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Toward New Concepts of Management Applicable to the U.S. Bureau of Mines' Energy Research Program

Robert S. Culter, Mary Ellen Golby

Project SOAP
Technical Analysis Division
Institute for Applied Technology
National Bureau of Standards
Washington, D. C. 20234

July 1973

Status Report

April - June 1973

Prepared for
Office of Assistant Director - Energy
U.S. Bureau of Mines
Department of the Interior
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U. S. DEPARTMENT OF COMMERCE, Frederick B. Dent, Secretary
NATIONAL BUREAU OF STANDARDS, Richard W. Roberts, Director

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Special gratitude is extended to Mr. William L. Crent., Assistant Director-Energy, U. S. Bureau of Mines, whose guidance and sponsorship of this assignment constituted a noteworthy step towards the introduction of a results-oriented program management philosophy into an established government research organization.

The authors wish to thank Dr. Alan J. Goldman for his helpful comments and encouragement during the review of this report. Acknowledgement is also due to Mrs. Ruth M. Ciufolo and Mrs. Diane R. Beall, without whose assistance the report would not have been possible.

ABSTRACT

This report describes the progress to date of an effort to develop new concepts of management applicable to the U.S. Bureau of Mines' program of Energy Research. A systems analysis task group was organized to identify principal problems associated with implementing a mission-oriented research program and, in particular, to design a mechanism for determining research project priorities in terms of stated goals.

The Phase I Exploratory Survey, consisting of 14 group interviews at the Washington Headquarters and at two operational Research Centers, is detailed. Results thus far include listings of acknowledged "problem areas," where reasonable improvements are considered possible. In addition, a methodology analogous to the "peer-review" procedure used elsewhere in government for evaluating research projects in terms of "technical quality" and "program relevance" was introduced and tested in a simulation exercise. Preliminary results were encouraging and suggest direction for the additional work needed before this mechanism can become a useful management tool for budget review purposes. A second exercise is recommended involving all six USBM Energy Research Centers in conjunction with a forthcoming Mid-Year Budget Review.

TABLE OF CONTENTS

| | |
|---|----|
| 1. INTRODUCTION | 1 |
| 1.1 Background Perspective | 4 |
| 1.2 Scope of Assignment | 7 |
| 1.2.1 Objectives | 8 |
| 1.2.2 Approach | 8 |
| 1.2.3 Preliminary Results | 9 |
| 2. PHASE I: EXPLORATORY SURVEY | 11 |
| 2.0.1 Project SOAP Orientation | 11 |
| 2.0.2 The Initial Task | 12 |
| 2.1 Washington Staff Interviews | 13 |
| 2.2 Morgantown Energy Research Center Interviews | 15 |
| 2.2.1 MERC Visit #1 | 17 |
| 2.2.2 MERC Visit #2 | 21 |
| 2.3 Bartlesville Energy Research Center Interviews | 22 |
| 2.3.1 BERC Visit #1 | 22 |
| 2.4 Exercise I: Preliminary Assessment of Research Project Proposals | 27 |
| 3. FINDINGS AND CONCLUSIONS | 30 |
| 3.1 MERC "Problem Areas" | 31 |
| 3.2 BERC "Problem Areas" | 32 |
| 3.3 Exercise I Preliminary Results | 33 |
| 3.4 Conclusions | 40 |
| 4. APPENDIX Sections A and B | |

TOWARD NEW CONCEPTS OF MANAGEMENT APPLICABLE TO THE U.S. BUREAU OF MINES'
ENERGY RESEARCH PROGRAM

1. INTRODUCTION

This report describes the first three months of work performed under an Interagency Agreement by which the National Bureau of Standards (Department of Commerce) is to assist the Energy Research Group of the Bureau of Mines (Department of Interior) in developing new concepts of Management applicable to their program of Energy Research.

This work comprised the initial part of an Exploratory Survey aimed at clarifying principal issues concerning the newly integrated program of Energy Research within the Bureau of Mines' research organization. Such exploration and clarification necessarily precede the formulation of possible means for improvement. Specifically, the task involved the identification of actual problems associated with implementing mission-oriented research projects within the context of the existing six Energy Research Centers and Laboratories operated by the Bureau of Mines. To date, only two of the six Research Centers have been visited.

To perform this survey, a joint task group was organized by the Technical Analysis Division of NBS and requested to make an objective examination of the functional operating activities and principal information flows at three decision levels within the Bureau of Mines Energy Research organization. The Task Group (called "Project SOAP"*) conducted

*Project SOAP: A systems analysis task group identified by the acronym for Systems/Operation Analysis of Programs. The term "systems analysis" refers to a method for determining information relevant to managing an organized activity, for the purpose of improving its decision-making process in a more rational way. In the context of this assignment, it is intended to be used as a prerequisite for implementing the discipline of Program Management.

a series of 14 group interviews in April and May 1973 during visits to the Washington Headquarters and to two of the six field locations, the Morgantown Energy Research Center (MERC) in West Virginia and the Bartlesville Energy Research Center (BERC) in Oklahoma.

This status report summarizes the work activities of the Project SOAP task group from March 26th. through June 30, 1973, as required by the terms of the Interagency Working Fund Agreement*. It describes the type of approach employed and identifies the progress made, to date, as well as some of the difficulties encountered during this attempt to improve the general understanding of the decision-making process for managing the Energy Research activities of the Bureau of Mines.

The details of the initial part of this Exploratory Survey (covering field visits to the Washington Headquarters, MERC and BERC only) are presented in Section 2 of this report. Preliminary findings from the two visits to MERC (during April 1973) are presented in Section 3 and were reported at a briefing to the Washington Staff and Research Directors, Energy Research Group, at their annual meeting in Washington, May 1, 1973. Also, an informal briefing following the field trip to BERC was given to the Project Officer and the Assistant Director-Energy on May 30, 1973.

In order of presentation, this report first outlines the background for this assignment and identifies its scope and objectives; then, in the main body, it briefly describes the two field visits (to MERC and BERC);

*In accordance with provisions of Public Law 89-672 (80 Stat. 951); Public Law 92-369 (86-Stat. 514); and Section 601 of the Federal Economy Act, APPVD June 30, 1932, as amended (31 USC 686).

and, lastly, in Section 3, it summarizes the principal findings and conclusions to date. No formal analyses or recommendations are included in this first status report. The Appendix contains material referenced in the main text.

1.1 Background Perspective

In his first two Energy Messages to Congress,* the President established guidelines for the development by the Federal government of a National Energy Policy and Program to assure the country has a sufficient supply of energy at reasonable costs, while providing adequate incentives for Industry to sustain a healthy economic growth and improve the quality of national life.

To implement this Policy, the Secretary of Interior accepted the responsibility for establishing an Energy and Minerals Mission, and charged the U.S. Bureau of Mines (USBM) with a portion of the Interior Department's mission pertaining to Energy Research.

The Energy Research Mission of the U.S. Bureau of Mines was recently formulated with the following primary goal:**

To develop effective means that will increase the availability and improve the utilization of the Nation's energy resources at reasonable costs and in a manner that will help attain desirable social and environmental improvements.

To meet this important challenge, the existing organizational resources of USBM are to be combined into an integrated, mission-oriented Energy Research Program. Currently, specific areas of commodity research are conducted separately, and somewhat independently, at each of six

*March 10, 1972, and April 18, 1973.

**USBM Energy Research Program Mission Statement, May 25, 1972.

principal USBM Research Centers and Laboratories* employing about 900 people across the United States.

From the Bureau of Mines' Budget of FY 73, almost \$20 million was spent on research and development allocated to the four separate commodity research areas: coal, petroleum, natural gas, and oil shale. In order to respond more effectively to the R&D priorities in the President's Energy Messages, the USBM has recently initiated a new concept of mission-oriented program planning and evaluation. The primary aim of instituting such explicit management methods for its research activities is to assist the six Research Center Directors in developing a more rational and coordinated approach for allocating research resources toward recognized national Energy goals, and to provide a consistent way of monitoring progress toward those goals.

To help organize the major research activities (and their relative priorities) to be undertaken by the various Centers and Laboratories, an integrated Energy Research Mission Statement was prepared in May of 1972. It was hoped that this "Mission Statement" would provide the basis for planning and evaluating the various USBM research projects in terms of the "Energy Mission" objectives. This document, while useful at the Washington Headquarters level, was not immediately accepted at the field level because of the precedent**it established. (It has since been thoroughly reviewed, however, at both the Washington and field levels, and is expected to be released shortly.)

*Morgantown Energy Research Center (MERC), Morgantown, West Virginia; Pittsburgh Energy Research Center (PERC), Pittsburgh, Pennsylvania; Bartlesville Energy Research Center (BERC), Bartlesville, Oklahoma; Laramie Energy Research Center (LERC), Laramie, Wyoming; San Francisco Energy Research Laboratory, San Francisco, California; Grand Forks Energy Research Laboratory, Grand Forks, North Dakota.

**That of an integrated research program with its strategic technological goals determined by the Washington Headquarters.

From this prolonged review of the Energy Research Mission Statement document, it appeared there were "communications problems" between the Headquarters Staff and the Researchers in the Field concerning Research priorities. In addition, a mechanism for implementing the new management concepts presented in this Statement was needed.

In February 1973, through the recommendation of Mr. Harry R. Johnson, Assistant to the Assistant Director-Energy (by way of Mr. Leo A. Schrider [MERC] and Dr. Jack Byrd, Professor of Industrial Engineering at West Virginia University), a report entitled "Toward A Discipline for Program Management (A Summary of Project SOAP Activities)" came to the attention of the Bureau of Mines. This report, presented at the 1973 TIMS/ORSA Meeting* in Atlantic City on November 7, 1972, was the result of a two-year project conducted by a task group from the Technical Analysis Division of the National Bureau of Standards. It describes an application of Management Science by a systems analysis task group to resource allocation problems within a sister Federal research agency--the National Institute of Allergy and Infectious Diseases (NIAID) of the National Institutes of Health. Johnson and Schrider were of the opinion that the methods used by the SOAP team within NIAID might be applicable to certain Program Management problems within the USBM Energy groups.

Accordingly, in early March 1973, preliminary discussions were held between members of the Bureau of Mines and the National Bureau of Standards. On March 26, 1973, Interagency Agreement WFA-SO 133054 was executed authorizing the initial part of this four-phased assignment.

*Joint Meeting of the Operations Research Society of America and The Institute of Management Sciences, Atlantic City, N.J., November 7-9, 1972.

The following is a detailed description of the Task Group's objectives, its approach, and findings during the first part of its first phase--the Exploratory Survey.

1.2 Scope of Assignment

This Interagency Agreement between the U.S. Bureau of Mines, Department of Interior, and the National Bureau of Standards, Department of Commerce, was undertaken to assist the Bureau of Mines Energy Group develop new concepts of management applicable to their program of Energy Research. (The complete Assignment consists of four phases: Phase I - Exploratory; Phase II - Analysis; Phase III - Prescriptive; and Phase IV - Implementation.)

The primary purpose of the initial Phase I Exploratory effort was to seek the clarification of principal issues associated with the implementation of mission-oriented Program Management concepts within the USBM Energy Group.

The scope of the agreement was limited to only the first part of that phase: to visits to the Washington Headquarters and to two operational Field Centers (Morgantown, West Virginia, and Bartlesville, Oklahoma). Emphasis was directed toward investigating the potential usefulness of an explicit mechanism for evaluating research projects. It was also expected that this survey would provide the organization with the broader perspective required to coordinate some of the Bureau of Mines' other Program Management activities.

1.2.1 Objectives

Specifically, the joint task group* was organized to perform the following tasks:

- To improve the general understanding of the External/Internal and Institutional context within which the decision-making process operates.
- To clarify principal issues and identify "tractable problems" associated with the implementation of mission-oriented R&D projects.
- To define a mechanism for evaluating "Quality" and "Relevance" of research projects in terms of stated program goals.

1.2.2 Approach

The method the SOAP team used was the surveying of various peer groups within each location--at MERC, BERC, and the Washington Headquarters--to determine the existing functional information flows, feedbacks, and decision points in order to identify the nature and extent (and precise location) of significant problems amenable to solution by improved management methods. The mode of operation was the face-to-face, open-ended group interview technique, with the above three-point agenda used for focusing discussion on the objectives of the task group.

*The Project SOAP task group members included: Robert S. Cutler, Vincent A. Martino, and Dr. Mary Ellen Golby from TAD/NBS, and Dr. Jerry D. Ham and Harry R. Johnson (Project Officer) from USBM. (At MERC, the group was assisted by Leo A. Schrider, and at BERC, by William D. Howell.)

1.2.3 Preliminary Results

The results anticipated from this survey included a briefing delivered on May 1 and this report, describing:

- Details of work performed, to date, under the Interagency Agreement.
- Listing of acknowledged "Problem Areas" where reasonable improvements are considered possible.
- A recommendation concerning whether the use of quantitative methods for implementing new concepts of program management within USBM Energy Research Centers and Laboratories is operationally feasible.

To date, the Project SOAP task group has followed an orderly procedure for establishing a firm factual basis concerning the nature of actual "problem areas" identified at each operating location visited. The preliminary results obtained thus far include statements of acknowledged "problem areas" considered amenable to solution by available management methods. These results are contained in Section 3 of this report.

It would be unreasonable to expect that any task group could attain such insight into the myriad problems of a complex organization after just two site visits as to identify any single problem as the crux of the matter and recommend how it should be solved. Only after completing its exploratory work, which assures that the factual foundation is properly laid, can the SOAP team engage in a more comprehensive analysis of the principal problems associated with this assignment--the development of a new concept of management applicable to the entire USBM Energy Research Program.

From its findings thus far, from the 14 interviews with groups at three locations within the USBM Energy Research organization and from the preliminary results of Exercise I*, the Project SOAP task group concludes that it is worthwhile to proceed with the additional work needed to implement an operational "peer-review" mechanism for evaluating individual research projects in terms of program goals.

*A preliminary assessment of a sample set of Research Projects involving 56 individuals in six groups at three locations (WASH/MERC/BERC) during May 1973. See Subsections 2.4 and 3.3 for details.

2. PHASE I: EXPLORATORY SURVEY

The following details the activities performed and the observations made by the Project SOAP team during the initial part of this Exploratory Survey.

2.0.1 Project SOAP Orientation

A preliminary meeting was held March 7, 1973, at the National Bureau of Standards between three members of the U. S. Bureau of Mines Program of Energy Research and five members of the Technical Analysis Division* to discuss more fully the possibility of TAD's people doing a systems analysis study similar to the one previously conducted by TAD for one of the National Institutes of Health.** It was to be, essentially, a study of Program Management conditions within the Bureau of Mines' Energy Research Centers.

After a lengthy discussion devoted to the managerial structure of the USBM Energy Program, the USBM people stressed that the main problem of their Program, as they understood it, was one of communication and the flow of technical ideas and information--of vertical communication between Headquarters and the Field, and of horizontal communication between various levels of one Research Center and those of the other Centers. Somewhere--they didn't know precisely where--there were barriers to this vital communications flow.

*From USBM: Harry R. Johnson, Dr. Andrew W. Decora, Leo A. Schrider; from TAD: Louis C. Santone, Robert S. Cutler, Vincent A. Martino, David M. Glancy, Dr. Mary Ellen Golby.

**Cutler, Robert S., "Project SOAP: A Systems Approach to Biomedical Research Program Management-A Case Study," NBS Technical Note 761, (April 1973).

The TAD people noted that, in addition to the "communications" problem, there also seemed to be a "control" problem and that, before considering any new management concepts, they ought to understand the nature of the current resource allocation process used by USBM throughout its Energy Research Program. However, as was clearly pointed out, there was too little time to deal effectively with the whole organization. It was finally agreed that an initial survey covering operations at the Washington Headquarters and at one or two Field Centers would constitute the initial part of this Exploratory Phase.*

The next step recommended by the TAD/SOAP team members was that they be permitted to meet as many of the USBM people knowledgeable about USBM Energy Research as possible before visiting the Field Stations, because the team operated then, as always, upon the premise that problem-finding must necessarily precede problem-solving. Dr. Jerry Ham in the Arlington office and Mr. Harry Johnson in the Washington office volunteered to help set up meetings with people they felt the SOAP team should interview, including Mr. William L. Crentz, the Assistant Director of the USBM program of Energy Research; Dr. G. Alex Mills, Chief of the Division of Coal; J. Wade Watkins, Chief of the Division of Petroleum and Natural Gas; and Jack Phillips, Chief of Shale Oil, and their immediate Staffs.

2.0.2 The Initial Task

Initially there was an "identity problem" to solve. Because the aim of this assignment and the objectives of this survey were not clearly understood by everyone in advance, the USBM Energy Program personnel felt uncertain about what to expect in terms of project results. Part of this

*See letter, Santone, L. C. to Crentz, W. L., dated March 9, 1973 in Appendix, pp. A-2.

difficulty lay in their skepticism about the usefulness of system analysis techniques. Similarly, the systems analysis people from TAD/NBS recognized their lack of familiarity with the technology of Energy Research. Thus, there were mutually recognized difficulties in achieving desired results within the allotted time. Fortunately, however, there was also a sincere resolve on both sides to make a meaningful and productive start. Dr. Jerry D. Ham, Petroleum Engineer, USBM Washington Staff, was assigned part-time to the Project SOAP team to act as the liaison with the operating units of the USBM Energy Group.

2.1 Washington Staff Interviews

A series of meetings was scheduled with members of the Washington Staff of the USBM Energy Research group to acquaint them with the purpose of Project SOAP and gain their guidance on things to look for during the field trips. In these (as in later interviews) the SOAP team was cordially received, even when healthy skepticism was voiced about what the team was supposed to do.

Following is a list of the initial Washington Staff meetings held during this time:

- April 2. Orientation Meeting with Dr. Jerry Ham (USBM/Arlington), at NBS.
- April 3. Initial Meeting with Mr. Crentz, Asst. Director-Energy (USBM), in his office, in Washington, D.C.
- April 3. Orientation Meeting with Messrs. Watkins, Phillips, Gooding, Ramsey, and Dr. Ham, in their office at Arlington, Va.

April 4. Orientation Meetings with Dr. Mills and with Mr. Corey (USBM) in their offices, in Washington, D.C.

As a result of these initial discussions, the SOAP team gathered the following information and impressions to guide its further investigations:

- (1) There is no mission "indoctrination" for new researchers at the various Centers, either initially or subsequently.
- (2) Management pressures (e.g., influence of labor unions) are extremely important at some Centers, almost non-existent at others.
- (3) There tends to be too much parochialism (single-commodity interest) at all of the Centers.
- (4) The Research Supervisors appear to be the most inflexible link in the Centers' managerial chain-of-command.
- (5) The general career history of the Centers' research people is one of migration from universities into business and then to government.
- (6) The presence of a university near a Research Center tends to intellectually stimulate the atmosphere of the Center.
- (7) Washington tends to lose sight of changing technologies, while people at the Centers do not.
- (8) Washington feels the need for a study of the "relevance" of the research conducted at the USBM Energy Research Centers.
- (9) Researchers in the Field tend to have no concept of completion time-frame.
- (10) If the new Mid-Year Review is to be useful to people other than just the Asst. Director-Energy, review comments should always be followed by a feedback to the field [as was recently done for FY73].

- (11) The Bureau of Mines seems to have more difficulty selling its programs to the Department of Interior and OMB than to Congress.
- (12) Many line-decisions (directives) formerly made in the Field are now made by the Washington Staff.
- (13) There is a mutual Headquarters/Field need for understanding the functional decision-making processes at the Centers.
- (14) There is something believed wrong with the Bureau of Mines' present resource allocation methods.
- (15) Something is needed to improve the effectiveness of the "New Idea Referral System."

It was also suggested, later, by Mr. Crentz that the SOAP team visit not MERC and PERC, as originally planned (they had the virtue of proximity), but MERC and BERC,* by way of contrast. Located in different areas of the country--West Virginia and Oklahoma--they had unique environments and might perhaps exhibit contrasting problems.

2.2 Morgantown Energy Research Center Interviews

Before the SOAP team arrived at the Morgantown Center they were aware of the existence of certain stresses there. For one thing, there had been a Reduction in Force (RIF) the last fiscal year and the prospect of another one during the next fiscal year, a situation which did not help morale. For another, there was an organized Labor Union Negotiation pending at the time. Then, too, the Center's former

*For acronyms, see p. 5.

Director had recently died and his successor, Mr. William C. Eckard, had barely arrived. Lastly, there was the imminent possibility that the proposed FY74 budget of \$3.5 million was going to be cut to \$2.7 million.

Fortunately, however, the new Center Director had taken positive steps to understand the precise nature of the problems which currently existed at MERC. He had created several internal task forces from among his people, thirteen of whom had recently participated in a Leadership Systems Workshop.* Because of these internal task force efforts, the SOAP team had an easier time identifying significant "problem areas" than it might otherwise have had. For example, one MERC task force had concluded that employees have "great difficulty...in getting a fair and reasonable hearing for their ideas on possible new projects that fit... [their] mission."** They stated that the "idea referral system is pitiful" and that the "project proposal system is fine in theory, but poor in practice. The major problem is not the mechanics of these systems, but rather [the] failure of the supervisory chain to nurture the system and make it work." They complained that "little information goes below the Research Supervisor level," including mission statements and budget information, and they called for more visits from the Washington Staff to MERC.*** All seemed to agree that "communications was a part of all the problems,"****

*Sponsored by the Bureau of Mines.

**"Report of Task Force to Consider Recommendation to Maximize Productivity and Job Satisfaction in MRED and MERC," February 14, 1973, p. 2.

***Ibid., p. 3.

****"Report of Task Force on Communication and Organization," March 19, 1973, Introduction.

though they believed (contrary to what SOAP was to learn that Washington Headquarters actually wants) that the job of the Research Supervisor was to "sell the Washington staff on...[their] ideas for new or continuing programs."* They called for two Mission Statements, one from Washington and one from MERC, wherein guidelines "should be developed to outline areas in which project proposals are described within the framework of both mission statements."** They also called for the selection of Project Managers from within the Center,*** in cases where extremely important projects were involved.

It was evident from all this that MERC not only had serious problems but was keenly aware of them. Moreover, it was attempting, largely as a result of the stimulus of their new Director, to do something about them.

2.2.1 MERC Visit #1 (April 10-11, 1973)

The first group interviewed by the Project SOAP team**** the afternoon of April 10 was comprised of the Research Center Director, the Deputy Director, and the Center's five Research Supervisors. These men, in turn, were later asked to select three men from each of their sections to attend a similar meeting to be held the following day. Mr. Leo A. Schrider, Petroleum Engineer, was asked to assist the SOAP team by providing necessary support to the group while at MERC.

In an attempt to make proper introductions and to dispel suspicion that the Project SOAP team had been sent down by top management in Washington to conduct a "witch-hunt," the Director, Mr. William E. Eckard,

*Ibid., p. 3.

**Ibid., p. 4.

***Ibid., p. 6.

****Robert S. Cutler, Vincent A. Martino, David M. Glancy, Dr. Mary Ellen Golby (all of TAD), and Dr. Jerry Ham (USBM, Arlington).

introduced the individual members of the SOAP team before each meeting. He explained their mission and how they came to be involved in it, and then he discreetly disappeared (except for the meeting with the Research Supervisors) in order to promote complete frankness on the part of the others. The team learned that there was a general feeling within the Center that nobody up there (in Washington) cared about them--a feeling the team attempted to probe, pointing out that their mere presence there to help them identify "problem areas" was proof that "someone up there" did, indeed, care.

Early in the course of these meetings, and quite by accident, the term "Research Monitor" came up. When the men at MERC were asked to explain who this person is and what he was supposed to do (i.e., what his functions was), they were unable to be precise.

It was then that Dr. Ham mentioned that he was a Research Monitor; but he, too, could not give a definitive answer on the subject. (Nor is this surprising, because, as will be seen, there is great confusion among the Washington Staff--among the Research Monitors themselves--about the exact function of this person.) The SOAP team then concluded that one of the first things it would have to do once back in Washington was find out more about the role of the Research Monitor. He loomed too large on the horizon to be overlooked; moreover, the uncertainty as to his function seemed symptomatic of the general lack of communications between the Field and Headquarters.

Back in Washington, the team reviewed their notes and impressions from the two previous days of meetings and developed a tentative listing of "identified problem areas" (shown below) believed amenable to solution. The next step was to report to the Assistant Director what they had learned, at MERC, about the confusion over the functions of the "Research Monitor." They then asked for permission to schedule a return trip to Morgantown in order to ascertain whether the identified problems would in fact be acknowledged as real and salient by the participants in the initial discussions at MERC.

The following lists the findings from this first visit:

"Problem Areas" Identified from Initial Visit To Morgantown

Energy Research Center, April 10-11, 1973

1. Need for Explicit Station Mission Statement.
 - Translation of Energy Research Program "Goals" into Research Project "Objectives."
 - Participation in Project-Planning Process.
 - Results-Oriented Task Group Approach.
2. Clarify Research Monitor Function.
 - Explicit Role in "Communications" Process.
 - Strategic-Level Planning and Assessments.
 - Program Planning/Evaluation Staff.
3. Improved Mechanism for Evaluating Projects in Terms of Stated Program Goals.
 - Project Priority Determination.
 - "Quality" (Peer-Review Judgements).
 - "Relevance" (Internal/External Opinions).
 - Time-Frame for Results.
 - Costs (Multi-Year, Total Investment).
4. Improved Organizational "Feedback."
 - Intra-Communications (Within Center).
 - Inter-Communications (Between Centers, HQTRS/Field).
 - Participation in Decision Process.
5. Idea Development/Project Proposal System.
 - Stimulate "Good" Research Projects.
 - Assure Useful Research Results.
 - Consistent Criteria.

On April 16 and 18, before returning to MERC, the SOAP team met all of the ten Washington Research Monitors who were in town and who did not have prior commitments.* The gist of what they learned from these meetings is that there was as much confusion among the Research Monitors themselves concerning their role as there was among the men at MERC.

While the men at Morgantown complained of the lack of efficacious monitoring of programs by Washington and called for more on-site visits by Monitors (hopefully, once a month), SOAP received the following diversity of comments from the Research Monitors themselves: (a) that there really was no such a person as a Research Monitor; (b) that there was, indeed, such a person, and he was very valuable to the decision-making process; (c) that the Monitors, who are scientific experts, make no scientific judgements on the scientific proposals that are sent to them; (d) that the present Research Monitor function has replaced the former Program Manager function--and the latter never really got off the ground, anyway; (e) that one of the Research Monitor's functions, in addition to keeping tabs on the research going on in the Field, is to keep abreast of the state-of-the-arts in industry and elsewhere; (f) that all of the Washington Staff serve as Research Monitors, whether or not officially designated as such, and that frequently one substitutes for another; (g) that the actual function of the Monitor is to make recommendations to the Assistant Director-Energy; (h) that Research Monitors and Research Coordinators are one and the same; (i) that at least one Monitor was given a list of seven projects he had never seen before and was asked to give his opinion on them within 48 hours.

*Dr. Jerry Ham, Richard Gooding, Larry Burman, Jerry Ramsey, Richard Corey, Jack Smith, and Brian Harney.

2.2.2 MERC Visit #2 (April 25-26, 1973)

On April 25, two of the SOAP team members* returned to the Morgantown Energy Research Center. The visit coincided with the thirty-first meeting of the Petroleum Industry Technical Advisory Committee to the Morgantown Energy Research Center on Fluid Energy Resources. The SOAP team was invited to attend as observers. Being somewhat ignorant about technical matters up to now, the NBS members were enlightened by the proposals for GAS DEVEL, Underground Coal Gasification and reports of Hydraulic Fracturing and Microseismic Monitoring.

The second day of this visit was devoted to scheduled meetings with the same four groups of the MERC personnel the team had met with on April 10-11. After further discussion and feedback of what the team had learned in Washington, they asked each of the four groups to re-rank, in order of their concept of priority, the list of the five identified "problem areas" the team had gleaned from its initial visit. The results of these rankings are shown on p. 31, Section 3, of this report. The visit concluded with a brief informal report to the Center Director, Mr. William E. Eckard.

*Robert S. Cutler and Dr. Mary Ellen Golby. (Harry R. Johnson, from the USRM Washington office, was also present for the conference.)

2.3 Bartlesville Energy Research Center Interviews

Prior to its visit to the Bartlesville Energy Research Center, the SOAP team knew little about either the Center or the town. It had, however, been informed that Bartlesville was an "oil" community ("It's a one-company town," the team was told); that there was no labor union at the Center; that the University closest to the Center, Tulsa, was sixty miles away; that one of the best Thermodynamics groups in the country was employed by the Center.

2.3.1 BERC Visit #1 (May 21-22, 1973)

On Monday, May 21, 1973, two SOAP team members* met with Mr. John S. Ball, the Research Director of BERC, for lunch. During this informal gathering, the team briefed him on what it hoped to accomplish while at Bartlesville, and he, in turn, briefed the team on the situation at BERC, as he saw it.

The SOAP team had decided well in advance that they would follow essentially the same procedure for interviews that they had followed at MERC. They requested the Center Director schedule his Research Supervisors for the first meeting with the SOAP team and that the Supervisors, in turn, nominate additional men for a series of three meetings the following day. All these requests were granted.

That afternoon, from 1:00-2:30 P.M., the SOAP team met with the Director, four Research Supervisors, the Superintendent, and the appointed liaison man, William D. Howell (who attended all the meetings).

*Robert S. Cutler and Vincent A. Martino, of TAD.

This session was particularly interesting in one respect. Although the Director introduced the SOAP team by way of remarking that they had not been sent down by Headquarters on a subversive mission but had, rather, come to identify and help solve problems, there existed an unmistakable air of skepticism. Fully two-thirds of this meeting was spent by the SOAP team in justifying both its credentials and the reason for its mission. One Supervisor bluntly challenged the assumption that there were any "problems" at BERL.*

However, in due time, these "problems," voiced as complaints, began to surface (and were duly noted by the SOAP team). At the conclusion of the meeting, the Staff agreed to select three men each from their groups to attend the next day's sessions.

The three groups met with the SOAP team on May 22. Again, the Director, John S. Ball, introduced the SOAP team members to all three groups and then left, in an attempt to assure frankness on the part of those participating. And the men were frank. That night, the SOAP team drew up the following list of "problem areas" they had identified as a result of these four meetings.

*This remark was all the more interesting in view of the following: As at MERC, BERL had its own Leadership Task Force on improving productivity and job satisfaction. While the group found that, on the plus side, salaries, facilities, and support functions were good at Bartlesville, they called for more "active, attentive management at the Washington level"; the creation of a staff to serve as a liaison between Washington and the field, spending much of its time in the field; funding of only that research which the Bureau can best perform; better communication, both vertical and lateral; and "recognition of work by other peer groups." See Memorandum on "Evaluation of Bureau of Mines Management Operation," Leadership Systems, Inc. Task Force, Bartlesville Energy Center, March 7-12, 1973.

"Problem Areas" Identified From Initial Visit To
Bartlesville Energy Research Center, May 21-23, 1973

1. **Feelings of Frustration Concerning Inadequate Funding Support for BERC Research Capabilities in Face of Current National Energy Crisis**
 - Lack Confidence in Washington Salesmanship
 - Need for Review of Policy on Outside Agency Funding
 - Clarify Budgetary Decision Process
2. **Recognition of "Communication Gap" Between Washington Headquarters and Field Stations**
 - Clarification of Research Direction - Mission Statement
 - Improved Program Planning/Evaluation Staff Capability
 - Assignment of Specific Energy Research Program "Requirements" (and Priorities) From Headquarters to Centers
3. **Clarification of Headquarters Energy Division Staff Function**
 - Research Monitor/Coordination
 - Headquarters-Level Planning and Evaluation
 - Liaison with Technical/Industry Advisory Groups
4. **Improved Project Management Review Mechanism**
 - Determination of "Technical Quality" and "Program Relevance" of Research Activities
 - Establish Center Priorities
 - Provide Basis for Program Evaluation
5. **New Idea Development/Project Proposal System**
 - Present Procedure Too Complicated, Ineffective
 - Lack of Incentive (Funding) to Stimulate Innovation
 - Require Meaningful Feedback

Because they had only the morning of May 23rd. for quick wrap-up sessions, the SOAP team allotted approximately one-half hour to each of four meetings--with the Research Supervisors and the same three groups of Project Leaders interviewed the preceding day. They asked the Research Director and the Research Supervisors to review and re-rank the list of five identified "problem areas" and then return the revised listing to TAD. A letter* from John S. Ball, Research Director of BERC, describes the results of the process. Instead of having just the Research Supervisors participate in Exercise I,** as originally planned, the team requested the participation of all four groups, with the Research Supervisors and one group of Project Leaders judging "program relevance" only*** and the two other groups of Project Leaders judging "technical quality" only. The men were asked to mail their tally sheets directly to TAD/NBS by June 1.

The next step for the SOAP team was an informal feedback report to the Washington Staff about their first visit to BERC. On May 30, 1973, Mr. Crentz, Harry Johnson, Dr. Ham and three members of the SOAP team**** held a long meeting in Mr. Crentz's office. Because the primary aim of this session was the recapitulation of the team's visit to Bartlesville, the team gave a detailed account of their stay at BERC, including a contretemps between one of their members and one of BERC's Project Leaders, with apologies from the involved team member.

*See letter, John S. Ball, Research Director, to Robert S. Cutler, Project SOAP, dated June 1, 1973, in Appendix, pp. A-4 thru A-6

**To be explained more fully in the following pages.

***Because certain persons in one group were not qualified to judge on technical matters, they and the rest of their group were asked to judge on the basis of their concept of "program relevance".

****Robert S. Cutler, Vincent A. Martino, Dr. Mary Ellen Golby, all of TAD.

While discussing the submitted list of "problem areas" identified during this first visit, Mr. Crentz made several observations, among them these three, which are very pertinent to SOAP's assessments of this Center's relationship to its Washington Headquarters:

- Bartlesville Energy Research Center is unique in its funding. It receives approximately 50% of its funding from agencies other than DOI--from private and other Government agencies, as well as from the state of Oklahoma. Recently, there has been a steady decrease in this outside funding, and BERC has looked to USBM to fill its diminishing coffer. This the USBM has been unable to do, simply because there are no dollars to be had.
- To the charge of one man at BERC--that one of the reasons BERC was suffering from insufficient funding was that petroleum research did not have the powerful lobby on the Hill that coal research had--Mr. Crentz responded negatively. He pointed out that the petroleum industry has no difficulty in making its voice heard in Washington, but differs considerably from the coal industry in its attitude toward and reliance on government research. Whereas the coal industry conducts virtually no research of its own (and is, therefore, always delighted when the government offers to do so), petroleum has a multi-million dollar proprietary research program and tends not to seek USBM research projects precisely because they are not proprietary and the results are made public for anyone to exploit.
- The most fruitful way for a researcher to promulgate a new idea is to get the Research Director behind it. If he confirms it is "good" and advances the idea to Washington for funding, Mr. Crentz believes, "in almost no cases at all," would he run into a stumbling block. The logic here is simply that if the new idea is actually "good" it should surely be sponsored by the Research Supervisor or the Research Director, and it will therefore eventually receive funding and won't be the victim of the funding of on-going projects. In fact, if it is sufficiently good, on-going projects may be its victim. (These remarks were, in effect, a reiteration of Mr. Crentz's statement to the Mid-Year Review Conference for May 1, 1973, that he wanted two sources of information upon which to base his budgetary decisions: the Research Director and the Division Chiefs.)

2.4 Exercise I: Preliminary Assessment of Research Project Proposals

Following its May 1st. briefing to the USBM Research Directors, who were meeting in Washington for a Mid-Year Review, the SOAP team was urged to conduct a test of a management tool for evaluating projects in terms of stated program goals. What was desired was a means for ascertaining: (a) how consistently various people associated with the USBM Program of Energy Research would rate on-going Project Proposals, and (b) what their rationale was.

A preliminary Exercise was then designed to determine the feasibility of obtaining a meaningful assessment of the "quality" and "relevance" of individual research projects (and their criteria), by requesting selected review groups to evaluate a representative sample of research Project Proposals submitted to the U.S. Bureau of Mines for FY-74 funding.

Two separate assessment scores were sought: one for "technical quality," and the other for "program relevance." These scores would later* be used as a basis for comparing the resulting rank order for the sample set of projects with the actual experience of the organization in establishing priorities for the funding of research projects.

Specifically, the objectives of this Preliminary Exercise were:

- To determine the feasibility and acceptability of evaluating Energy Research Project Proposals separately, for "technical quality" and "program relevance."
- To analyze the scoring patterns of specific review groups in determining the "relevance" of particular Energy Research projects to the new Energy Research mission of the U.S. Bureau of Mines.
- To identify and explicate the criteria used in assessing the "quality" and "relevance" of the sample set of projects.

*At a later stage in the work.

Using a modification of the traditional "peer review" procedure, which calls for the informed judgment of competent individuals to evaluate the "scientific merit" of particular research Project Proposals, the SOAP team sought also to emphasize in this Exercise the concept of Program Evaluation. They did this by including separate assessments for "technical quality" and "program relevance" of the individual projects in order to help the U.S. Bureau of Mines determine funding priorities for its Energy Research.

For this Exercise*, six review groups, or "juries," consisting each of three to five members, were asked to rate a representative sample of research Project Proposals submitted to the Assistant Director-Energy, U.S. Bureau of Mines, for FY-74 funding.

With Dr. Ham's help, the team selected, at random, seventeen typical on-going (FY '73-74) Project Proposals to be evaluated.

Juries selected were:

| <u>Jury</u> | <u>Research Review Groups</u> |
|-------------|-----------------------------------|
| I. | USBM Washington Staff |
| II. | USBM Washington Staff |
| III. | WASH/MERC/BERC Staff |
| IV. | MERC Research Supervisors |
| V. | BERC Research Supervisors |
| VI. | Industry Technical Advisory Panel |

On May 16, 1973, three of the SOAP team members** met with the Project Officer, Harry R. Johnson,*** in his office to present their plan for conducting Exercise I and to gain his approval for administering it. He was of the opinion that the idea was "great," so the team made arrangements for the USBM Washington Staff to meet the following day at Ballston Towers, in Arlington, Virginia, in order for them to participate.

*See Project SOAP - Exercise I Memorandum, May 15, 1973, Appendix B-1. Thru B-4.

**Dr. Jerry Ham of USBM, Arlington, and Robert S. Cutler and Dr. Mary Ellen Golby, both of TAD.

***Leo Schrider was also present that day.

At this afternoon meeting on May 17,* the details of Exercise I were explained and each person present was given a packet of materials which included: the seventeen Project Proposals; a four-page explanatory memorandum; pertinent material excerpted from the USBM Mission Statement to serve as a guide for judging the "relevance" or the "quality" of these same Project Proposals; and a tally sheet.** These participants were asked to mail their completed tally sheets to TAD/NBS before June 1, 1973.

A similar orientation briefing by the Project SOAP team was given to four groups at BERC (on May 23) and four groups at MERC (on May 31). In all, 67 individuals were asked to participate in this research evaluation exercise. They were informed of the background and purpose for requesting this type of subjective assessment, and each member of each "jury" was asked to rate the sample set and indicate a "priority score" based upon his own judgment of the facts presented in the proposal. A set of guideline criteria was included in the reference materials. It was stressed, each time, that participation in the Exercise was voluntary and that if a person participated but wanted to remain anonymous, he might.

The Research Supervisors at both Centers (and one group of Staff) were asked to rate the seventeen sample project proposals for "program relevance" only, while the other two groups of Technical Staff were asked to rate them for "technical quality" only. A table summarizing the participation by the various "juries" is included in Section 3.3*** of this report.

*Attending were Dick Gooding, Larry Ramsey, Larry Burman, Jerry Ham, all of USBM, Arlington; Henry Jacobson, John Tosh, of USBM, Washington; and Bob Cutler and Mary Ellen Golby, of TAD. Leo Schrider (who is not a Monitor), of MERC, also attended. Because they were not able to be present at this meeting, Alex Mills, Harry Johnson, Dick Corey, and Brian Harney, of USBM, Washington, were given their packets the preceding day.

**See Appendix B.

***See Table A, p. 38.

3. FINDINGS AND CONCLUSIONS

The primary purpose of this Exploratory Survey was to seek clarification of principal issues and identification of some of the actual problems associated with implementing mission-oriented projects within the Bureau of Mines Energy Research organization. Such exploration and clarification of desired "ends" must of necessity precede the analyses of possible "means" for improvement.

The Project SOAP team conducted a series of 14 group interviews at three different locations within the USBM Energy Research organization. These included meetings with key personnel at both the Washington Headquarters and at MERC and BERC. In addition, 67 individuals from these groups were involved in a preliminary assessment of a sample set of Energy Research Project Proposals. The purpose was to test a program management mechanism for evaluating the "quality" and "relevance" of individual projects in terms of stated program goals. (No analysis of the results of this "Exercise I" is included in this report.)

The following represents the essence of the findings obtained thus far. Each item listed is the result of many man-hours of discussion and deliberation by USBM personnel at the Centers involved. These differ from the listings shown on pages 19 and 24, respectively, in that they represent revisions and acknowledgements of certain "problem areas" identified by the SOAP team. Although these findings are not all-inclusive, they clearly indicate a consensus by knowledgeable people on some of the program management problems that are believed to be solvable with available methods and personnel.

3.1 MERC "Problem Areas"

Acknowledged "Problem Areas" Associated with New Management Concepts
Resulting from Second Visit, Morgantown Energy Research Center,
April 25-26, 1973

1. Explicit Mission Statement

- Translation of Energy Research Program "Goals" into Research Project "Objectives"
- Participation in Program Planning Process
- Results-Oriented Approach

2. Improved Organizational "Feedback"

- Research Supervisor Function Clarified (Intra-Communications: within the Center)
- Research Monitor Function Clarified (Inter-communications: between the Centers)
- Strategic-Level Planning/Evaluation Staff

3. Mechanism for Evaluating Projects in Terms of Stated Program Goals

- Project Priority Determination
 - "Quality" (Peer Review Judgments)
 - "Relevance" (Internal/External Opinions)
 - Time-Frame for Results
 - Costs (multi-Year, Total Investment)
- Idea Referral/Project Proposal System
 - Stimulate "Good" Research Projects
 - Assure Useful Research Results
- Projects Proposal/Budget Review Process
 - Targeted Research Activities
 - Consistent Evaluation Criteria

While the majority of the men at MERC originally felt that an explicit "Mission Statement" was the primary thing they needed to give direction to their work (and nearly all agreed that an individual, or Station, Mission Statement could be subsumed under such guidelines), they had now come to recognize that the Research Supervisor's function had greater need for clarification than that of the Research Monitor, though they ranked both

"problem areas" as second in importance. And moreover, after consideration of relative priority, they felt that a mechanism for judging the "quality" and "relevance" of a project was more important than improving either the New Idea Referral System or the Project Proposal System.

The SOAP team reported these findings at the May 1st. briefing to the USBM Research Center Directors and others from the USBM Energy group.

3.2 BERC "Problem Areas"

After the team's visit to Bartlesville, the Center Director, John S. Ball, met with his Research Supervisors to draw up a response to the list of "problem areas" identified by SOAP and presented to them for reconsideration. The resulting list emerged:

"Problem Areas" Acknowledged as a Result of
Project SOAP Initial Visit to Bartlesville Energy Research Center
May 21-23, 1973

1. Improved Project Management Review Mechanism
 - Determination of "Technical Quality" and "Program Relevance" of Research Activities
 - Continuing Assessment with Feedback of Center Priorities
 - Assessment of Program Results as a Basis for Program Evaluation
2. New Idea Development/Project Proposal System
 - Present Procedure Vague and Ineffective
 - Lack of Incentive (Funding) to Stimulate Innovation
 - Requires Meaningful Feedback
3. Clarification of Headquarters Energy Division Staff Function
 - Improved Program Planning/Evaluation by Staff
 - Research Monitor Function not Clearly Defined
 - Liaison with Technical/Industry Advisory Groups
4. Recognition of Failure of Communication Between Washington Headquarters and Field Stations and Between Field Stations
 - Clarification of Research Direction—Correlation of Policy Positions and Mission Statement
 - Acceptance of Specific Energy Research Program (and Priorities) from Headquarters by Centers
 - Proliferation of Reports and Lack of Evidence of Their Usefulness
 - Budgetary Decision Progress
 - Inadequate Funding Support to BERC Capabilities in Face of Current National Energy Crisis

While at Bartlesville, the SOAP team had learned that BERC differs as much from MERC as the Oklahoma plains differ from the West Virginia hills or as oil differs from coal. One sensed that the Staff at BERC are unusually strong administrators and are highly individualistic. One sensed, too, that there existed at BERC the suspicion, frequently iterated, that the Washington Staff, who are primarily "coal men," are not sensitive to the needs of the "oil men" at Bartlesville. The consensus was that the top decision-makers at Headquarters are "99% coal and 1% petroleum." From the basis of a balanced Energy Program, there appears to be some inequality in the distribution of funds to research in coal and petroleum: petroleum provides 75% of the total energy used, while coal provides only 25%, yet coal research has an annual appropriation of \$12 million, while petroleum has an appropriation of only \$3 million. At any rate, the SOAP team learned that BERC is definitely oriented to one commodity, namely, petroleum, although they did note that several coal research and Health and Safety projects are being conducted.

3.3 Exercise I Preliminary Results

Essentially, what the SOAP team hoped to find out from this preliminary exercise was whether the use of a "peer-review" mechanism to aid in evaluating Energy research projects was operationally feasible. They tested, by obtaining actual ratings, the opinions of various people in "the system" who were asked to become involved in a simulation of this decision process.

Of the 67 professionals involved,* 56 actually participated by submitting their tally sheets. Each participant rated a sample of 17 Project Proposals on the basis of his own concept of either "technical quality" or "program relevance," but not both. Their ratings were subjected to a preliminary analysis to determine if there exists a meaningful and consistent concept underlying each of these two criteria dimensions to warrant their operational

*See Table A, p. 38.

use in a Program Management evaluation tool. (See Figure a., following page.)

The findings from a preliminary analysis of this first Exercise are quite indicative though, of course, not definitive:

1. There was implicit in the participation of 83.5% of the individuals asked to serve as reviewers (and in their subsequent expressions of curiosity about and interest in the results) a general agreement that such quantitative methods for evaluating research project priorities within the two USBM Energy Research Centers (MERC and BER) are operationally feasible.
2. As can be seen from Figure a*, which presents the "modes" (most frequent rating given each project along each axis), there is some obvious agreement among those reviewers in applying their concepts of "program relevance," but not a clear consensus. (The concept of "program relevance" is a complex one requiring greater specificity and communication to assure a common understanding within the organization.)
3. The greater degree of consistency among the reviewers in judging "technical quality" was partially due to the clearer definition of this concept and also the fact that the sample set were on-going projects. The concept underlying "technical quality" as used in this Exercise was found to include more than simple technological considerations. These additional criteria appear to be closely related to priority considerations.
4. If the reviewers had experienced great difficulty in separating "relevance" from "quality" considerations, the plotted points would have been clustered around the "45 degree" diagonal line in Figure a. This is clearly not the case; the distinction between the two criteria is one which can be rendered operational in such a rating procedure and, indeed, people at two different Research Centers are capable of concurring that a particular project (here, 'Project G') ranks quite high on one scale but low on the other.
5. It is interesting to note that Project M (an "oil" Project from BER) was judged by the MERC people to be more "relevant" than by BER, and similarly, Project B (a "coal" Project from MERC) was considered more relevant by the reviewers at BER than at MERC. This finding suggests that the reviewers can indeed broaden their concept of mission to include the goals of the Energy Research Program as a whole, when evaluating the particular merits of projects originating from USBM Research Centers other than their own. (See Figures b. and c., pages 36, 37.)

*And its comparison with Figures b. and c. (See pp. 35, 36, and 37.)

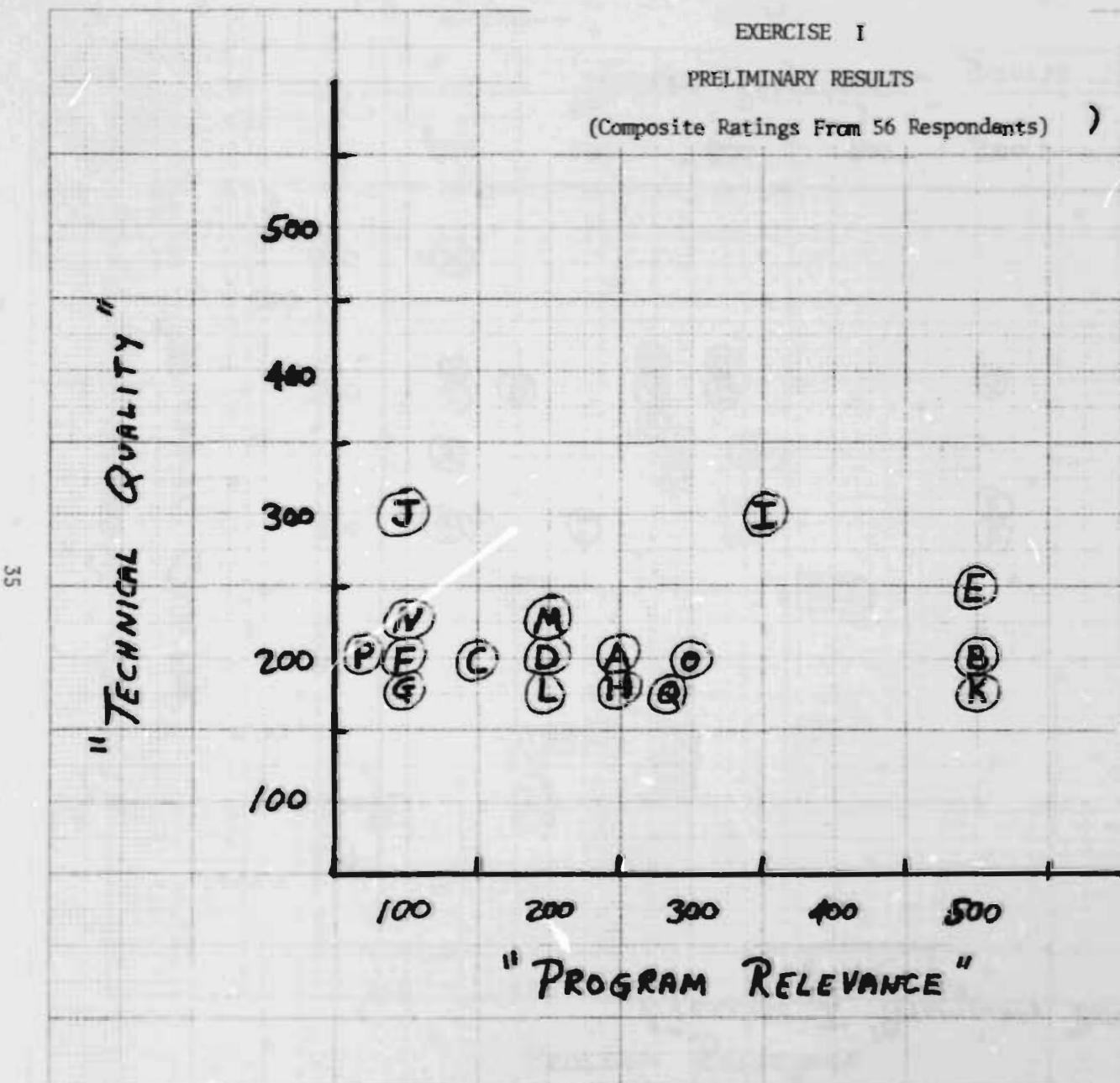
EXERCISE I

PRELIMINARY RESULTS

(Composite Ratings From 56 Respondents)

EQUAL-WEIGHT
Priority Rank

| | | |
|----|---|---|
| 1 | - | G |
| 2 | - | F |
| 3 | - | N |
| 4 | - | P |
| 5 | - | C |
| 6 | - | J |
| 7 | - | L |
| 8 | - | M |
| 9 | - | D |
| 10 | - | A |
| 11 | - | H |
| 12 | - | Q |
| 13 | - | O |
| 14 | - | I |
| 15 | - | B |
| 16 | - | K |
| 17 | - | E |



EXERCISE I PRELIMINARY RESULTS

MERC

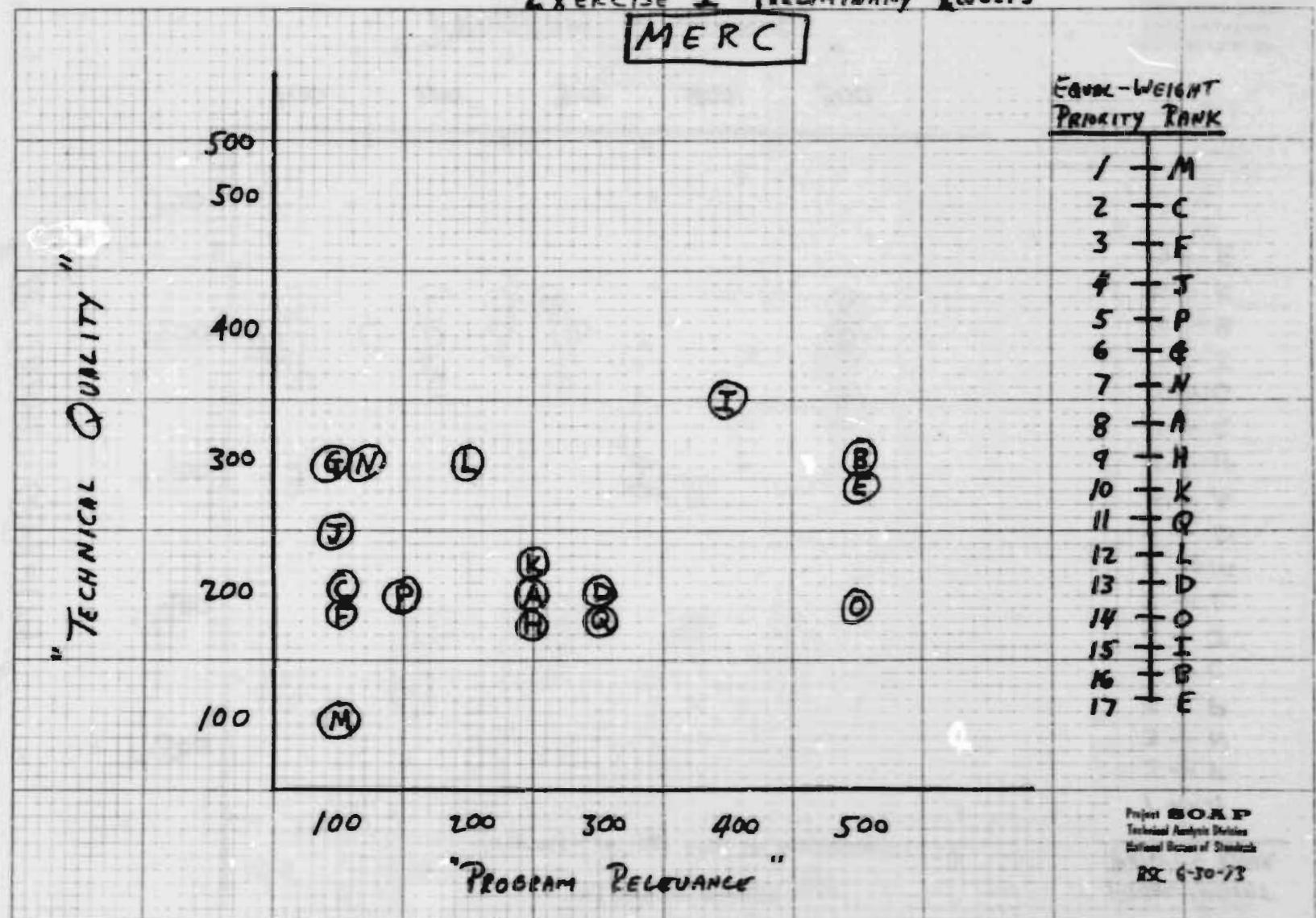


Figure b.

EXERCISE I PRELIMINARY RESULTS

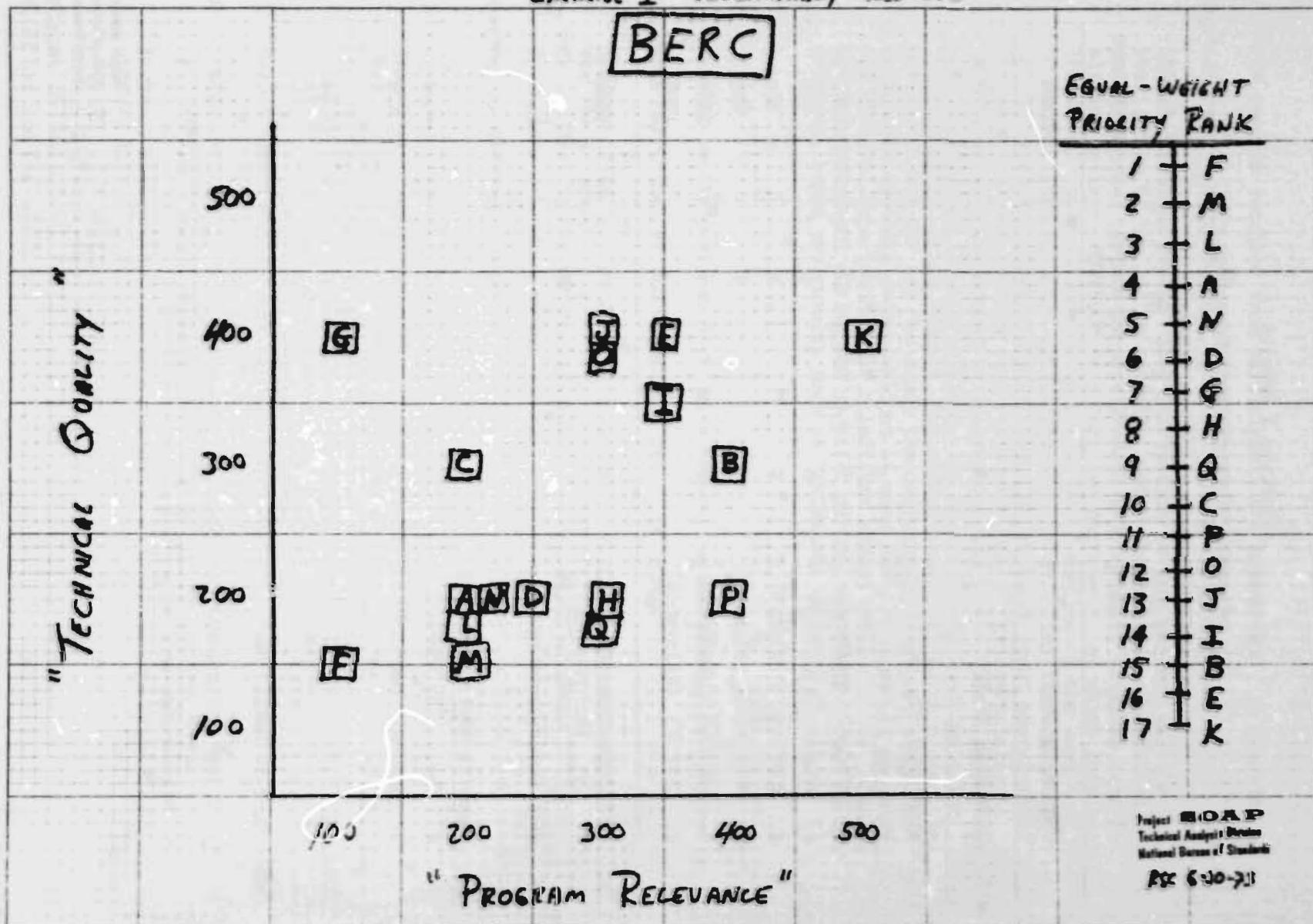


Figure c.

TABLE A

Exercise I Results
 Summary of Participant Responses
 (As of June 10, 1973)

| JURY | PARTICIPANT | RESPONSES RECEIVED | PERCENTAGE |
|------------------------------|-------------|--------------------|------------|
| I. USBM WASH Staff | 5 | 5 | 100% |
| II. USBM WASH Staff | 4 | 3 | 75% |
| III. WASH/MERC/BERC Staff | | | |
| a. WASH #3 (quality) | 4 | 3 | 75% |
| b. MERC #1 (Relevance) | 5 | 2 | 40% |
| c. MERC #2 (Quality) | 6 | 3 | 50% |
| d. MERC #3 (Quality) | 5 | 4 | 80% |
| e. BERC #1 (Quality) | 5 | 4 | 80% |
| f. BERC #2 (Quality) | 5 | 5 | 100% |
| g. BERC #3 (Relevance) | 5 | 5 | 100% |
| IV. MERC Supervisors | 7 | 7 | 100% |
| V. BERC Supervisors | 6 | 6 | 100% |
| VI. Industry Advisory Panels | | | |
| a. Industrial Members | 5 | 5 | 100% |
| b. Academic Members | 5 | 4 | 80% |
| TOTAL | 67 | 56 | 83.5% |

Other Summary Data:

1. No. Criteria Statements Received 46
2. No. Signatures Received 36

Project **SOAP**
 Technical Analysis Division
 (National Bureau of Standards)

RSC/RMC
 10 June 1973

The remarks received from participants are noteworthy. In describing his reaction to Exercise I, one BERC Project Leader wrote:

The most obvious result of participation in this project was the realization of how little actually useful information is contained in the typical project proposal. Some 16 proposals, totaling over 5 million dollars, averaged less than two pages each, of which less than a half page is devoted to a very brief outline of the work to be accomplished with the capabilities of the principal investigator and his available facilities, arriving at an intelligent appraisal of the potential for success of a particular project is essentially impossible with the amount of information supplied. Even allowing for the briefness of the presentation, the proposals are inadequate for the most part. As an example, the objective of a research project is not (or should not be) "to study the composition ----", it should be to make specific determinations of some facts as a result of study and physical experiment. The objectives should state what is intended for accomplishment during the specific period, not simply broad indefinite, hoped for results such as "increased recovery of oil".

Another participant had difficulty separating his concept of 'program relevance' from that of "technical quality." He wrote:

I found it quite difficult to determine "Program relevance" for the selected projects without also considering technical feasibility, as technical feasibility is dependent on other parameters such as funding, timing, competence, manpower....

Further, he went on to add:

The resulting rating should be recognized as only a partial evaluation of the priority of a project. Likewise, a technical feasibility evaluation also is only a partial evaluation.... What I'm leading up to is the difficult and less "clear cut" subjective judgment that must be used in selecting the "mix" of short-, intermediate-, and long-term projects as well as the mix of basic, development, and applied research that must be maintained for a balanced program. I realize determining the ratios of the mix may be arbitrary decisions, but they must be made to assure an adequate background of fundamental and developmental work and competence necessary for the pursuit of long-term projects. To change the present situation would require a skillful surgeon, a sharp knife, and probably a considerable degree of pain. The USBM Energy Group appears to suffer from a number of illnesses that compound the problem. For example, there are too many Chiefs and not enough Indians. Many of the Directors, both in the Field and at the Washington Office, are required to operate with staffs that are too small and as a result are believed by some to be

incapable of thorough analysis and coordination of research projects before they are implemented. There seems to be pressure to "get into the field" with projects before adequate laboratory research work is completed, apparently because of the better visibility of field research.

The basic missing ingredient is specific program direction from the Washington office. Because of the lack of it, most projects are written on the basis of what the researcher would like to do rather than what needs to be done. The simple suggestion to "improve the efficiency of oil recovery" is not enough. Field personnel are too restricted in their viewing area, in their work experience, and in their contacts with Industry (except in a few special cases), to effectively relate their capabilities with broad needs. They either over estimate the amount of research that can be accomplished at a given funding level and consequently spread themselves too thinly, or they concentrate all effort on a minuscule portion of the real problem, either through lack of understanding of the problem or because of personal reasons of self interest. Only direct, detailed, and coordinated program direction from an informed and concerned Washington Staff can correct this situation....

One person at MERC summed it up when he said: "the Washington Office has exercised little in the way of guidelines for Energy programs in the past and has had little or no time to formulate thoughts on any program or to evaluate what is submitted to them from the field. Yet, the researchers annually look to them for some relatively defined goals towards which efforts are to be directed. In this time of concern over energy shortages, however, perhaps we need a NASA-type 'systems approach' to accomplish some important development."

3.4 Conclusions

Thus far into this exploratory survey, the Project SOAP task group has followed a planned fact-finding procedure. Based upon interviews at three locations (WASH, MERC, BERC), it has focused attention on principal problems observed (and verified) at each of the operating units visited.

Of the many problems the USBM management has been aware of, the lists of acknowledged "problem areas," identified in Sections 3.1 and 3.2 above, represent those where reasonable improvements are considered possible, both by the SOAP team and by the Field Center personnel themselves. These lists include a recognition from two Research Centers of the need for some rational mechanism for evaluating the quality and relevance of individual projects for use in determining project priorities at the Field Station level.

At this early stage, the SOAP team (including members of the USBM Washington Staff) have concluded that two of the key functions of the decision-making "pipeline" in most need of attention are those of the Research Supervisor and the Research Monitor. There is apparently confusion at both the Headquarters and Field levels concerning what is or ought to be their respective roles in bringing about the new concept of mission-oriented program management.

As for the existing "Idea Referral System," the procedure appears to some at both MERC and BERC to have become an effective process for killing "good ideas." There is a need for more dialogue between the Washington Headquarters, who should establish program "requirements," and the Field Centers, whose functions ought to emphasize matters of technical feasibility. However, if each Research Center Director is to be responsible for establishing budget priorities, questions concerning the comparative "program relevance" of particular "ideas" which would be in competition with on-going projects will have to be resolved. As it is, there is little incentive, and much difficulty, in motivating individuals to propose new projects from the Field level.

Perhaps this is the main beneficial result of the Project SOAP Exploratory Survey: the gaining of insights by the people within "the system" about precisely what it is they believe is wrong, and what ought to be done by way of remedy. One of the facts generally recognized about operational improvement is that the remedy cannot work unless most of the people involved are convinced that it will work. There is, we have found, much more to implementing a new concept of Program Management than systems analysis alone can provide.

The SOAP team concluded from its preliminary interpretation of the results of Exercise I that the mechanism simulated for determining priorities based on separate assessments of "quality" and "relevance" appears to provide a reasonable basis for further work, at least for MERC and BER. That is, the development of a management tool for determining the priorities of individual projects at the Center level upon which to base program priorities for Mid-Year Budget Review and for evaluating New Idea Proposals seems feasible. However, more work is needed before this evaluation mechanism can be useful as an indicator of specific program performance* based upon the two generalized research management criteria: technical excellence and relevant results.

Certain changes in this mechanism are suggested. They include the formation of more sharply contrasting "peer group" juries; the translation of Mission Statement "goals" into achievable Energy Program "objectives"; and improvement of the Project Proposal descriptions themselves. These procedural items can be worked out in practice.

*The former is judged typically by professional peers, and the latter by Budget Administrators, Congressmen and various people within particular industrial research organizations.

A second simulation exercise is recommended incorporating the above improvements but also involving all six USBM Energy Research Centers and dealing with actual projects (both on-going and new proposals) to be evaluated at the forthcoming Mid-Year Budget Review in October 1973.

It is anticipated that decision-makers at various levels in the Bureau of Mines' organization will then be able to obtain a more precise picture of what is happening within their overall program of Energy Research. Further development and use of this 'peer review' mechanism would provide a new basis for making decisions about program priorities and strategies effecting a more rational balance in research resource allocations.

Project **SOAP**
Technical Analysis Division
National Bureau of Standards

APPENDIX

(Section A)

Letters and Memoranda

PROJECT SOAP: SYSTEMS/OPERATION ANALYSIS OF PROGRAMS

National Energy Research Program

U. S. Bureau of Mines

PURPOSE: This Interagency Agreement between the U. S. Bureau of Mines, Department of Interior, and the National Bureau of Standards, Department of Commerce, was undertaken to assist the Bureau of Mines Energy Group develop new concepts of management applicable to their program of Energy Research.

PHASE I: EXPLORATORY SURVEY

OBJECTIVES:

- To improve the general understanding of the External/Internal/Institutional context within which the decision-making process operates.
- To clarify principal issues and identify tractable "Problems" associated with implementation of mission-oriented R&D projects.
 - Existing System
 - Desired System
- To define a mechanism for evaluating "Quality" and "Relevance" of research projects in terms of stated program goals.

APPROACH: A Joint Task Group investigation of principal decision-levels within the Bureau of Mines Energy Research Organization, consisting of interviews at Headquarters level and at two field Centers.

EXPECTED

RESULTS : Briefing report of findings and recommendations from the PHASE I: EXPLORATORY SURVEY which includes:

- Description of work performed to date under Interagency Agreement
- Listing of "Problem Areas" where reasonable improvements are considered possible.
- Recommendation indicating whether the use of quantitative methods for implementing new program management concepts within USBM Energy Research Centers and Laboratories is operationally feasible.



U.S. DEPARTMENT OF COMMERCE
National Bureau of Standards
Washington, D.C. 20234

March 9, 1975

Mr. William L. Crentz
Assistant Director - Energy
U.S. Bureau of Mines
Washington, D. C. 20240

Dear Mr. Crentz:

As a result of the March 6 meeting at the National Bureau of Standards between Harry Johnson, Leo Scirider, and Andy Decora of your staff and members of our Project SOAP Team, we are pleased to assist your Energy Group staff in implementing the new mission and management concepts associated with the National Energy Program.

We understand that your primary interest is improving communications between Headquarters and field levels. This would be useful for developing more effective management controls for directing individual research activities toward the new goals defined by the Energy Research Program. In this regard you would like us to make an objective examination of functional operating activities and information flows at various decision levels within the organization. Such an examination will serve to clarify certain issues concerning your broader mission and new evaluation requirements for mid-year project reporting.

Of secondary concern, but possibly the simpler problem to address, is the need for a practical mechanism for evaluating both major program segments and individual research projects in terms of program goals. Because of the large number of ongoing projects and the many new and potentially useful proposals which come to the Research Center Directors as contract proposals (or from the research interests of individual scientists and engineers within their field research centers) a systematic means for determining "technical quality" and "program relevance" is an important management tool for them to use when approving new research projects and for establishing priorities. These program relevance values can also be used as criteria for integrating special emphasis research areas, for making inter-program trade-offs, and for providing visible evidence of the coherence of program management at all levels.

In order to be of real help to your Program's staff, we must first clarify the principal issues and identify the actual problems that currently exist. One of these central issues, as Harry and Leo described it to us, is one of communication of new ideas between Headquarters and the field--more specifically, between the individual researchers, who are the main strength

of the energy program, and top management personnel in Washington. Further, we were informed, there is a need for improving vertical information flow, and horizontal communication (cross-talk) between individual scientists at one field center with those of other centers and between individual project leaders and research supervisors with their peers elsewhere. Therefore, before undertaking prescription of any particular methods for improving the accuracy and precision of feedback information, we believe, as a result of our experience, that a careful examination must be made to assure that the desired benefits to the organization would result.

In short, we propose to make a three-month exploratory survey of your "Program Management System." We hope to develop, for your staff, a basis for objectively determining the nature and extent of the "communication problem" at each level. This initial phase should also provide you with a basis for considering the feasibility of extending this approach, leading ultimately toward your organization's implementing a quantitative method for improved management control.

We are ready to start this assignment on March 19, 1973, and plan to complete the work by June 30, 1973. Participation from your staff is, of course, required as soon as possible, so that our necessary orientation and survey planning can proceed on schedule.

Upon receipt of a formal work order in the amount of \$37,400, for reimbursement of the estimated salary and expenses indicated on the proposed budget, this project will be authorized. If there are further questions or related matters, please let me know.

We look forward to working closely with your staff on this interesting and important assignment.

Sincerely,

Louis C. Santone
Louis C. Santone, Acting Chief
Technical Analysis Division

Enclosure

cc: Cutler



United States Department of the Interior

BUREAU OF MINES

BARTLESVILLE ENERGY RESEARCH CENTER

P. O. BOX 1398

BARTLESVILLE, OKLAHOMA 74003

June 1, 1973

Mr. Robert S. Cutler
Project SOAP, Director
Technical Analysis Division
Institute for Applied Technology
National Bureau of Standards
Washington, DC 20234

Dear Bob:

I have worked with our Research Supervisors to develop a statement of problem areas derived from the list that you left but with our reconsideration. This list is attached and as you will note places highest priorities on program development and lesser priorities on the attitude and morale problems.

In considering possible improvements in the Management Review system, we believe that the double scale of "technical quality" and "program relevance" has merit. The assessment of these in the test exercise, however, by our Research Supervisors was less satisfying because we believe that if they had rated both elements they would have been better able to separate the considerations. In rating program relevance, it is probably a mistake to have the project proposal with its description of the way the project would be developed. It is extremely hard to give a high priority, even though the program relevance is unquestioned to a poorly developed project.

The second item evolved from "Establish Center Priorities" inasmuch as I believe these are adequately established by authorizations. However, the Mission Statement includes statements which apparently differentiate between the assignments of the various Centers and this may have been the concern. As the new statement stands, it refers to adjustments between authorizations.

The third item is one on which I feel strongly--namely that more attention should be paid to the success of past and present projects as a basis for judging the desirability of proposed projects. It appears to me that much less attention is paid to insure the successful completion of a project than is paid to the proposal.

Ltr. R. S. Cutler, NBS, 6/1/73

Under New Idea Development, the idea referral system appears to be an effective system for killing ideas. The Issue Paper route is better but ill-defined, and normally to be used only on invitation from the Washington Office. There is little incentive to develop a new program if the reply is to kill some present programs in order to reprogram funds. The development of strong programs requires a dialogue between the Washington Office who establish program relevance and the field whose function is to determine technical feasibility.

The Clarification of the Headquarters Staff Function would perhaps help to focus discussion where it would do the most good. We are rather uncertain as to what mix of monitoring functions and purely staff operations are desired. Manuscripts and convention travel requests go directly to staff while proposals and management review reports apparently are not staff functions. Some industry advisory groups have liaison through the Washington Office while others are directly with the Research Centers.

The section labeled "Failure of Communication" was changed from "Communication Gap" because we believe it is not a problem of speaking different languages but rather of failing to speak at all. This is understandable with the urgency and confusion, but it does at times present problems. The positions presented by the Project SOAP team as representing Washington thinking did not always match our understanding. Specifically we found some differences between the Mission Statement and our understanding of the energy research policy. We were surprised to hear that Washington regarded our acceptance of programs and priorities as less than complete. We do feel that reporting requirements have been increased and wish we had more feedback to indicate that they are being used. We are particularly uninformed as to budgetary decisions and are unable to relate such decisions to the preparation of further proposals. We feel that the present energy crisis is the first opportunity in many years to increase our usefulness and are dismayed that instead we face a reduction.

I believe that the visit of the SOAP team was beneficial in that it caused us to stop and assess our problems. In particular, the exercise of rating projects brought

Ltr. R. S. Cutler, NBS, 6/1/73

home to some of our people the competition that they face. We will look forward with interest to your report of June 30. If there is additional information we can furnish, call or write us.

Sincerely yours,

John S. Ball
John S. Ball
Research Director

Enclosure

**Problem Areas Identified as a Result of
Project SOAP Initial Visit to Bartlesville Energy Research Center
May 21-23, 1973**

1. Improved Project Management Review Mechanism
 - Determination of "Technical Quality" and "Program Relevance" of Research Activities
 - Continuing Assessment with Feedback of Center Priorities
 - Assessment of Program Results as a Basis for Program Evaluation
2. New Idea Development/Project Proposal System
 - Present Procedure Vague and Ineffective
 - Lack of Incentive (Funding) to Stimulate Innovation
 - Requires Meaningful Feedback
3. Clarification of Headquarters Energy Division Staff Function
 - Improved Program Planning/Evaluation by Staff
 - Research Monitor Function not Clearly Defined
 - Liaison with Technical/Industry Advisory Groups
4. Recognition of Failure of Communication Between Washington Headquarters and Field Stations and Between Field Stations
 - Clarification of Research Direction--Correlation of Policy Positions and Mission Statement
 - Acceptance of Specific Energy Research Program (and Priorities) from Headquarters by Centers
 - Proliferation of Reports and Lack of Evidence of Their Usefulness
 - Budgetary Decision Progress
 - Inadequate Funding Support to BERC Capabilities in Face of Current National Energy Crisis

APPENDIX

(Section B)

Exercise I Materials



U.S. DEPARTMENT OF COMMERCE
National Bureau of Standards
Washington, D.C. 20234

May 15, 1973

Project SOAP - Exercise I

PRELIMINARY ASSESSMENT OF ENERGY RESEARCH PROJECT PROPOSALS

EXERCISE I

This preliminary Exercise seeks to determine the feasibility of obtaining a meaningful assessment of the "quality" and "relevance" of individual research projects (and their criteria), by requesting selected review groups to evaluate a representative sample of research project proposals submitted to the U. S. Bureau of Mines for FY-74 funding.

Two separate assessment scores are to be sought; one for "technical quality" and the other for "program relevance." These scores will be used to provide a rational basis for comparing the resulting rank order for funding the sample set of projects with the actual experience of the organization in setting research project priorities.

Objectives:

1. To determine the feasibility and acceptability of evaluating Energy Research project proposals, separately, for "technical quality" and "program relevance."
2. To analyze the scoring patterns of specific review groups in determining the "relevance" of particular Energy Research projects to the Energy Research mission of the U. S. Bureau of Mines.
3. To identify and explicate the criteria used in assessing the "quality" and "relevance" of the sample set of projects.

Approach:

Using a modification of the traditional "peer review" procedure, which uses the informed judgment of competent individuals to evaluate the "scientific merit" of particular research project proposals, this Exercise seeks to broaden the concept of Project Evaluation to include separate assessments for "technical quality" and "program relevance" when determining funding priorities for Energy Research projects supported by the U. S. Bureau of Mines.

For this preliminary Exercise, six review groups, or "juries," consisting each of three to five members will rate a representative sample of research project proposals submitted to the Assistant Director-Energy, U. S. Bureau of Mines, for FY-74 funding. The juries selected are as follows:

| <u>Juries</u> | <u>Research Review Groups</u> |
|---------------|-----------------------------------|
| I. | USBM Washington Staff |
| II. | USBM Washington Staff |
| III. | MERC Research Supervisors |
| IV. | WASH/MERC/BERC Staff |
| V. | BERC Research Supervisors |
| VI. | Industry Technical Advisory Panel |

Procedure:

Following the orientation briefing by Project SQAP team describing the background and purpose of this preliminary Exercise, each member of each "Jury" will rate the sample set and indicate a "priority score" based upon his own judgment of the facts and information presented, in accordance with the appropriate "criteria" described below.

Juries I, II, IV, and V will rate each project for "program relevance" only, while Juries III and VI will rate "technical quality" only.

Each member will register his vote (priority score) on the tally sheet supplied. This will indicate the Juror's professional opinion of the particular Research Project rated. Scoring will consist of selecting a number between 1.0 to 5.0 (or N/R) where 1.0 signifies HIGHEST value and 5.0 lowest value, with N/R meaning "not qualified to render judgment." (0.5 increments are allowed.)

After each reviewer has completed his rating, he is to send the tally sheet only to NBS in the supplied pre-addressed envelope.

Criteria:

For this Exercise, "Technical Quality" refers to the probability of achieving the stated research objective, taking into account:

1. Qualifications of Principle Investigator.
2. Availability of Competent Staff/Facilities.

3. Scope of Work/Research Objectives.
4. Technical Approach/Work Schedule.
5. Adequacy of Proposed Budget.

In addition to the above necessary technical considerations, "program relevance" is intended to be used as a variable measure for estimating the utility (or "worth-whileness") of the proposed research results for which no generally accepted standards or criteria has been established. In other words, assuming the particular research project is successful, how important would it be toward meeting the goals of the Bureau of Mines Energy Research Program (as described in the Energy Research Mission Statement, May 25, 1972).

It has been possible for many people (Research Scientists, Administrators, Congressmen, Industrial Executives), to render judgments about "program relevance," based upon various criteria. It has been difficult, however, for the Research Scientists to explicate these "benefits" of proposed research output, it is not clear to Budget examiners within the Department of Interior (and The Office of Budget and Management) whether similar criteria are being used by the various people, particularly those with obviously different backgrounds, experience, and interests. Moreover, the importance of evaluating Energy Research "results" in terms of meeting the needs of the Energy Crisis (and admittedly these "results" are difficult to define) is often lost in this process.

For consideration by participants in this Exercise, the following perspective is offered:

"To establish a conceptual framework for our role, research might be viewed as a continuous flow of information that begins with basic discoveries and continues through commercial development....The problem-oriented research we conduct is both useful and essential for the development of new processes (of Energy Production) needed by our society....In delineating major Research activities to be undertaken by Energy Research, and relative priorities, we have been guided by: (1) the national energy policy, (2) technological needs, and (3) our concept of mission...."

These statements should be regarded as a framework for establishing a common base for evaluating the proposed results of Energy Research conducted by the U. S. Bureau of Mines in advancing production technology of coal, oil shale, petroleum and natural gas.

Results Expected:

Based on the analyses of the priority scores received from the six Jury groups, a series of tabulations and charts will be developed to indicate:

1. Any significant differences or agreement between the various review groups in assessing "program relevance" of the particular research projects rated.
2. Computed rank order listing of sample set of research projects, based on mathematical combination of technical "quality" and "program relevance."
3. Degree of acceptability (in principle or practice, as indicated by abstentions) with this mechanism for evaluating energy research project proposals within the U. S. Bureau of Mines.
4. List of explicit "program relevance" criteria.

Project **SOAP**
Technical Analysis Division
National Bureau of Standards

RSC/RMC
5-15-73

Project SOAP

Exercise I Tally Sheet

| CODE | TITLE | "PRIORITY SCORE" (Scale: 1.0-5.0) | CRITERIA STATEMENT (Basis for Judgment) |
|------|--|--------------------------------------|--|
| A | Stimulating Tar Sand Production | | |
| B | Formcoke | | |
| C | Earth Fracture Systems-- Application to Hydrocarbon Recovery | | |
| D | Utilization of Solid Wastes from Combustion and Mining of Coal | | |
| E | Studies of Asphalt and Asphaltic Materials | | |
| F | Reduced SO ₂ in Combustion Gases | | |
| G | Demonstration of Improved Secondary and Tertiary Methods of Recovering Petroleum | | |
| H | Coal Disproportionation by Catalytic Hydrogenation | | |
| I | Factors Affecting New Oil Recovery | | |
| J | Development of Marginal Gas Resources Utilizing Natural and Induced Fractures | | |
| K | Corrosion of Fireside Surfaces in Coal-Fired Boilers | | |
| L | Fuels and Engine Systems to Enhance Fuel Economy in Clean Air Cars | | |
| M | Waste Oil Recycling | | |
| N | Pressurized Gas Producer and Gas Cleanup and Purification | | |
| O | Development of a "Preburn" Propellant for in situ Underground Coal Gasification | | |
| P | Demonstration of Methane - Methanol Coal Conversion Plant | | |
| Q | Underground Gasification of Coal | | |

Jury No. 11 Name (optional) _____

ATTACHMENT I

U. S. BUREAU OF MINES
ENERGY RESEARCH PROGRAM
MISSION STATEMENT

May 25, 1972

(Annotated Excerpts from Mission
Statement for reference by Exercise 1
Participants - 5/15/73)

Project SOAP
Exercise I Tally Sheet

| CODE | TITLE | 'PRIORITY SCORE' (Scale: 1.0-5.0) | CRITERIA STATEMENT (Basis for Judgment) |
|------|--|--------------------------------------|--|
| A | Stimulating Tar Sand Production | | |
| B | Formcoke | | |
| C | Earth Fracture Systems-- Application to Hydrocarbon Recovery | | |
| D | Utilization of Solid Wastes from Combustion and Mining of Coal | | |
| E | Studies of Asphalt and Asphaltic Materials | | |
| F | Reduced SO ₂ in Combustion Gases | | |
| G | Demonstration of Improved Secondary and Tertiary Methods of Recovering Petroleum | | |
| H | Coal Disproportionation by Catalytic Hydrogenation | | |
| I | Factors Affecting New Oil Recovery | | |
| J | Development of Marginal Gas Resources Utilizing Natural and Induced Fractures | | |
| K | Corrosion of Fireside Surfaces in Coal-Fired Boilers | | |
| L | Fuels and Engine Systems to Enhance Fuel Economy in Clean Air Cars | | |
| M | Waste Oil Recycling | | |
| N | Pressurized Gas Producer and Gas Cleaning and Purification | | |
| O | Development of a "Preburn" Propellant for in situ Underground Coal Gasification | | |
| P | Demonstration of Methane - Methanol Coal Conversion Plant | | |
| Q | Underground Gasification of Coal | | |

Jury No. 11 Name (optional) _____

ATTACHMENT I

U. S. BUREAU OF MINES
ENERGY RESEARCH PROGRAM
MISSION STATEMENT

May 25, 1972

(Annotated Excerpts from Mission
Statement for reference by Exercise I
Participants - 5/15/73)

PREFACE

Energy, the foundation of our industrial economy, is being used in enormous and ever increasing amounts. Efforts to satisfy these requirements and at the same time provide for a clean environment have sharply altered traditional concepts of energy production and use. Traditionally, the Nation's response to any change in established patterns has been to react to events as they unfold.

This statement seeks to anticipate technologic needs and promote those actions that will assure the most effective use of the Nation's energy resource potential. In striving to attain this goal, it is essential that we in Energy Research understand what our central purpose is and what our goals are. These are delineated herein.

This document is to be used as a guide for energy research programming, but the prescribed actions should not be considered unalterable. Instead, these actions should be regarded as only a strategy outline for meeting the challenges implicit in our appraisal of future technologic needs and are the first step in establishing a common base for our research on coal, oil shale, and petroleum and natural gas. The Mission Statement will be revised as needed to refine and direct our action responses to anticipated future changes.

William L. Crentz
Assistant Director--Energy

POLICY IMPLEMENTATION

The specific actions by the Department of the Interior and the Bureau of Mines to implement President Nixon's Clean Energy Policy are guided by the President and by the directives of Congress. The policy of Congress, embodied in various laws, has recently been supplemented by enactment of the Mining and Minerals Policy Act of 1970 (84 Stat. 1876). That act states:

. . . it is the continuing policy of the Federal Government in the national interest to foster and encourage private enterprise in (1) the development of economically sound and stable domestic mining, minerals, metal, and mineral reclamation industries, (2) the orderly and economic development of domestic mineral resources, reserves, and reclamation of metals and minerals to help assure satisfaction of industrial, security, and environmental needs, (3) mining, mineral, and metallurgical research, including the use and recycling of scrap to promote the wise and efficient use of our natural and reclaimable mineral resources, and (4) the study and development of methods for the disposal, control, and reclamation of mineral waste products, and the reclamation of mined land, so as to lessen any adverse impact of mineral extraction and processing upon the physical environment that may result from mining or mineral activities.

The Secretary of the Interior has been assigned the responsibility to carry out these policy directives in exercising his legal authority.

To implement this responsibility, the Interior Department has established the following energy and minerals mission:

To assure a continuing and adequate flow of energy and minerals from reliable sources at the lowest cost consistent with the attainment of social and environmental objectives

and has charged the Bureau of Mines with the responsibility:

To conduct those programs of inquiry and regulation necessary to keep the Government informed and to stimulate the private sector to produce the minerals and fuels needed to supply an appropriate and substantial share of the national needs in a manner acceptable to the public interest.

To help discharge these responsibilities, the mission of Energy Research within the Bureau of Mines has been formulated as follows:

To develop effective means that will increase the availability and improve the utilization of the Nation's energy resources at

reasonable costs and in a manner that will help attain desirable social and environmental improvements.

Specific areas of research are conducted at six energy research facilities which employ more than 900 people. The location, field manager, and mission for each of these facilities are given in Appendix A. Priorities for the research are based upon anticipated patterns of energy consumption and the technologic needs as subsequently outlined in this statement.

The production and consumption of energy in the United States are complex activities that are slow to respond to change. Thus, the investments already made for installed electrical generating capacity and the more than 100 million vehicles currently in use have committed us, over the short-term, to established patterns of energy consumption. Our only option in this time frame is to continue to supply adequate amounts of those fuels that now constitute our energy mix.

Not all of the short-term potential problems lend themselves to solution through advanced technology. For example, a shortage in gaseous fuels is expected to be in full force within the next few years despite anything that might be done. This shortage is already having an effect on applications for new customers; some industrial and other users will be forced to use alternate energy sources--petroleum and coal. Adequate domestic supplies of these commodities cannot be produced quickly and/or used freely under current environmental standards, forcing increasing reliance on low-sulfur imports of foreign oil.

Although improved technology will not solve all short-term energy problems, it can contribute to substantial reductions in potential impacts for many of them. Over the longer term, new and revolutionary technology may be developed and adopted that will help provide energy in the forms and amounts needed by the Nation while at the same time preventing environmental degradation. Some of the more important

1/ Needed technologic developments are actually more complex than as indicated in this section. For a more thorough discussion see: U.S. Department of the Interior, United States Energy; A Summary Review, January 1972, and Energy Research Needs, a report to the National Science Foundation by Resources for the Future, Inc., in cooperation with MIT Environmental Laboratory, October 1971.

possible approaches that are expected to yield results over the short, intermediate, and long term are discussed in the sections that follow.

Short term needs (1972-1980) - An immediate problem is to increase our available energy supply base and develop means by which these resources can be used without environmental degradation. One way to increase supplies is by a concentrated effort to stimulate production from known oil and gas fields. Such fields contain nearly 60 billion barrels of oil and 300 trillion cubic feet of gas that do not lend themselves to economical recovery at current prices with existing technology. Methods that may be employed in an effort to recover these resources include

- o fracturing methods: nuclear, chemical explosives, hydraulic, and gas;
- o displacement techniques: improved water and gas flooding, miscible, solvent, and thermal drives;
- o production methods: fracture orientation and subsurface hydraulic fracture mapping, and
- o combinations of various methods that would improve total recovery.

Increased exploration and development for all of the Nation's primary energy resources must be stimulated, including the search for new, low-sulfur coal deposits and low-cost uranium. Developments are needed in

- o exploration techniques: radiometric, seismic, magnetic, radiation halo, infrared, ultraviolet and laser photography, and side blocking radar and side looking sonar;
- o production and distribution techniques for new production areas: Northern Alaska and offshore; and
- o means to convert coal to gaseous utility fuels.

As supplies and consumption of these energy fuels increase, methods

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TOWARD NEW CONCEPTS OF MANAGEMENT APPLICABLE TO THE US BUREAU

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must also be developed to use them in a manner designed to enhance the environment. Of importance are:

- o methods to reduce sulfur discharges from stack gases; and
- o fuel/engine changes to restrict undesirable vehicular emissions with minimal impact on combustion efficiency.

Intermediate term needs (1975-1985) - This period represents the transitional time between, and thus overlaps, the short and long-run time frame. Of importance in this period is the development of indigenous energy resources in the form most needed, including

- o conversion of coal to liquid fuels and pipeline quality gaseous fuels;
- o production of gaseous and liquid fuels from organic wastes; and
- o production of liquid and gaseous products from the Nation's oil shale, heavy oil, and tar sand deposits, and methods of processing them.

A distinguishing feature of each of the above is that the primary resource is a solid or semi-solid. Except for organic wastes, each must be processed in situ or mined, then it must be converted to a usable liquid or gaseous form. The materials extraction and handling problems will be on a scale never before undertaken and current technology is not adequate for the task. Significant developments are needed in

- o materials handling systems to process bulk materials at an unprecedented rate;
- o developing new concepts that would optimize resource recovery, provide for underground placement of waste products for local support and subsidence control, and protect the health and safety of personnel and the environment;
- o in situ techniques to recover energy fuels; and

- o training greater numbers of engineers and skilled workers in the general minerals technology field.

Long term needs (1980-2000) - The Nation is rapidly moving toward electricity as the predominate energy form. But on the average, less than a third of the energy going into the boiler of a thermal electric powerplant emerges at the bus bar in the form of available electrical output. Nuclear plants now being built approximate the general nation-wide average of 32 percent power generating efficiency, while the very best steam electric plants attain an efficiency level of only 40 percent. Moreover, from 5 to 10 percent of the generated electricity is lost during transmission. Every effort must be made to increase the conversion efficiency of our power generating and transmission methods.

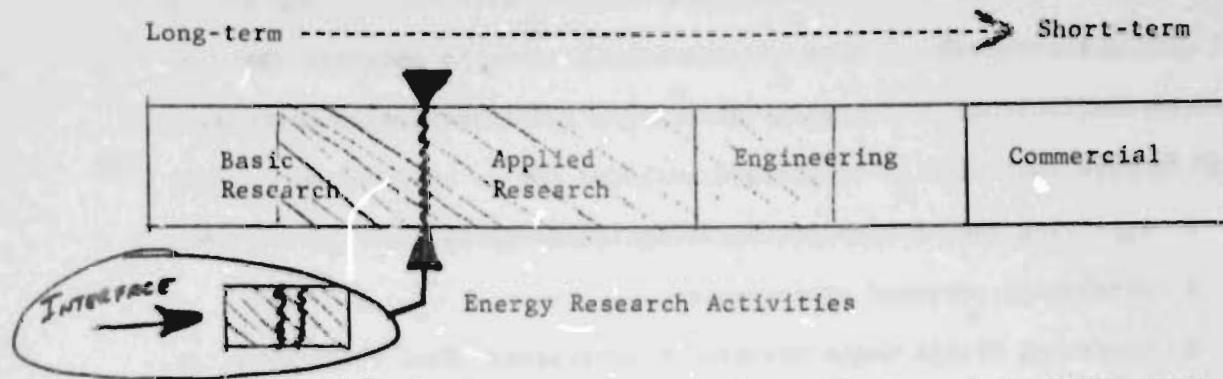
Chief options that need to be pursued include

- o improving the methods of upgrading fossil fuels;
- o developing advanced power cycles;
- o improving fossil fuels conversion processes: fuel cells, MHD, thermionic, and thermoelectric;
- o developing more efficient nuclear breeder reactors;
- o developing new energy systems: nuclear fusion, tidal, wind, and solar; and
- o developing unique energy transmission systems: electricity at cryogenic temperatures and natural gas and hydrogen moving in liquefied form through pipelines.

ENERGY RESEARCH PROJECT SELECTION

The preceding section outlined some of the research needed, if we are to meet the Nation's future demands for clean energy. Energy Research can continue to make many important contributions. However, certain boundaries on our activities and establishment of priorities are required, if our expertise is to be effectively utilized.

To establish a conceptual framework for our role, research might be viewed as a continuous flow of information that begins with basic discoveries and continues through commercial development. Such a flow can be illustrated as



Within this framework, our research covers some of the basic area, the applied area, and some of the engineering area, all of which fall within the boundaries established by our mission concept. Full development of any discovery to commercial practice is rarely pursued, as is basic research which seeks "knowledge for the sake of knowledge alone."

The problem-oriented research we conduct is both useful and essential for the development of new processes and products needed by our society, whether for economic, cultural, or military applications. Ordinarily, industry supports only that research which has a practical aspect--that which leads to increased profit margins and new corporate earnings. Moreover, this is usually on a short range payout basis, generally less than 5 years. General guidelines to determine whether a particular

research effort is suitable for action by the Federal Government are detailed in Appendix B.

If a particular activity is judged to be suitable for research by the Federal Government, the proposed research will be considered appropriate for Energy Research, provided it also receives affirmative judgments in three major regards: (1) The research represents progress toward accomplishing our assigned mission, (2) the research is unique or complementary in reference to prior, ongoing, or anticipated research by others, and (3) adequate staff and other resources can be provided to accomplish the research in a timely fashion. If these criteria are met affirmatively, detailed proposals will be developed for consideration in our proposed budget. Priorities for the proposed work will be established by the Assistant Director--Energy in consultation with the appropriate Division Chief and Research Director.

Ordering of priorities requires and will receive continual review as the results of ongoing programs are evaluated and as new ideas prove worthy of increased funding support. Our best assessment of current program emphasis is contained in the following section; this list will be revised as needed to guide our overall efforts toward the attainment of our mission.

| | | | |
|---|--|--|---|
| U.S. DEPT. OF COMM. BIBLIOGRAPHIC DATA SHEET | 1. PUBLICATION OR REPORT NO. NBSIR 73-245 | 2. Gov't Accession No. | 3. Recipient's Accession No. |
| 4. TITLE AND SUBTITLE Toward New Concepts of Management Applicable To The U. S. Bureau of Mines' Energy Research Program | | 5. Publication Date July 1973 | 6. Performing Organization Code |
| 7. AUTHOR(S) Robert S. Cutler, Mary Ellen Golby | | 8. Performing Organization NBSIR 73-245 | 10. Project/Task/Work Unit No. 4314420 |
| 9. PERFORMING ORGANIZATION NAME AND ADDRESS NATIONAL BUREAU OF STANDARDS DEPARTMENT OF COMMERCE WASHINGTON, D.C. 20234 | | 11. Contract/Grant No. WFA-S0133054 | 12. Sponsoring Organization Name and Address Office of Assistant Director - Energy U. S. Bureau of Mines Department of the Interior Washington, D. C. 20240 |
| 15. SUPPLEMENTARY NOTES | | 13. Type of Report & Period Covered Status Report April - June 1973 | 14. Sponsoring Agency Code |
| 16. ABSTRACT (A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.) This report describes the initial progress of an effort to develop new concepts of management applicable to the U. S. Bureau of Mines' program of Energy Research. A systems analysis task group was organized to identify principal problems associated with implementing a mission-oriented research program, and in particular to design a mechanism for determining research projects priorities in terms of stated goals. The Phase I Exploratory Survey, consisting of 14 group interviews at the Washington Headquarters and at two operational Research Centers, is detailed. Results thus far include listings of acknowledged "problem areas" where reasonable improvements are considered possible. In addition, a methodology analogous to the "peer-review" procedure used elsewhere in government for evaluating research projects in terms of "technical quality" and "program relevance" was introduced and tested in a simulation exercise. Preliminary results suggest need for additional work before this mechanism can become a useful management tool for budget review purposes. A second exercise is recommended involving all six USBM Energy Research Centers in conjunction with a forthcoming Mid-Year Budget Review. | | | |
| 17. KEY WORDS (Alphabetical order, separated by semicolons) Energy research; Program Management; R&D management; systems analysis; Organizational Development; peer-review; program evaluation. | | | |
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