

February 21st, 2002

Report
of the Subpanel on
Performance Measurement
in the Office of Science
U.S. Department of Energy

Introduction

At the request of the Acting Director of the Office of Science (SC) of the Department of Energy (DOE) a Subpanel of the Basic Energy Sciences Advisory Committee (BESAC) was formed to examine the approach of the Office of Science to performance measurement. The letter requesting the formation of the Subpanel and the charge is found in Appendix (1) of this report, and the membership of the Subpanel is given in Appendix (2).

The charge to the Subpanel asked us to review the following four topics:

- the Office of Science's methods for performance measurement;
- the appropriateness and comprehensiveness of the methods;
- the effects on science programs; and
- SC's integration of performance measures with the budget process as required by the Government Performance and Results Act (GPRA) of 1993.

The Subpanel met in Washington on January 24-25, 2002, and heard from a number of officials from the DOE, as well as representatives from the National Science Foundation (NSF), the National Institutes of Health (NIH), the Office of Management and Budget (OMB), and the General Accounting Office (GAO), concerned with the issue of performance measurement. The meeting agenda, which included both individual presentations and three roundtable discussions, is attached as Appendix (3).

The presentations at the meeting, the materials we were given, and the discussion in general made it clear that the major issues before us were related to the use of the Office of Science's performance measurement methods in the budgetary process being developed by OMB as a result of GPRA. Our report therefore addresses these broader issues; as a consequence, we have not presented our conclusions in a way that directly matches the four points listed above, although we have addressed them all.

Concern about measuring the performance of government programs and their relevance to agency missions led to the passing of the 1993 Act. Appendix (4) to this report contains a very brief outline of this Act. Its application to research raises issues not only of measuring scientific progress in the abstract but also of measuring research in the context of the funding agencies agency's mission, goals, and plans. The new Administration has reviewed the budgeting process and has directed that its outcome be compatible with the President's Management Agenda; a brief summary of the relevant points in this document are also included in Appendix (4).

The ways in which the performance measurement processes are to be used in the annual budget process are being developed by the Office of Management and Budget (OMB), and some of their guidelines are also shown in Appendix (4).

Following the passage of GPRA, its implications for research have been reviewed several times, most notably by the Committee on Science, Engineering, and Public Policy (COSEPUP) of the National Academy of Science, National Academy of Engineering,

and the Institute of Medicine. A brief summary of their reviews is contained in Appendix (5). Their most recent report was published in 2001, under the title *Implementing the Government Performance and Results Act for Research: A Status Report*.

The COSEPUP observations and recommendations are very pertinent because, during the past 50 years, the Department of Energy and its predecessor agencies have been a major source of support for long-range basic research programs in the United States, especially in the physical sciences. A direct product of that basic scientific research is new knowledge that leads to a better understanding of our world. It is widely recognized that advances in basic science also underlie and propel developments in applied science and technology that are needed for national security, economic competitiveness, new sources of energy, the environment, and improved health care in the United States.

DOE is a mission-oriented agency. The Department, through its Office of Science, supports research at both its National Laboratories and universities. As part of its mission, the DOE constructs and operates major user facilities (light sources, neutron sources, fusion devices, and a range of accelerators) that are essential to the research communities across a broad range of basic and applied sciences. The part of DOE's mission that relates to the Office of Science is best described by the following Goal, which is taken from the FY 2003 Congressional Budget Request:

“Deliver the scientific knowledge and discoveries for DOE's applied missions; advance the frontiers of the physical sciences and areas of the biological, environmental, and computational sciences; and provide world-class research facilities and essential scientific human capital to the Nation's overall science enterprise.”

The Subpanel received a detailed description of the range of the activities of the Office of Science from Dr. Patricia M. Dehmer, Associate Science Director for Basic Energy Sciences, and a brief summary of this description is included in Appendix (6). This Appendix also lists a number of important points from the presentation by Mr. William J. Valdez, Director of Planning and Analysis.

The Report begins with the Subpanel's recommendations, and these are followed by a summary of our analysis of what we consider to be the major issues presented to us.

Recommendations

1. *The Subpanel recommends that the Office of Science complete its Strategic Plan as soon as possible.*

This is a key part of the GPRA process, and is particularly important in relation to developing criteria for basic research because its five-year scope allows for longer-term planning, and the review on a three-year basis allows for the introduction of new discoveries into the research planning process. Furthermore, because the Strategic Plan must relate to the Office's Science Goal, and through that to DOE's mission, this gives criteria against which the 'relevance' criterion can be measured.

2. *The Subpanel recommends that the Office of Science continues to follow the general principles of performance assessment it has used in the past.*

The success of the Office of Science in maintaining a very effective program of world-class research and the development of a significant number of world-class facilities has been recognized by a large number of independent reviews. These assessments underscore the effectiveness and appropriateness of the management methods and techniques employed by the Office.

3. *The Subpanel recommends that the Office of Science's performance measurement criteria be aligned with those that have been developed by the Committee on Science, Engineering, and Public Policy (COSEPUP), and with their ongoing studies on the development of criteria for Basic Research, to allow a common basis for the different Federal Agencies that support basic research programs.*
4. *The Subpanel recommends that the discussions between the Office of Science and the Office of Management and Budget regarding appropriate criteria for the assessment of the progress of basic science programs be continued, to allow the development of appropriate metrics.*

This discussion should take into account the considerable qualitative component in measuring the quality of basic research, and the intrinsically longer time scales involved. To the extent that other Federal Agencies are supporting basic research, discussions should include considerations as to the extent to which similar methods of assessment might be appropriate.

5. *The Subpanel recommends that criteria to assess the ‘world leadership’ element in the assessment of the Office of Science’s research should be developed.*

6. *The Subpanel recommends that work-force issues, including the development of succession plans for the research staffs, and the education and training of a technically sophisticated personnel reservoir for the future of the nation, be incorporated into the GPRA goals of the Office of Science.*

The DOE should describe in their strategic and performance plans the goal of developing and maintaining adequate human resources in fields critical to their mission. Human resources should become a part of the evaluation process.

Analysis of the Major Issues

The research program of the Department of Energy's Office of Science is an outstanding program, which has been remarkably successful in advancing basic research in the United States, developing world-leading research in a number of important areas, and developing both an important research infrastructure and a remarkable set of major user facilities. The processes being developed in the GPRA management plans should help to make these contributions better understood by the stakeholders; and should assist the Office of Science in managing the existing program and developing the case for further advancements. All the parties involved in this exercise are in alignment with this view, and are trying to develop procedures which will help improve this valuable program, and avoid introducing processes which would harm it. Our discussion points below are not intended to criticize any of the contributors to this exercise, but are offered to help in pointing out issues that seem to us to need attention. In particular, our concern is with the development and maintenance of a world-leading program in basic research within a mission-oriented agency.

The Development of a Strategic Plan

One of the requirements of GPRA is that a Strategic Plan for program activities shall be submitted to OMB and to the Congress. This Plan is to cover a period of not less than five years from the fiscal year in which it is submitted, and shall be updated and revised at least every three years.

This is a very important part of the overall planning process, since the annual plans for work to be supported in the next fiscal year must relate to it. In the case of basic research, the strategic plan has an appropriate time scale: the Subpanel was concerned that goals concerned only with the next year were inadequate to describe basic research projects. In addition, the provision for updating and revising allows for the incorporation of new discoveries, again a matter of concern to the Subpanel.

It is important that everyone understands that the Strategic Plan has to be worded in such a way that it allows for the management function that GPRA defines, and for this reason the structure and the wording are a matter for agreement with OMB. In particular, the Plan must address the issues associated with the definition of appropriate performance assessment metrics. In addition, of course, it has to be a management tool for the Office of Science; and involvement of the appropriate scientific communities is highly desirable. These different entities (and there may be others) form what is called in this management context "a Stakeholder Group".

The Subpanel believes that the writing of a new Strategic Plan is therefore a matter of great importance, and the Office needs to start the planning process as soon as possible. The Subpanel was told by the Office of Science staff that development of a new Plan is already underway, but it appears that as yet there has been little formal involvement of the stakeholders identified above.

Assessment of the Performance of Research Programs

The COSEPUP Reports have re-affirmed the principle that performance of research programs should be assessed in terms of (a) quality; (b) relevance; and (c) leadership. This has been the objective of the Office of Science for many years, but the new role of assessment in the budgetary structure means that the meanings of these terms, and the ways in which they are assessed, have to be reexamined.

Quality has been assessed by review by peers and experts, and this process has been examined several times over the years. The Office of Science's methods of peer review are defined in two public documents: the first is the *Office of Science Merit Review System*, published in March, 1991; it was amended in August, 1999 to reflect the change in name of the former Office of Energy Research to the Office of Science. This publication describes the Office of Science Merit Review System in its entirety. The second document is Regulation 10 CFR 605, which is a more formal specification of the requirements for awarding research contracts. The peer review methods of the Office have themselves been reviewed by external bodies several times, as has the use of the results of the peer reviews by the Office in the management of the research portfolio. These have always indicated that the methods are appropriate and effective. COSEPUP has stated clearly in its reports that peer review is still the most effective means of evaluation of quality.

The Subpanel believes that the methods currently being used by the Office to measure quality are appropriate and adequate, and that they should continue to be used.

Relevance has traditionally been interpreted in terms of the relevance of the research to progress in the appropriate scientific discipline, but in a mission-oriented agency it must also mean relevance to the mission of the agency. The President's Management Agenda indicates that this relevance must, in turn, relate to the Administration's goals. This matter has also been discussed by COSEPUP, and the Subpanel believes that the Office needs to review its procedures in the light of these broader definitions of relevance, using the COSEPUP analyses as guidelines.

Leadership means both leadership in the domestic context and in the global context. This is discussed by COSEPUP in terms of benchmarking, but this aspect is yet to be fully defined. The "world-leadership" (or "world-class") metric has been implicit in many evaluations because U.S. scientific communities strive for world-class status, and it has been explicit in fields where international collaboration is common. Increasingly, a global view of progress is becoming the norm. The Office of Science is very conscious of this metric (for example in its decisions relating to the justifications for new large user facilities), and for upgrading the existing facilities, but the Subpanel believes that it appears that the new criteria may require wider assessment of the status of U.S. fields of research in the global context, and the guidelines being developed by COSEPUP may provide methods to assess this aspect.

The Use of Assessment Methods by the Office of Science

In addition to the assessment of research programs described above, the breadth of the activities supported by the Office of Science requires a much broader range of methods.

The Office of Science's research program can be described in terms of five distinct categories:

- Research projects at Universities and within the National Laboratories.
- Operation of the National Laboratories for which the Office of Science is responsible, including oversight of the Contractor Operators.
- Construction of the Large User Facilities, including the new Computer Facilities.
- Operation of the Large User Facilities.
- Operation of the Distributed Facilities.

This diversity of activities of the Office of Science, from supporting individual scientists in universities to managing large facility construction projects, makes a variety of different review mechanisms a necessity. It is clear that different methods are needed to measure the performance for each of these categories – one size does certainly not fit all. Peer Review, as described above, is the preferred method for research projects, included those conducted at the Large User Facilities. Review by experts, using broader stakeholder panels, including the Advisory Committees and their Subpanels, is used for the operation of the Large User Facilities. Review by experts is also the major method used for assessing the National Laboratories, and in particular the performance of the Contractor Operators. The Facility Construction program involves what are known as Lehman Reviews, supplemented with some newer quantitative assessment techniques once the construction is in process. In addition, the Office routinely collects quantitative data on research output, such as publications, professional awards and so forth. These mechanisms help set broad goals in terms of major commitments for facilities, they advise on priorities in choosing research options, and they judge the quality of the research product in terms of meeting goals and cost-effectiveness.

The Subpanel believes that the range of methods used by the Office of Science to set goals, determine priorities, and to evaluate accomplishments and outcomes have worked well in the past and should be continued. The concept of Committees of Visitors, which are used as a review technique in some areas of the Office of Science and in other Agencies, should be considered as an additional tool.

Recent Experience in the Application of GPRA to the Office of Science

The Subpanel was shown some of the procedures for the implementation of GPRA in the 2003 Budget Submission for the Office of Science. The Subpanel was told that it is recognized by most of the participants that it did not meet several of the GPRA

requirements, including for example that the program descriptions should give a comprehensive description of the program.

In the current budget submission, the overall Science Goal is supported by eight Strategic Objectives. Each of these has related Program Strategic Performance Goals (PSPGs): there are a total of 22 of these.

The Subpanel members from the Office of Science Advisory Committees considered that the set of these for the parts of the programs with which they are familiar distorted the aims and accomplishments of the SC research programs. With PSPGs that are only representative and not at all comprehensive, the Office's programs are portrayed as significantly less than they truly are. The Subpanel was concerned that this could even be detrimental to programs where their misportrayal could lead to unfortunate misunderstandings. The current Budget Submission thus fails as an effective communication tool, which is one of its most important roles.

The full Budget Submission is a much larger document, containing much more detail, of course; but the Subpanel believes that the opening Executive Summary should be consistent with the GPRA wording that "an agency may aggregate, disaggregate, or consolidate program activities, except that any aggregation or consolidation may not omit or minimize the significance of any program activity constituting a major function or operation for the agency."

At the same time, the Subpanel recognizes that the preparation of the budget document is very demanding of DOE staff time: reconciliation of this issue clearly requires more discussions between the Office of Science and OMB, and we were told that such discussions are in progress in connection with the FY 2004 budget exercise.

While our Charge Letter did not ask the Subpanel to address this issue, the presentations and our discussions during our meeting made it clear that these problems may affect the general matter of performance assessment.

Quantitative and Qualitative Assessment Criteria

One of the issues that were discussed by the Subpanel related to designing performance metrics which are quantitative, as opposed to qualitative. There is no doubt that it is easier for the sort of comparative assessments that have to be made in a budgeting process if the annual results of the programs can be expressed in objective quantitative terms; but it is clear from the description of the peer review process above that these assessments are generally qualitative; attempts to make them quantitative, for example by making reviewers score projects on a scale of one to ten, is artificial, and scarcely objective. GPRA requires the plan to "establish performance goals to define the level of performance to be achieved by a program activity;" and "to express such goals in an objective, quantifiable, and measurable form *unless authorized to be in an alternative form under section (b)*". (Our italics). Such an alternative form may be authorized by the Director of the Office of Management and Budget.

COSEPUP have discussed the use of qualitative, as well as quantitative, goals, and once again their guidance should act as a basis for discussions between OMB and the Office of Science.

The Subpanel believes that much basic research is better assessed in qualitative terms. While this offers challenges to the concept of being 'measurable' this should not lead to the imposition of quantitative goals. To do this would have significant negative effects on basic research, and would certainly not be consistent with the principle that application of GPRA should "do no harm"; a principle which is agreed to by all the participants in this exercise. In its ongoing discussions with OMB, this issue should be reviewed.

Experience in Other Related Federal Agencies

Other Federal Agencies also support basic research, to a greater or lesser degree, notably the National Science Foundation (NSF), the National Institutes of Health (NIH), the National Aeronautics and Space Administration (NASA), and the Department of Defense. The Subpanel heard presentations from NIH and NSF outlining their responses to the GPRA directives. All of these agencies are different, and the Subpanel recognizes that this will lead to differences in the ways in which OMB will wish to see the performance assessed.

However, there will be some overlap in the character of specific basic research programs, and the Subpanel believes that it would be worthwhile in the Office of Science's ongoing discussions with OMB on procedures for this aspect to be reviewed in relation to the development of appropriate goals and metrics.

Appendix 1: The Charge Letter to the Subpanel



Department of Energy

Washington, DC 20585

November 15, 2001

Professor Geraldine L. Richmond
Department of Chemistry
University of Oregon
1371 East 13th Street
Eugene, OR 97403-1253

Dear Dr. Richmond:

I am requesting that the Basic Energy Sciences Advisory Committee (BESAC) examine the Office of Science's (SC) approach to performance measurement, an issue that concerns all the programs in SC. I would like for the Committee to assemble a subpanel to review:

- the Office of Science's current methods for performance measurement;
- the appropriateness and comprehensiveness of the methods;
- the effects on science programs; and
- SC's integration of performance measures with the budget process as required by the Government Performance and Results Act.

The subpanel should consist of at least one representative from each of the six SC advisory committees and two or three additional members who are familiar with performance measurement issues.

I anticipate that the work of the subpanel can be completed in a 2-day meeting, consisting of (1) presentations from SC, other Federal agencies, and those with experience in performance measurement; and (2) discussion and recommendations. Pertinent background material is available and will be sent to the subpanel members for reference. I would like a report on the findings and recommendations at the February 25-26, 2002, BESAC meeting.

I appreciate BESAC's willingness to undertake this important SC-wide activity.

Sincerely,

James F. Decker
Acting Director
Office of Science

cc: Dr. Fred Gilman, Chair, HEPAP
Dr. Richard Hazeltine, Chair, FESAC
Dr. Keith Hodgson, Chair, BERAC
Dr. James Synnons, Chair, NSAC
Dr. Margaret Wright, Chair, ASCRAC



Appendix 2: The Membership of the Subpanel

Office of Science Panel on Performance Measurement

PANEL MEMBERS

Panel Chair

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Appendix 3: The Agenda of the Meeting Held on January 24th – 25th.

Agenda

Office of Science Panel on Performance Measurement

January 24 –25, 2002

Marriott at Metro Center

775 12th Street, NW, Washington, DC 20005

202/737-2200

Purpose:

1. SC's current methods for performance measurement
2. Appropriateness/comprehensiveness of the methods
3. Effects on science programs
4. Integration of performance measures with the budget process as required by GPRA

January 24, 2002

Montreal I and II, 2nd Floor

8:00 am	Welcome and Introductions	William J. Valdez Director, Office of Planning and Analysis, DOE
8:05 am	Overview of the Office of Science and the Charge to the Panel on Performance Measurement DOE	Dr. James F. Decker Acting Director, Office of Science,
8:30 am	Performance Measurement in SC – What's Happening Now	Dr. Patricia Dehmer Associate Director, Office of Basic Energy Sciences, DOE
9:15 am	Integrating Performance Measurement and the Budget in SC	William J. Valdez
9:45 am	Break	
10:15 am	Integrating GPRA and the Budget Process – General Evaluation	James Powers Director, Program Analysis and Office of the Chief Financial Officer, DOE
10:45 am	Administration Expectations	Dr. Michael J. Holland Program Examiner, OMB
11:15 am	Congressional Expectations	Robin Nazzaro Assistant Director, Natural Resources and Environment, GAO
11:45 am	Buffet Lunch (Montreal I and II, 2 nd Floor)	

1:30 pm 1st Roundtable: Effects of Performance Measurement on Science Programs Supported by SC
Discussion Leader: Dr. Milton Johnson
Acting Principal Deputy Director, Office of Science, DOE

Dr. Patricia Dehmer Associate Director, Office of Basic Energy Sciences
Office of Science, DOE

Dr. Anne Davies Associate Director, Office of Fusion Energy Sciences
Office of Science, DOE

Dr. Ed Oliver Associate Director, Office of Advanced Scientific Computing Research
Office of Science, DOE

Dr. Ari Patrinos Associate Director, Office of Biological and Environmental Research
Office of Science, DOE

Dr. Alan Schriesheim Director Emeritus
Argonne National Laboratory

Dr. Robin Staffin Deputy Associate Director
Office of High Energy and Nuclear Physics
Office of Science, DOE

3:00 pm Break

3:30 pm 2nd Roundtable: Effects of Performance Measurement on Facility Construction and Operation Supported by SC
Discussion Leader: James Turi
Acting Deputy Director for Operations
Office of Science, DOE

Dr. Patricia Dehmer Associate Director, Office of Basic Energy Sciences
Office of Science, DOE

Dr. Anne Davies Associate Director, Office of Fusion Energy Sciences
Office of Science, DOE

Dr. Ed Oliver Associate Director, Office of Advanced Scientific Computing Research
Office of Science, DOE

Dr. Ari Patrinos Associate Director, Office of Biological and Environmental Research
Office of Science, DOE

James A. Rispoli Principal Deputy Director
Office of Engineering and Construction Management, Office of the Chief Financial Officer, DOE

Dr. Robin Staffin Deputy Associate Director
Office of High Energy and Nuclear Physics
Office of Science, DOE

5:00 pm 3rd Roundtable: Alternative Approaches to Evaluation and Other Agency Experiences
Discussion Leader: William J. Valdez
Director, Office of Planning and Analysis
Office of Science, DOE

Dr. Irwin Feller Professor of Economics
Pennsylvania State University

Dr. Gretchen B. Jordan Principal Member of Technical Staff
Sandia National Laboratories

Dr. Nathaniel Pitts
Director, Office of Integrative Activities
National Science Foundation

Dr. Lana Skirboll
Associate Director for Science Policy
National Institutes of Health

6:00 pm Adjourn

January 25
Montreal I and II, 2nd Floor

8:30 am Panel Members Discussion and Report Drafting

12:00 pm Working Lunch

5:00 pm Adjourn

Appendix 4: A Brief Summary of Relevant Points from the Government Performance and Results Act, 1993; the President's Management Agenda, FY 2002; and Some Information from the Office of Management and Budget.

4.1 A Brief Summary of the Relevant Parts of the Government Performance and Results Act, 1993.

The original overall objective of GPRA was “to provide for the establishment of strategic planning and performance measurement in the Federal Government” and one of the purposes was to “initiate program performance reform with a series of pilot projects in setting program goals, measuring program performance against these goals, and reporting publicly on their progress”. The Strategic plans included: “No later than September 30, 1997, the head of each agency shall submit to the Director of the Office of Management and Budget and to the Congress a strategic plan for program activities.....The strategic plan shall cover a period of not less than five years forward from the fiscal year in which it is submitted, and shall be updated and revised at least every three years.”

The Act also modifies earlier legislation concerning performance plans, to begin with fiscal year 1999, and states that: “the Director of the Office of Management and Budget shall require each agency to prepare an annual performance plan covering each program activity set forth in the budget of such agency.” It further requires this plan to “establish performance goals to define the level of performance to be achieved by a program activity;” and “to express such goals in an objective, quantifiable, and measurable form *unless authorized to be in an alternative form under section (b)*”. (Our italics). Such an alternative form may be authorized by the Director of the Office of Management and Budget

The Act says that “an agency may aggregate, disaggregate, or consolidate program activities, except that any aggregation or consolidation may not omit or minimize the significance of any program activity constituting a major function or operation for the agency.”

“No later than March 31, 2000, and no later than March 31 of each year thereafter, the head of each agency shall prepare and submit to the President and the Congress, a report on program performance for the previous fiscal year.”

4.2 The Strategic Plan and The President’s Management Agenda

One of the requirements of GPRA is that agencies should produce Strategic Plans, and the Department of Energy did indeed publish a Strategic Plan, which is dated September 2000. The Subpanel were advised that this Plan is no longer regarded as acceptable because of the changes in approach of the new administration, described in *The President’s Management Agenda* dated Fiscal Year 2002, and issued by The Executive Office of the President, Office of Management and Budget. This states that: “The Administration is developing objective assessment criteria for federal R&D projects. These criteria will be used to assess the performance of research programs. A well directed R&D portfolio should demonstrate progress towards the portfolio’s strategic goals, without necessarily expecting success from each and every project.” An initial pilot program to develop performance criteria for DOE’s applied research and development

programs was undertaken by DOE and OMB to guide funding for the 2003 Budget for the Department's Solar and Renewable Energy, Nuclear Energy, Clean Coal, Fossil Energy, and Energy Conservation programs. Following this, "OMB will assist in the transfer of investment criteria to the rest of DOE, and other Departments and applicable agencies with applied R&D programs in time to assist in the formulation of the President's 2004 Budget. OMB and the Office of Science and Technology Policy will also work with NASA, the National Science Foundation, the Department of Defense, the National Institutes of Health, and DOE to develop separate criteria, to be issued in Spring 2002, for evaluating basic research during formulation of the 2004 Budget." The long-term results expected include the statement: "Basic research programs will better target improving the quality and relevance of their research. These investment criteria will promote our nation's leadership in important science and technology areas."

The following statement from Dr. Jack Marburger (January 8th, 2002; American Astronomical Society meeting) shows how this Agenda will affect the science programs funded by the Federal Government, including those in the Department of Energy: "... this Administration strongly emphasizes good management for all Federal agencies, and The President's Management Agenda will be applied to science as well as other federally funded operations. The Agenda includes the principle that performance is an important basis for funding allocations, which implies that measures of performance are essential ingredients in the budget process....."

4.3 OMB Input on the Process

On January 15th, 2002, Marcus Peacock, Associate Director for Natural Resource Programs at OMB discussed the White House efforts to implement this Agenda in a presentation to a meeting on "Measuring the Return on the Federal R&D Investment" organized by the American Chemical Society. He said there are six criteria that OMB will use to review requests for applied research funding: the aim was to use these criteria for the applied R&D programs identified above in the FY 2003 cycle, but noted that OMB did not begin working with the Energy Department early enough in the budget cycle, so it was unable to fully apply the criteria. They intend to apply the six criteria to all agencies that conduct applied research as they submit their fiscal year 2004 budget requests. The experience of the applied R&D programs with the new OMB criteria during the 2003 cycle will be discussed at the February 27th COSEPUP meeting, together with the new criteria that OMB is developing for basic research funding.

The six criteria for applied research funding are:

- Is the project a presidential priority?
- Will the project clearly benefit the public in an area where the private sector does not have sufficient market incentive to sufficiently fund the research?
- Is support for applied research the best means to accomplish the federal goal?

- Is the project comprehensive, meaning it includes milestones to measure progress and guidance as to when the research should stop?
- Was the project selected in a competitive manner based on its merits?
- If the project was previously funded, did it deliver results on time and in a cost-effective manner?

While several of these do not appear to be relevant to basic research proposals, they give a view of the general philosophy of OMB in making funding decisions.

Appendix 5: COSEPUP Reviews of GPRA

COSEPUP Reviews of GPRA

COSEPUP began its review of the implications of GPRA in January 1998, remarking that “Developments of plans to implement the act has been particularly difficult for agencies responsible for research activities supported by the federal government because of the difficulty of linking results with annual investments in research.” Their study is in three parts: the first aims to identify and analyze the most effective ways to assess the results of research, on the basis of consultation with federal agencies, oversight entities, the research community, industry, states, and agencies of other nations. The second aims to help the federal government determine how its agencies can better incorporate research activities in strategic and performance plans and improve the management and effectiveness of research programs, including a determination of what can be reliably measured and the best mechanisms for doing so, and a determination of what cannot be measured. The third part is to develop mechanisms to evaluate the effects of implementing GPRA on agency program decisions and on the practices of research. Their study began with three workshops, addressing the first two of these aims. Probably the most significant point made in their first report from the point of view of our study was this: “Because applied research programs by definition have desired outcomes directly related to agency missions, evaluating such programs can be relatively straightforward and agencies can use methods similar to those used by industry.” “It became clear, however, that substantial problems existed for agencies trying to evaluate basic research programs. Urgent concern was expressed that basic research could not be effectively evaluated in the context of GPRA and that misguided attempts to do so could cause great damage”.

In the conclusions to their first report, published in February 1999, COSEPUP states that “The most effective means of evaluating federally funded research programs is expert review. Expert review – which includes quality review, relevance review, and benchmarking – should be used to assess both basic research and applied research programs.” (Their Conclusion 3.)

“Federally supported programs of basic and applied research should be evaluated regularly through expert review, using the performance indicators of quality, relevance, and, where appropriate, leadership.” This last point refers to the assessment of the research in a global context; it is thought that U.S. research should be among the leaders in all fields, and the clear leader in some.

Following this report, Dr. Neal Lane, then the Director of the White House Office of Science and Technology Policy (OSTP), asked the Academies in April 5th, 1999, to undertake a more in-depth study of the actual application of GPRA to research programs as the agencies were shortly to release their first performance reports under GPRA (March 2000). However, the COSEPUP panel determined that it was not possible to respond to this request, and instead decided instead to focus on the general methods and approaches of the agencies. They decided to select the five agencies that provide most

financial support for federal research programs: the National Science Foundation (NSF), the National Institutes of Health (NIH), the Department of Defense (DOD), the Department of Energy, and the National Aeronautics and Space Administration (NASA).

The report repeats the earlier conclusion that the most effective technique for evaluating research programs is review by panels of experts.

Appendix 6: The Office of Science View of its Role

The Office of Science View of its Role

The Subpanel received two detailed reviews from senior staff at the Office of Science: Dr. Patricia M. Dehmer, Associate Science Director for Basic Energy Sciences, and Mr. William Valdez, Director of Planning and Analysis.

Dr. Dehmer's presentation included the following information.

There are four functions for the Office:

- Support of basic research that underpins DOE missions
- Supports basic research in important fields of science essential to the Nation's research infrastructure
- Construction and operation of large scientific facilities for the U.S. scientific community
- Providing infrastructure support for the ten SC laboratories

DOE's Office of Science contains six program areas: Advanced Scientific Computing, Basic Energy Sciences, Biological and Environmental Research, Fusion Energy Sciences, High Energy Physics, and Nuclear Physics. Each of these has an Advisory Committee of recognized experts, which is a significant part of the external review process.

Very approximately, the budgets for these programs in FY 2001 were:

ASC	\$161M
BES	\$974M
BER	\$514M
FES	\$242M
HEP	\$696M
NP	\$352M

Overall, and again approximately, 27% of the funding went to the Major User Facilities, 25% to the Research Laboratories, 23% to Universities, 10% to Construction, 7% to Capital Equipment, 4.5% to Program Direction, and the remainder to small items.

The Office of Science is a major source for funding basic research in the U.S., in a number of fields, and the largest source for two major areas:

Following the GAO report *Federal Research – Peer Review Practices at Federal Science Agencies Vary* (GAO/RCED-99-99) the House Committee on Science requested a follow-up study at DOE, which included an audit of the peer review procedures of BES, which covered a sampling of research projects funded in FY 1998. The resulting report *Federal Research is Providing Independent Review of the Scientific Merit of Its Research* (GAO/RCED-00-109, April 2000) notes, in part, that OBES was following the merit

review procedures that they had established, are selecting reviewers with the requisite knowledge, are requiring those reviewers to apply appropriate criteria in making their evaluations; and are using the merit review evaluations in making award decisions.

The review procedures for the University-based research, that at the National Laboratories, and the operation of the Major Facilities are summarized in two documents: the first is the *Office of Science Merit Review System*, published in March, 1991; it was amended in August, 1999 to reflect the change in name of the former Office of Energy Research to the Office of Science. This describes the Office of Science Merit Review System, in its entirety. The second document is Regulation 10 CFR 605, which is a more formal specification of the requirements for awarding research contracts.

In addition to the peer review and expert review processes, quantitative techniques, such as counting publications in distinguished archival journals, identifying major awards for research, citation indices, and so forth are conducted.

Mr. Valdez's presentation was concerned with the measurement processes that will be needed by the GPRA process, and included the following points.

Principles for the Performance Measurement process:

- Simple, Elegant and Defensible Approach
- A Balanced Portfolio of Performance Measures
- An Open and Participatory Process
- Respect for Practitioners – “Do No Harm”
- Emphasis on the Future, Informed by the Past
- Supportive of Science Excellence and Appropriate Risk Taking

SC, on the basis of COSEPUP's guidance, argues for an approach to corporate measures which will combine qualitative and quantitative measures. The elements to be assessed are:

- Excellence
- Relevance
- Science Leadership
- Science Infrastructure Stewardship
- Management and Operational Excellence