it should be noted, are in addition to other reviews administered by the program managers and serve as an independent measure of research quality and relevance.

Finally, above the project level, at higher levels of decisionmaking in the organizational hierarchy, the Department makes extensive, although not comprehensive, use of expert advisory bodies, constituted under the Federal Advisory Committee Act, and the National Academies. Peer input is also obtained from workshops, technical society meetings and symposia, and extensive publication in the peer-reviewed literature.

# III. Current Peer Review Practices at the Department of Energy

The scientific and technology development missions of the Department of Energy are extraordinarily diverse and far-ranging. The Department is among the largest supporters of fundamental science and basic research across many disciplinary areas and technical fields. Its applied research and technology development programs concentrate primarily on the Department's energy, environmental, and national security missions, but in doing so embrace countless forefront areas of research vital to industry, commerce, and trade. The Department also builds and equips many of the premier R&D facilities vital to U.S. competitiveness and used by U.S. universities, corporations, and nonprofit research institutes.

In these respects, the Department is endowed with highly valuable R&D resources for which there is intense competition. The Department has found over the years that this competition is most

productively and equitably managed by merit review practices that involve objective reviews and advice, that is, by peer review. It has also found, however, that peer review practices must be appropriately tailored to each context, depending on the nature of the research activities performed and the R&D community served.

Finally, and importantly, peer review systems at the Department do not now, nor must they in the future, preclude the possibility of initiating some research programs without peer review. Preserving this flexibility is vital. Programs representing entirely new research directions, research at the interfaces between established communities, or essential elements in critical mission areas often do not survive traditional peer review. If the Department had applied peer review rigidly, without flexibility or regard to such weaknesses, it might not have funded Dr. Luis Alvarez, whose work ultimately led to the meteor-impact theory of the extinction of the dinosaurs. This was world-class science—neutron activation analysis of iridium anomalies in soil samples at the Cretaceous-Tertiary geologic boundary—that used the Department's skills and facilities in novel ways that led to a revolution in thinking about our planet and its history.

## Fundamental Science and Energy Research

Virtually all of the Department's fundamental science and energy research programs undergo merit review of one form or another in order to ensure scientific excellence and mission relevance. Peer evaluation is used extensively in these merit review processes.

Nearly all research conducted by R&D performers outside the Department and its laboratory system is governed by formal processes of prospective merit review with peer evaluation and competitive selection. Such processes are codified under the Office of Energy Research's Financial Assistance Program (10 CFR Part 605), which, with some exceptions for flexibility, requires each funded grant proposal to receive a minimum of three external peer reviews. Proposals are peer reviewed for scientific excellence. This process shares many features of the merit review system of the National Science Foundation. Performance is also reviewed as part of all renewal proposals, which typically occur on three-year cycles.

Internal research programs at the Department's laboratories, likewise, undergo merit review. These reviews consist of a mix of prospective and retrospective reviews, and in many cases, both. They employ varying degrees of peer evaluation at both the laboratory and Departmental oversight levels, including regular annual re-

views of program management and onsite project reviews by Departmental staff. In addition, all labs, user facilities, and major research divisions have visiting committees of outside experts that provide annual peer review of research relevance and quality.

Every internal laboratory research program is also reviewed annually by Headquarters as part of the laboratory Field Work Proposal (FWP) submission process, in accordance with the provisions of the governing M&O contracts. Field Work Proposals are the means by which the laboratories formally propose future work and seek authorization for expending R&D funds. Field Work Proposals may vary in the extent of their specificity, but in those programs that depend heavily on the use of prospective peer review in approving laboratory R&D funding, FWPs are required to be of peer review quality. Such practices are routine in the Office of Health and Environmental Research, the Experimental Plasma Research portions of the Fusion Energy Program, several major divisions of Basic Energy Sciences, and others.

In the Office of Health and Environmental Research, for example, all FWPs are required to be of peer review quality and to be externally reviewed by independent experts. Regardless of merit review method, all research projects are annually reviewed, and any project may be redirected or terminated as a result of these reviews. All new proposals are subject to merit review with peer evaluation.

Because one of the primary goals of all scientific research is to advance the forefront of knowledge, publication of original work is an essential element of the overall research activity. DOE-supported scientists, whether outside R&D performers or internal to the laboratories, are continually evaluated by the quality of their original research as published in archival, peer-reviewed journals. This publication of original work in the open literature in itself constitutes another and important form of peer review. The Department relies upon it to both guide and gauge the relevance and productivity of its internal research activities.

The Department also makes extensive use of the National Academy of Sciences and a number of standing committees constituted under the Federal Advisory Committee Act. The Office of Energy Research, for example, routinely obtains advice on program content, quality, future direction, priorities, and proposed facilities from the Basic Energy Sciences Advisory Committee, the Health and Environmental Research Advisory Committee, the High Energy Physics Advisory Panel, the Nuclear Sciences Advisory Committee, and the Fusion Energy Advisory Committee. Their expert

and independent nature enable these advisory committees to provide additional and valuable outside advice used to guide the Department's R&D activities at the overall program level.

## Civilian Energy Technology and Related R&D

The objectives of the civilian energy technology and related R&D programs, such as those focused on energy efficiency, pollution prevention, environmental management, renewable energy, coal, oil, and natural gas, largely aim at advancing technologies for use in the general economy. This means that the management and direction of such programs must involve not just technical experts, but also those who will ultimately manufacture, market, and use the technologies. This calls for collaborative modes of R&D review and conduct that fully engage participation among those who understand competitive markets and consumer demands.

Accordingly, many of the Department's energy technology development and related R&D programs are deliberately designed to accommodate industrial partners. In various ways, these industrial partners provide substantial opportunities for external merit review by engaging themselves as full participants helping to plan, execute, and commercialize the R&D.

In addition, the Department makes extensive use of R&D procurement arrangements that not only involve industry, but require cost-sharing by industry. Section 3002 of the Energy Policy Act of 1992 establishes minimum cost-sharing thresholds of 50 percent for technology demonstration and commercialization projects, and 20 percent for all other civilian energy research. The resulting contracts thus benefit both from the routine competitive selection practices, as prescribed in Section 935.016–1 of the Department of Energy Acquisition Regulation, and from one of the most severe outside tests of research relevance, that is, substantial financial investment from industrial R&D partners.

At the Department's national laboratories, there is likewise a significant degree of external review of, and internal competition for, the energy technology development and related R&D programs. Every laboratory has an array of industrial advisory panels employed to review the R&D activities of each of its major research divisions. Individual research investigators must continually submit to a battery of scientific and technical reviews, both prospective and retrospective. Prospective evaluations include merit reviews of individual work proposals, almost always involving internal peers and sometimes involving external peers. Prospective evaluations also include multilevel internal reviews of the labora-

tories' formally submitted Field Work Proposals before they are sent to Departmental headquarters. Retrospective evaluations are performed on all R&D projects at least annually, but more typically are performed as an integral part of the course of ongoing research—by colleagues, laboratory superiors, clients at Headquarters, as well as by peer reviewers of research publications. In addition, retrospective evaluations using peer review are employed on an ad hoc or sampling basis to review ongoing research involving specific projects, cooperative research and development agreements (CRADAs), and other forms of joint R&D.

Input from peers is also obtained from contractor review meetings, workshops, technical society meetings, and symposia. Fossil Energy programs and Energy Efficiency programs have made use on a selective basis of the Office of Energy Research's Office of Program Analysis to conduct formal, independent, retrospective peer reviews of their applied research projects.

Peer review processes in some elements of the Department's civilian R&D programs are currently undergoing significant enhancement. The Technology Development program of the Office of Environmental Management, for example, is instituting peer review at the program level (see below), and is strengthening the use of "focus area review groups" at the subprogram level. Beginning in Fiscal Year 1995, laboratory Field Work Proposals, known in the Environmental Management program as Technical Task Plans, will be reviewed by teams of subject matter specialists from technical, regulatory, business, and stakeholder perspectives.

Virtually all major energy technology development and related R&D programs are periodically subjected to higher level overall program reviews involving extensive use of scientific and technical experts and industry stakeholders. The most visible of these are review committees of the National Academy of Sciences and the standing Departmental advisory committees constituted under the auspices of the Federal Advisory Committee Act. These bodies are asked primarily to comment on the content and direction of the R&D programs, including their 5-year R&D plans and associated strategic plans.

In the Technology Development program of the Office of Environmental Management, for example, top-level program reviews are conducted by the Environmental Management Advisory Board and, beginning in Fiscal Year 1995, a newly established Committee on Environmental Management Technologies of the National Academy of Sciences. Similarly, the Office of Fossil Energy is advised by the National Petroleum Council and the National Coal

Council. Altogether, there are eight active committees advising the civilian energy technology and related R&D programs.

Finally, with the implementation of strategic planning and Total Quality Management principles throughout the Department, most key planning and programming decisions are now evolved in full view of and with broad participation from outside stakeholders. For example, the Department's recently developed multiyear plan for Integrated Resource Planning was distributed to 350 stakeholders in the electric and natural gas utility industry, with formal comments received from 40 reviewers. In the Department today, every such plan must evidence extensive use of outside independent participation, review, and comment.

## National Security R&D

The Department's national security responsibilities require highly integrated, multidisciplinary, multiyear team efforts. These requirements are imposed by both the complexity and seriousness of the nuclear weapons enterprise. The Department must maintain its responsible stewardship of the nuclear weapons stockpile and preserve the special nuclear weapons technology infrastructure and core competencies that may be needed in future national security situations. At the same time, it must dismantle nuclear weapons and dispose of special nuclear materials, as specified by international agreement, and contribute to the enforcement of arms control agreements and to the prevention of the proliferation of nuclear weapons. The R&D needed to support these missions requires unique facilities, special materials-handling procedures, and highly classified knowhow that, while amenable to technical review and peer review, are not always amenable to the same kind of peer review processes that are employed in the realm of unclassified research.

The Department has established, for example, formal peer review processes in the Office of Defense Programs. Weapons life-cycle activities are addressed by formalized joint Department of Energy-Department of Defense project teams whose members come from both organizations. The Nuclear Weapons Council provides a high-level mechanism for advising on Defense Programs directions. Interaction with the Department of Defense also provides close customer feedback on major aspects of program performance.

The Department also uses formal committees composed of outside experts to review or advise on Defense Programs, including the

Safety, Security, and Control Committee; the Weapon Safety Advisory Review Group; and the Inertial Confinement Fusion Advisory Panel. The Containment Evaluation Panel and the Threshold Test Ban Review Panel have also reviewed issues related to nuclear testing.

Defense Programs also uses independent outside expert groups, such as JASON (a highly qualified advisory body of scientists), to review its classified programs. The National Academy of Sciences has also reviewed Defense Programs technical activities. A large amount of unclassified research conducted within the Defense Programs is published in open peer-reviewed journals. There is also a classified peer-reviewed journal to which laboratory researchers actively contribute.

In the case of nuclear device design and much of the related weapons science and technology, detailed review requires active expertise, and there exists no broad industrial or university base from which to draw such experts. Historically, technical competition has proven invaluable in this field and peer reviews are so designed into program activities in large part by the existence of two nuclear design laboratories, at Lawrence Livermore and Los Alamos. One-on-one interactions between researchers in highly classified but related fields at these two laboratories add considerably to the quality improvement process at both laboratories.

Sandia National Laboratory employs an effective means of intramural review, using "red teams" to ensure the safety and reliability of Sandia components and processes. Defense Programs has further established a formal interlaboratory (Los Alamos, Lawrence Livermore, and Sandia) peer review process for specific weapon R&D, certification, and surveillance activities. For example, every five years, with annual updates, Lawrence Livermore-Sandia and Los Alamos-Sandia teams in the Weapons Assessment Process conduct peer-reviewed studies of each other's stockpile weapons.

Recent M&O contracts for Los Alamos and Lawrence Livermore require the University of California to conduct annual science and technology self-assessments stressing external peer reviews with specific criteria. These are being implemented using evaluations by appropriately constituted external review committees of experts. These committees, taken together, evaluate all technical activities at these laboratories. The University of California President's Council Panel on National Security reviews the weapons programs of Los Alamos and Livermore. Panel members include technical experts drawn from outside the University of California and labo-

ratory communities. These and other mechanisms are used to assess and maintain quality in these programs.

# IV. Comparisons with Other Federal Agencies

More than 20 Federal agencies carry out R&D programs. Of these, the Department of Energy's R&D program is one of the largest, being responsible for about 10 percent of the total Federal R&D budget of $72 billion in Fiscal Year 1994. In addition, the Department of Energy has perhaps one of the most diverse set of missions, complicated by the unique demands of nuclear weapons design.

Because of this diversity and size, the Department's R&D programs taken together resemble the many facets of Federal R&D programs as a whole. Similarly, the Department's application of peer review principles and methods share many of the strengths, as well as some of the weaknesses, of such practices as applied to Federal R&D in general. Other agencies, for example, use an array of peer review methods, at all organizational levels, to promote quality, relevance, and productivity in R&D programs. The Department, likewise, applies these methods to the different levels in the management process hierarchy, and to the different types of R&D activities, as is most appropriate to each situation.

The National Institutes of Health, the National Science Foundation, and many parts of the Department of Energy's fundamental science, health and environmental research, and basic energy sciences programs all have extensive external research programs in the physical and life sciences. Each agency uses similar prospective peer review methods, by mail, or by panels, before funding proposals. Some agencies with their own laboratories also make available their research facilities for the benefit of other users, such as the National Aeronautics and Space Administration's wind tunnels. Research at such user facilities, like that at the Department's facilities, is merit-reviewed using prospective peer reviews.

Like the Department of Energy, the Departments of Defense and Commerce (the National Institute of Standards and Technology), the National Aeronautics and Space Administration, and, to some extent, the National Institutes of Health (NIH) all conduct internal laboratory research programs. Each agency relies primarily

upon in-progress, retrospective reviews for guiding and gauging its internal laboratory research.

In the area of basic research, the National Institutes of Health is an agency often cited as a model for emulation in its use of merit reviews with peer evaluation. Ninety percent of the research activities at NIH are external, and are subjected to a two-stage review process. In the first stage at NIH, a panel of 15 to 20 scientists, experts in the relevant field, read each proposal. Generally, three panel members review each proposal in detail against specified criteria and prepare formal briefs, while the other panelists familiarize themselves with each proposal. All panelists take part in a group discussion and vote formally. The panel then reports to a National Advisory Council for the second stage. Each institute of the NIH has a single National Advisory Council of at least 12 members, not all of whom are necessarily scientists (in most proposals, there are considerations beyond pure science).

Review of internal laboratory research at the NIH is conducted by the Board of Scientific Counselors for each institute. Each board consists of outside scientists chosen for their expertise related to each institute. However, it should be noted that many Board members are funded by the institute under review.

An authoritative critique[3] of the NIH peer review system concluded that (a) the excellence of the overall NIH research program is built on a variety of approaches to managing research, using both prospective and retrospective reviews; (b) prospective and retrospective peer review have different strengths and weaknesses, and encourage creativity in different ways; and (c) the overall NIH research program was best served by retaining prospective review in its external (for example, R&D support via grants) programs and retrospective review in its internal (for example, in-house laboratory) programs.

As strong as the NIH and other agency peer review practices appear to be, in each area where commonality exists among research kind (for example, basic research) and communities (for example, universities, research centers), the Department of Energy has well-established peer review practices that are quite comparable and, perhaps, better in some areas. This comparability notwithstanding, the Department can only benefit by examining more thoroughly

[3]National Institutes of Health, "Report of the External Advisory Committee of the Director's Advisory Committee." (Washington, DC: National Institutes of Health, April 1994).

and understanding more completely the best practices of other agencies. To this end, the Department intends to continue its study of other agency practices, participate in interagency fora on peer review, and implement some pilot programs to test innovative approaches.

The sharing of peer review strengths, however, means that the Department may also share some of its weaknesses. The process of merit review with peer evaluation, in general, is under pressure and has been criticized by many in the research community, in part, due to its cost, complexity, administrative burden, lack of available peers, slowness, and questions about equity and fairness. Even with these concerns, however, peer review is still widely regarded as the best method available for allocating scarce R&D resources. Accordingly, the Department of Energy seeks ways to both respond to these concerns and develop improved peer review systems, as outlined below.

# V. Conclusions and Opportunities for Improvement

As documented in this paper, the Department of Energy uses peer review extensively throughout its R&D programs to both guide research direction (prospective peer review) and gauge research progress (retrospective peer review). In many instances, both forms of peer review are applied to the same research activity. The Department's peer review practices in many of its more mature R&D programs may be counted among the best practices of all agencies. Peer review practices in some of the more recently established and growing R&D programs are evolving and being strengthened. Virtually all major R&D programs experience multiple levels of review by qualified and independent review and advisory committees.

External R&D activities conducted via grants, contracts, and cooperative agreements are governed by an elaborate system of statutory, regulatory, and procedural requirements that virtually ensure that the vast majority of R&D awards are subjected to merit reviews with peer evaluation and competitive selection. Internal laboratory R&D activities are likewise subjected to multiple reviews by peers, both prospective and retrospective, with increasing competition. Retrospective merit reviews with peer evaluation

have been confirmed by independent studies as an effective means for promoting research relevance and productivity in the laboratories. Moreover, in many Departmental laboratory R&D programs, retrospective reviews are increasingly being supplemented by prospective reviews of laboratory Field Work Proposals, where appropriate. Administrative requirements for cost-sharing and joint planning of applied R&D with industry add further to the checks and balances of R&D management.

In April 1994, the Department reaffirmed its strong commitment to peer review in its strategic plan, *Fueling A Competitive Economy*, by specifying that an important "success indicator" for its science and technology programs is

> "quality of science, as indicated by favorable outside peer reviews and judgement of expert advisory committees."

Recognizing the importance of peer review, having surveyed peer review practices at other Federal agencies, and having reviewed the suggestions of such experts as Chubin and Hackett,[4] Bozeman,[5] and Kostoff[6] for the evaluation and improved use of peer review, the Department intends to strengthen further its use of peer review, in forms appropriate to its missions, in all of its technical programs, and at all levels of decisionmaking.

In so proceeding, the Department recognizes that serious reviews can impose major costs on those being reviewed, as well as on the reviewers and supporting staff. Peer review systems can introduce significant delays in R&D program execution. If implemented too rigidly, peer review systems can stifle flexibility and creativity. The experiences of several R&D agencies suggest that it is possible to create elaborate systems of overlapping reviews that are unnecessarily complex and burdensome.

Being aware of these potential risks, the Department has identified three broad areas for improvement.

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[4]Chubin, Daryl E., et al., *op. cit.*

[5]Bozeman, B., "Peer Review and Evaluation of R&D Impacts," in ed. Bozeman, B., and Melkers, J., *Evaluating R&D Impacts: Methods and Practice*, p. 79–98. (Boston, MA: Kluwer Academic Publishers, 1993).

[6]Kostoff, R., "Assessing Research Impact: Federal Peer Review Practices," in ed. Kostoff, R., *Evaluation Review* vol. 18, No. 1, p. 31–40. (Sage Publications, February 1994).

## Enhanced Application of Peer Review

First, *while recognizing the need for flexibility and efficiency, the Department of Energy will seek to enhance the use and application of peer review at all appropriate levels of R&D program management and execution*.

- Peer review applied at the highest level of management checks the research agenda and helps to inform the processes that establish top-level guidance for R&D priorities throughout the agency. Filling a gap in such coverage, an advisory task force for strategic energy R&D, similar to those advising the Secretary on science and defense matters, will be chartered to serve this function under the auspices of the Secretary of Energy Advisory Board.

- Where appropriate, gaps will also be filled in the coverage of expert advisory committees at the Assistant Secretary level and in the use of outside expert peer reviews at the major R&D program level.

- Recognizing that outstanding leadership can often take R&D programs to great heights of accomplishment, the Department will include R&D program leadership, at both Departmental headquarters and in the field, as a specific element in future major R&D program reviews.

- In its laboratory system of Field Work Proposals, the Department will encourage enhanced quality of FWPs and the expanded use, where appropriate, of prospective merit reviews with peer evaluation of FWPs for new projects, emulating current practices of many of the Department's basic research programs.

- At the outset of new major R&D program initiatives, plans will be established, as appropriate, to apply peer review principles and methods at all suitable levels.

- In implementing the Department's initiatives in contract reform, measurements of contractor performance, including M&O contractors, will be extended, as appropriate, to include an evaluation of the use of peer review principles and methods.

## Improved Peer Review Processes

Second, *the Department of Energy's management of its peer review processes will be strengthened, including the establishment of guiding policies and principles, improved oversight, and broadened documentation of use*.

- The Department will build on the successful peer review record of many of its programs, and establish guidelines for conducting peer review at various levels of management, tailoring them to meet the particular information needs and unique features of the programs and missions to which they would apply.

- Periodic and random sampling will assess the use and effectiveness of the peer reviews and identify areas for improvement. This may also include broadened coverage of the in-progress peer review program currently under way in the Office of Energy Research.

- A process for linking peer review principles and methods and other evaluative activities to the Department's strategic planning, budget formulation, and performance management activities will be developed and implemented, in conjunction with related efforts responding to the Chief Financial Officer Act and the Government Performance and Results Act.

- The Department will explore ways to reward the effective use of peer review, including simplification of administrative procedures and relaxation of oversight controls, in areas where R&D excellence has been demonstrated.

## Peer Review Research and Innovation

Third, *the Department will be a leader in examining peer review processes and best practices, and in developing and implementing recommendations for improvements in the application of peer review to today's science and technology environment*.

- As part of the Department's oversight of peer review practices and increased use of performance-based contracting, collection of data on the practice and nature of various forms of peer review will be established. Information on current peer review practices will address, to the extent practicable, methods, costs, and benefits, and identify areas of improvement.

- Research on improved methods for peer review will be encouraged and communicated. Trade-offs must be addressed between accountability and scientific freedom, efficiency and thoroughness, as must issues of the effectiveness, robustness, responsiveness, fairness of review, and adherence to technical standards of good measurement, including validity and reliability.

- A study, including surveys of the literature and interviews with both private and Federal agency R&D managers, will examine the various models for conducting Federal R&D and propose innovative approaches to the application and use of peer review to the accomplishment of the Department's R&D missions.

- A series of pilot programs will be established to test the expanded use of peer review, or modifications of peer review, in areas where prospective reviews might be beneficially substituted for some retrospective reviews, such as in some of the Department's internal laboratory R&D programs.

- While some parts of the Department have excellent peer review systems already in place, new criteria for selection and effective use of peers will be developed and added to Departmental guidelines, as needed. These criteria may address such issues as the competence and objectivity of peers and methods to deal with reviewer bias and dysfunctional group dynamics.

**Table D–1. Science and technology FY 92–94**

| | FY 1992 Actual Expenditures ($M) | FY 1993 Adjusted Appropriations ($M) | FY 1994 Adjusted Appropriations ($M) |
|---|---|---|---|
| **FUNDAMENTAL SCIENCE AND ENERGY RESEARCH** | | | |
| **Energy Research** | | | |
| Biological & Environmental Research | 369.5 | 380.6 | 412.3 |
| Basic Energy Sciences | | | |
| Materials Sciences | 253.4 | 273.3 | 271.6 |
| Chemical Sciences | 156.5 | 163.6 | 166.3 |
| Energy Biosciences | 24.4 | 25.5 | 26.6 |
| Engineering & Geosciences | 35.4 | 36.5 | 37.2 |
| Applied Math Sciences | 80.5 | 83.9 | 103.7 |
| Advanced Energy Projects | 54.7 | 11.0 | 11.2 |
| All Other BES | 155.5 | 258.1 | 173.8 |
| Subtotal BES | 760.4 | 851.9 | 790.4 |
| Other Energy Research | | | |
| Advanced Neutron Source | 0.0 | 0.0 | 17.0 |
| University & Science Education Programs | 54.1 | 55.9 | 57.9 |
| Laboratory Technology Transfer | 10.0 | 9.9 | 39.2 |
| Multi-Program Laboratory Support | 25.6 | 26.7 | 41.3 |
| All Other | 15.8 | 15.7 | 20.1 |
| Subtotal Other ER | 105.5 | 108.2 | 175.5 |
| **Total ER** | **1,235.4** | **1,340.7** | **1,378.2** |
| **General Science** | | | |
| High Energy Physics | 618.4 | 606.1 | 617.5 |
| Nuclear Physics | 351.4 | 306.6 | 348.6 |
| SSC Not Including Termination Costs | 482.6 | 515.4 | 0.0 |
| All Other | 6.4 | (21.7) | 9.0 |
| **Total GEN SCI** | **1,458.8** | **1,406.4** | **975.1** |
| **Total FND SCIENCE** | **2,694.2** | **2,747.1** | **2,353.3** |
| **CIVILIAN ENERGY TECHNOLOGY DEVELOPMENT AND RELATED R&D** | | | |
| **Clean Coal Technology** | | | |
| Advance Appropriation - Round 4 & 5 | 460.1 | 525.0 | 400.0 |
| Appropriation | (50.0) | (525.0) | (175.0) |
| **Total CCT** | **410.1** | **0.0** | **225.0** |
| **Fossil Energy R&D** | | | |
| Coal | 225.6 | 186.3 | 167.3 |
| Petroleum | 56.5 | 61.6 | 75.3 |
| Natural Gas | 63.2 | 79.5 | 96.1 |
| All Other | 95.2 | 86.7 | 92.0 |
| **Total FE R&D** | **440.5** | **414.1** | **430.7** |

***Table D–1. Science and technology FY 92–94 (contd.)***

| | FY 1992 Actual Expenditures ($M) | FY 1993 Adjusted Appropriations ($M) | FY 1994 Adjusted Appropriations ($M) |
|---|---|---|---|
| **Conservation R&D** | | | |
| Transportation | 109.3 | 138.6 | 178.6 |
| Utility | 4.7 | 4.9 | 6.8 |
| Industry | 96.7 | 111.7 | 125.0 |
| Buildings | 47.1 | 52.3 | 81.4 |
| Policy & Management | 2.7 | 3.6 | 4.7 |
| **Total Cons R&D** | **260.5** | **311.1** | **396.5** |
| **Renewables R&D** | | | |
| Solar Energy | 174.3 | 186.2 | 252.3 |
| Geothermal | 26.9 | 23.2 | 24.0 |
| Hydrogen Research | 0.0 | 0.0 | 10.0 |
| Hydropower | 1.0 | 1.1 | 1.1 |
| Electric Energy Systems | 30.4 | 32.1 | 38.6 |
| Energy Storage Systems | 7.2 | 10.2 | 17.5 |
| Policy & Management - CE | 1.9 | 2.9 | 3.9 |
| **Total Renew R&D** | **241.7** | **255.7** | **347.4** |
| **Nuclear Energy** | | | |
| Civilian Nuclear Power | | | |
| Light Water Reactor | 61.9 | 57.8 | 57.6 |
| Advanced Reactor R&D | 60.0 | 59.2 | 41.8 |
| Facilities | 96.6 | 92.7 | 6.7 |
| Subtotal Civ Nuc Pwr | 218.5 | 209.7 | 106.1 |
| Space-Related Programs | | | |
| Advanced Radioisotope Power | 51.9 | 54.4 | 52.7 |
| Space Reactor Power System | 40.0 | 29.8 | 27.4 |
| Space Exploration Initiative | 5.0 | 0.0 | 0.0 |
| Subtotal Space-Related | 96.9 | 84.2 | 80.1 |
| Others | | | |
| Oak Ridge Landlord | 0.0 | 0.0 | 24.9 |
| Test Reactor Area Hot Cells | 0.0 | 0.0 | 1.4 |
| Test Reactor Area Landlord | 0.0 | 0.0 | 0.0 |
| Adv Test Reactor Fusion Irridation | 0.0 | 0.0 | 0.0 |
| All Other Except Termination Costs | 48.9 | 48.0 | 23.1 |
| Subtotal Others | 48.9 | 48.0 | 49.4 |
| **Total NE R&D** | **364.3** | **341.9** | **235.6** |

*Table D–1. Science and technology FY 92–94 (contd.)*

| | FY 1992 Actual Expenditures ($M) | FY 1993 Adjusted Appropriations ($M) | FY 1994 Adjusted Appropriations ($M) |
|---|---|---|---|
| **Energy Research** | | | |
| Fusion Program | 332.2 | 335.2 | 343.6 |
| **Uranium Enrichment** | | | |
| AVLIS | 161.7 | 0.0 | 0.0 |
| Alternative Applications | 1.0 | 0.0 | 0.0 |
| **Total UE** | **162.7** | **0.0** | **0.0** |
| **Radioactive Waste R&D** | | | |
| Nuclear Waste Fund Activities | 275.1 | 275.1 | 260.0 |
| Civilian Waste R&D | 5.1 | 4.9 | 0.7 |
| Defense Nuclear Waste Disposal | 0.0 | 100.0 | 120.0 |
| **Total RW** | **280.2** | **380.0** | **380.7** |
| **Environmental Restoration and Waste Management** | | | |
| Technology Development Defense | 286.3 | 333.7 | 397.5 |
| Technology Development - Civilian | 0.0 | 0.0 | 0.0 |
| **Total ER & WM** | **286.3** | **333.7** | **397.5** |
| **ES&H - Environmental R&D** | | | |
| Epidemiology & Health Surveillance | 47.7 | 49.5 | 49.2 |
| **TOTAL TECH DEVEL & REL R&D** | **2,826.2** | **2,421.2** | **2,806.2** |
| | | | |
| **NATIONAL SECURITY R&D** | | | |
| **Atomic Energy Defense Activities** | | | |
| **Weapons Activities - R&D** | 1,431.7 | 1,536.0 | 1,298.8 |
| **Naval Reactors Development** | 695.2 | 730.0 | 684.4 |
| **Nonproliferation & Verification R&D**[1] | 210.0 | 219.9 | 235.0 |
| **Educations Programs** | 49.9 | 52.6 | 0.0 |
| **Total NATL SEC R&D** | **2,386.8** | **2,538.5** | **2,218.2** |
| | | | |
| **TOTAL DOE** | **7,907.2** | **7,706.8** | **7,377.7** |

[1]Estimated amount for FY 1992; actual amount not available.

# Appendix E
# Inspector General's Audit Report on the Department of Energy's Peer Review Practices

DOE/IG-0419

**AUDIT REPORT**

**THE DEPARTMENT OF ENERGY'S PEER REVIEW PRACTICES**

**APRIL 1998**


U.S. DEPARTMENT OF ENERGY
OFFICE OF INSPECTOR GENERAL
OFFICE OF AUDIT SERVICES

DOE/IG-0419

# AUDIT REPORT

## THE DEPARTMENT OF ENERGY'S PEER REVIEW PRACTICES

APRIL 1998

U.S. DEPARTMENT OF ENERGY
OFFICE OF INSPECTOR GENERAL
OFFICE OF AUDIT SERVICES

**DEPARTMENT OF ENERGY**
Washington, DC 20585

April 6, 1998

MEMORANDUM FOR THE SECRETARY

FROM: Gregory H. Friedman
Acting Inspector General

SUBJECT: INFORMATION: Audit Report on "The Department of Energy's Peer Review Practices"

## BACKGROUND

Fulfilling the requirements of the Government Performance and Results Act of 1993 has presented Federal science agencies with the challenge of defining ways to quantify and evaluate the outcomes of research. Measuring research program performance is particularly important for the Department of Energy because of its substantial investment (approximately $7 billion in Fiscal Year 1996) in research and development activities.

The Research Roundtable, in 1995, observed that the results of research could be evaluated using the performance indicators of relevance, productivity, and quality. One method for doing so is formal, objective evaluation by independent reviewers, or peer review. The objective of the audit was to determine whether the Department had established and was managing a peer review process for evaluating scientific and technical projects.

## RESULTS OF AUDIT

Peer review programs had been established to manage various research and development activities at the Department's National Renewable Energy Laboratory and the Pacific Northwest and Los Alamos National Laboratories. We found that peer reviews were conducted prior to competitive award of subcontracts, selection of projects from research proposals, and inclusion in scientific journals and/or conferences. In addition, the Department and the laboratories, in response to the Government Performance and Results Act and performance-based contracting, had incorporated peer review into the laboratories annual performance self-assessment process. The results of these reviews were used to determine program direction, obtain input on ongoing programs, and priority funding for laboratory and Departmental research activities.

This report does not include any recommendations since the laboratories had established processes in accordance with Office of Management and Budget and Departmental peer review requirements. The audit included only three of 20 laboratories that received Departmental research and development funding in FY 1996. Therefore, there is no assurance that our conclusions can be extended to the peer review practices at all DOE laboratories or research programs.

Attachment

cc: Deputy Secretary
Under Secretary

# THE DEPARTMENT OF ENERGY'S PEER REVIEW PRACTICES

## TABLE OF CONTENTS

# Overview

## INTRODUCTION AND OBJECTIVE

Recent laws enacted by the President and the Congress and program evaluation initiatives from the Office of Management and Budget (OMB) require Federal agencies, including agencies actively involved in scientific research, to develop annual performance plans. These plans should include suitable performance measures, document program outcomes, and use merit review with peer evaluation and competitive selection of Federal research and development (R&D) projects. Measuring program performance is particularly important for the Department of Energy (DOE) because of its substantial investment ($6.7 billion in Fiscal Year 1996) in R&D activities.

In 1995, the Research Roundtable, a group of Federal researchers and managers representing a cross-section of departments and agencies, concluded that the results of research program performance could be measured and evaluated using various assessment methods, including peer review, to determine the relevance, productivity, and quality of research activities.

Peer review is defined as a competent, qualified, objective, and formal evaluation by independent reviewers using specified criteria. As a scientific custom, peer review is an organized method for evaluating work that is used by scientists to certify the correctness of procedures, establish the plausibility of results, and allocate scarce resources such as research funds, special honors, and space in professional journals.

The Department emphasized its commitment to peer review in its 1994 and 1997 Strategic Plans. As a success indicator for its science and technology programs, the Department is committed to maintaining "the high quality and relevance of DOE's science as evaluated by annual peer reviews and advisory committees."

Peer review, in addition, plays a role in guiding the formation of research and development budgets. In 1994, the OMB, along with the White House, Office of Science and Technology Policy, issued a memorandum to Federal agencies that established peer review (merit review with peer evaluation) as an R&D principle. In developing their Fiscal Year 1996 budgets, Federal agencies were advised to "significantly enhance the utilization of merit review with peer evaluation and competitive selection in Federal R&D projects."

The objective of the audit was to determine whether the Department had established and was managing a peer review process for evaluating scientific and technical projects.

## CONCLUSIONS AND OBSERVATIONS

At the three laboratories where audit work was performed, the Department had established and was managing a peer review process for scientific and technical projects. The National Renewable Energy Laboratory (NREL), the Pacific Northwest National Laboratory (PNNL), and the Los Alamos National Laboratory (LANL) had instituted peer review programs in accordance with Administration policy and OMB requirements. In addition, the results of these reviews were being utilized to guide the R&D activities at the laboratories for the following programs: Defense Programs, Energy Efficiency, Environmental Management, Energy Research, and Nuclear Nonproliferation and National Security.

Third-party reviewers performed peer reviews of laboratory divisions. In addition, customers, ranging from principal investigators to assistant secretaries, utilized peer review results to guide Department and laboratory R&D activities. Results were used to determine program direction, obtain input on ongoing programs, and prioritize funding for projects based on research results. They were also considered as part of contractor self-assessments and Departmental performance evaluations.

Additionally, individual peer review committee members contacted during the course of the audit characterized the Department's peer review processes as an effective method for providing direction to the Department's R&D activities. Committee members stated they were satisfied that the results of their peer review efforts were being considered by the laboratories and the Department.

This report does not contain recommendations since the three laboratories had established and were managing peer review processes. However, the audit examined only three of 20 Department laboratories that received R&D funding in Fiscal Year 1996. Therefore, there is no assurance that our conclusions can be extended to the peer review practices at all DOE laboratories or research programs.

***/s/***

Office of Inspector General

# DOE Peer Review Practices

## Department And M&O Contractors Required To Conduct Peer Reviews

Administration R&D policy principles issued by the White House, Office of Science and Technology Policy, direct Federal agencies to use merit review with peer evaluation (peer review) and competitive selection in R&D projects. Chosen activities must be reviewed, in accordance with OMB Circular A-11, by appropriately qualified scientists and engineers outside the decision-making or supervisory chain.

Under the Government Performance and Results Act (Results Act) of 1993, Federal agencies are also required to establish long-term strategic goals, measure performance against those goals, and report publicly on how well they are doing. To facilitate this process, the Department of Energy has required its laboratories to develop a formal program to evaluate their research, science and technology, or scientific excellence and productivity programs. These evaluations, which are performed at least annually, are based on a combination of peer review and self-assessment.

The Department's 1994 and 1997 Strategic Plans underscored the importance of independent third-party reviews. In order to meet the Department's strategic goals for its science and technology, the Department plans to utilize peer review as a performance measure. Success in meeting its goals for science and technology would be indicated by favorable outside peer reviews and judgments of expert advisory committees.

## Implementation Of Peer Review Programs

The laboratories used peer review, and the outcomes of these reviews, as a mechanism to guide R&D programs and projects through their life cycle. With the advent of the Results Act and performance-based contracting, peer review had also become a part of the contractors' annual (or semi-annual) performance self-assessment and performance evaluation processes.

### Peer Review Practices

As a scientific custom, peer review was being used by the three laboratories to guide their R&D programs and projects. The peer review practices in place involved the competitive selection of subcontracts; submission of new research proposals; Departmental and other third party reviews; submission of scientific information at conferences or scientific journals, and determination of recognition and awards. For example, many of the programs reviewed at NREL

included subcontracted activities. External program review and standing advisory committees served as technical peer review groups for competitive selection of these subcontracted projects. Peer review was also used to evaluate new proposals. At PNNL, the peer review process was designed to ensure that proposals had scientific quality and were targeted to key technology problems.

Peer review has also been a traditional aspect of the Department's and other third-party evaluations of the contractors R&D activities. At NREL, the DOE Photovoltaics Division Director assessed the status, accomplishments, issues, and future directions for the NREL Photovoltaics Program. The laboratory used this assessment to develop a Draft Operating Plan that described NREL's strategy for supporting the DOE Photovoltaics program. New projects and programs at LANL were also subject to various peer reviews. To illustrate, the LANL research effort of Proton Radiography was reviewed in January and November of 1996 by external third party reviewers, as well as by the LANL Physics Division Advisory Committee. Appendix 2 provides a listing of the some of the peer reviews that occurred at the three laboratories in Fiscal Year 1996.

The publication of original work in the open literature constituted another form of peer review. The quality of written products by R&D performers was evaluated by third-party reviewers prior to being accepted for publication in archival, peer-reviewed journals. Two of the laboratories compiled data on staff publications. Database searches conducted by LANL and PNNL for Fiscal Year 1996 showed 1,456 and 491 publications, respectively, in peer-reviewed journals. Listings of NREL publications were available for each research line-of-effort included in the review.

Research products of the laboratories were also subject to peer review by independent parties in the determination of recognition and awards. R&D 100 Awards, for example, are provided to the 100 most significant technical products or advances in each year. The following table shows the R&D 100 Awards received by the three laboratories in 1996.

Table I
**1996 R&D 100 Awards**

| | |
|---|---|
| NREL | Automobile Exhaust Catalytic Converter |
| PNNL | SPIRE® (Spatial Paradigm for Information Retrieval and Explanation Software) |
| | Liquid Multilayer/Polymer Processes for Vacuum Deposition of Polymer Films |
| | CEO - Catalyzed Electrochemical Oxidation |
| | Autonomous Environmental Sentinel - AES |
| LANL | PLASMAX (Plasma Mechanical Cleaner for Silicon Wafers) |
| | TRACER (Transportable Remote Analyzer for Characterization and Environmental Remediation |

## Contractor Performance Self-Assessments

In response to the Results Act and performance-based contracting, the Department and the three laboratories built upon these traditional peer review practices and instituted peer review as a formal part of the contractors' self-assessments and the Department's performance evaluation process. In this regard, NREL, PNNL, and LANL incorporated peer review into their performance self-assessment processes.

For example, the laboratories relied on peer reviews by external Division Review Committees to provide independent assessments of R&D activities. At NREL, peer reviews were conducted on all technical work resulting from the Photovoltaics Program. These reviews were performed by Division Review Boards, Program Review Committees, and Standing Advisory Committees. All board and committee members were independent, third-party reviewers drawn from the university and industry community. Similarly, independent reviews were conducted on other NREL programs. Results from these reviews were incorporated into self-assessment reports that were provided to the Department for use in their annual performance evaluation of the laboratory.

In another case, the Department's Richland Operations Office teamed with PNNL to develop mutually agreed-on performance objectives and indicators. Independent Division Review Committees were formed to review and evaluate the laboratory's major programs/projects, and evaluate the core technical capabilities, product lines, and technologies. For example, the Energy Technology Division Revision Committee for PNNL was comprised of individuals external to the laboratory representing academia, industry, government, and other national laboratories. The division review committees at PNNL were intended to complement, but not replace, other technical reviews required by the sponsors of the program.

The Los Alamos National Laboratory also has an annual science and technology assessment program. Assessments are performed by independent Division Review Committees selected by the laboratory director. Participants are selected from the private sector, universities, and Federal laboratories based on the breadth of their experience, expertise, and ability to understand the full spectrum of division activities. The results of the LANL self-assessment are provided to the University of California's President's Council on National Laboratories and to the Albuquerque Operations Office for use in the annual contractor performance evaluation.

The Department uses contractor self-assessment results as a part of its annual contractor evaluation and appraisal process. Other components of the Department's appraisal process include an evaluation of Laboratory Management; Environmental, Safety and Health; and Science and Technology. The Department evaluates and provides scores to these areas to calculate the contractor's annual rating. These scores determine salary increase multipliers, performance-based fees, and/or award fees.

**Peer Review As An R&D Management Tool**

Independent reviews were used to provide data for program direction, obtain input, and prioritize research projects. To illustrate, based on the recommendations of the National Research Council, Environmental Management's Office of Science and Technology entered into an agreement with the American Society of Mechanical Engineers to provide independent and timely peer review over the development of environmental management technologies. The implementation of this recommendation resulted in the Department obtaining third-party reviews of research proposals, interim reports, and final reports.

Peer review was also used by DOE program managers to obtain input on ongoing programs. For example, the results of a peer review on the Atmospheric Radiation Measurement Program (ARM) addressed questions PNNL had regarding program design, execution, and management. Third-party external reviewers provided comments on the objectives and strategies of the program and how they had evolved since the program's inception, whether the level of expenditure was consistent with the scientific significance of the program, and whether data management was sound. The external review resulted in an emphasis being placed on properly identifying which scientific tests were to be performed, an increase in the interaction with satellite programs, and a recommendation to have one of the ARM sites designated as a user facility.

Merit review with peer evaluation was, in addition, used to prioritize projects. As an example, in July 1995, the Office of Energy Research coordinated a peer review of 115 research projects sponsored by the National Photovoltaics Program. The purpose of the review was to determine the quality of individual research projects, the impacts of these individual projects on the mission of the program, and the priority of future research opportunities. A group of 100 technical experts formed 15 panels, and the panels were each assigned between 7 and 9 projects for review. Based on the results of the review panels, 13 projects with serious deficiencies were terminated.

## The Value of Peer Review

We discussed the value of the DOE peer review process with members of peer review committees. Committee members, on the whole, held the laboratories' peer review programs in very high regard. Members who were interviewed identified three characteristics that distinguished peer review processes of Department of Energy funded R&D from their other peer review experiences.

First, committee members stated that, in Departmental peer reviews, adequate information was given to tie the project or program under review to the current organizational mix, and ultimately, to whether there was value in the project to the Department. One committee member noted that during NREL Peer Reviews sufficient time was spent examining the mission of the Department; tying it to the current organizational mix; reviewing specific projects; and then making a determination of the value of the project to the Departmental mission. This contrasted with the experiences of the committee members who had participated in non-Departmental peer reviews. In their opinion,

these other reviews did not provide enough information to put the research project or program in a larger context.

Second, interviewed peer review committee members agreed that the Department and the laboratories were responsive to recommendations. A member of the LANL committee commented on the high regard that management placed on comments of the peer review committee. This individual noted that they were pleased to see that recommended adjustments to a program had been implemented in response to a prior review, even though there had been "some severe comments." Similarly, NREL and PNNL committee members noted that recommendations were "seriously responded to" or "taken into consideration with appropriate changes made in the direction of research."

A third characteristic that provided value to the Department's peer review process was that committees were comprised from diverse and multiple disciplines. A PNNL committee member noted that the "multi-disciplinary team approach led to free and open review and analysis of an entire program." Similarly, committee members from LANL also commented that the "diversity of disciplines on peer review committees provided for a more thorough and in depth review capability than available for other peer reviews."

This report does not contain recommendations since the three laboratories had established peer review processes. No exceptions or issues that required management's attention were identified as a result of applying the audit procedures to the specified lines of effort. The results of this audit are not projectable to other research and development projects, lines of effort, or Departmental programs.

# Appendix 1

## SCOPE

The audit examined the peer review process for research and development (R&D) activities at three Department of Energy laboratories: Los Alamos National Laboratory (New Mexico), the National Renewable Energy Laboratory (Colorado), and Pacific Northwest National Laboratory (Washington). In Fiscal Year 1996, the Department's R&D effort totaled about $6.7 billion. Of that amount, about $4.5 billion was allocated to the Department's laboratories. The remaining $2.2 billion was allocated to Departmental field and operations offices research efforts.

Sites were selected and included in the review on the basis of whether or not the laboratory received funding for more than one program and whether line item funding was significant. The laboratories selected for review received $653 million of the $4.5 billion budgeted for R&D in Fiscal Year 1996. The following table shows the R&D line item selected for review and the respective program/project, laboratory, and Fiscal Year 1996 budget amount.

Table II
R&D Program/Projects Selected for Review

| | R&D Line Item | Program/Project | Lab | FY96 Budget |
|---|---|---|---|---|
| DP | Stockpile Stewardship | Nuclear Weapons Technology | LANL | $ 374,440,000 |
| EE | Energy Conservation | Transportation Sector | NREL | 44,991,000 |
| EE | Solar & Renewable Energy | Photovoltaic Energy | NREL | 38,000,000 |
| | | Biofuels/Biopower | NREL | 20,390,000 |
| ER | Biological & Environmental | Biological & Environmental | PNNL | 96,986,000 |
| EM | Technology Development | Technology Development | PNNL | 21,178,000 |
| NN | National & International Security | Nonproliferation & Verification R&D | LANL | 57,445,000 |
| | | | TOTAL | $ 653,430,000 |

## METHODOLOGY

To accomplish the audit objective, Federal regulations related to peer review were examined to determine their applicability to laboratory operations. A White House, Office of Science and Technology Policy, and Office of Management and Budget memorandum on Fiscal Year 1996 R&D policy principles and budget guidance was reviewed to identify the Administration's directive with regard to peer review. In addition, a Department of Energy "white paper" was analyzed to determine whether the report identified problems in Departmental peer review practices. Policies, procedures, and contractual requirements were obtained to determine peer review procedures and requirements included in M&O contracts. Finally, scientific research performance measures and criteria from the Department's Report of the Contract Reform Team were reviewed for their applicability to the DOE contracts with M&O contractors included in this review.

Listings of projects, programs, associated dollar amounts, and peer reviews performed were obtained at each of the three sites; and peer review practices were examined for projects with the highest dollar value. Selected projects were discussed with responsible scientists and managers who provided information on the purpose of the project or program, whether the project had been subject to either in-house or external peer review, and if the results of the review were used to guide the R&D effort. Listings were also obtained of program-related articles and conference proceedings that had been subject to peer review.

Discussions were held with Headquarters, field and operations office, and contractor officials who provided information regarding peer review practices, contractor performance self-assessments, and applicable contract clauses. Meetings were also conducted with Headquarters and contractor finance officials to obtain budget and reporting categories, specific program/project titles, as well as cost and funding amounts on programs selected for review. Technology managers, scientists, program managers, and others responsible for managing the R&D programs and projects at the laboratories met with the audit team to provide information on peer review practices specific to their projects and programs.

Finally, the audit team contacted peer review members to obtain their views on whether the peer review process was worthwhile and if their results were utilized. Fieldwork for the review was conducted from August to November 1997.

The audit was conducted in accordance with generally accepted Government auditing standards for performance audits, which included tests of internal controls and compliance with laws and regulations to the extent necessary to

satisfy the objectives of the audit. Internal controls were evaluated with respect to controls over peer review of Departmental R&D projects. Because the review of internal controls was limited, it would not have disclosed all internal control deficiencies that may have existed. Computer-processed data was only used to select the sites and projects included in the review; therefore, an assessment was not made regarding the data's reliability or accuracy.

# Appendix 2

Listed below are some of the peer reviews conducted during Fiscal Year 1996 at the National Renewable Energy Laboratory, the Pacific Northwest National Laboratory, and the Los Alamos National Laboratory. Departmental programmatic or internal reviews conducted by the laboratories are not included.

National Renewable Energy Laboratory

| | |
|---|---|
| Photovoltaic Energy Program | NREL Photovoltaics Advisory Committee<br>Science & Industry Review Committee |
| Biofuels/Biopower Demonstration Projects | NREL Staff - Observe Project Development - Advise DOE |
| Hybrid Electric Vehicles | National Research Council - Through its ongoing review of the Partnership for New Generation Vehicles |
| Alternative Fuels Utilization | NREL Staff - Monitor subcontracts/Advise DOE |
| Alternative Fuels Utilization | Coordinating Research Council |
| Biofuels Program | Ethanol Project Technical Review Panel |

Pacific Northwest National Laboratory

| | |
|---|---|
| Tanks Focus Areas Review | Tanks Focus Area - Technical Review Group |

Los Alamos National Laboratory

| | |
|---|---|
| Nuclear Weapons Technology/ Proton Radiography | JASON - The Mitre Corporation |
| Nuclear Weapons Technology | Physics Division Review Committee |
| Nonproliferation and International Security Division | Nonproliferation and International Review Committee |

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