INSTITUTIONAL ASSESSMENT
OF THE
FUEL RESEARCH CENTRE

PAKISTAN COUNCIL
OF SCIENTIFIC AND INDUSTRIAL RESEARCH

June 1989

CBY ASSOCIATES, INC.

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PREFACE

This Institutional Assessment of the Fuel Research Centre of the Pakistan Council of Scientific and Industrial Research was prepared by CBY Associates, Inc., Washington, D.C. for the USAID Mission, Pakistan. The Assessment Team leader was Donald A. Beattie and the other member of the CBY Team was Dr. Robert L. Kovach. Dr. Frederick O. Simon, U.S. Geological Survey, Office of International Geology, Reston, Virginia was appointed to the Team by USAID. Dr. William C. Peters, U.S. Department of Energy, Pittsburgh Energy Technology Center joined the Team in Pakistan and was available as an expert resource making many valuable contributions.

The Assessment Team wishes to thank the staff of The USAID Mission Pakistan, for assisting us in contacting and scheduling interviews with the Government of Pakistan personnel, and in particular Mr. T. David Johnston, Chief, Office of Energy and Environment, for his guidance and useful suggestions during the course of the Assessment. Mr. Asrarullah and Mr. Aftab Khan provided special assistance in helping the Team start the assessment rapidly and productively.

In addition, we would like to acknowledge the warm cooperation and openness of the Pakistan Council of Scientific and Industrial Research centre and laboratory personnel, especially the Council's Chairman, Dr. Qamar Iqbal, Member Technology, Mr. Naseeruddin Shaikh, and Member Science, Dr. Ahmad Shafiq Khan. Dr. Nisar Ahmad, Director Fuel Research Centre, and his staff were most gracious in making the facilities available, answering innumerable questions, and devoting many hours to the Assessment.

Finally the Team wishes to commend Mr. Saleh Mahmood and Mr. Abdullah Zafar for their diligence and long hours spent transcribing the Team's notes and preparing the draft report.

INSTITUTIONAL ASSESSMENT OF THE FUEL RESEARCH CENTRE OF THE PAKISTAN COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

EXECUTIVE SUMMARY

A. INTRODUCTION

The Fuel Research Centre (FRC) and its parent organization, Pakistan Council of Scientific and Industrial Research (PCSIR), can trace their beginnings back to 1949 when the Department of Scientific and Industrial Research was created under the Ministry of Industries. In the ensuing years both the PCSIR (established in 1953) and fuels research have grown leading to the establishment of the Fuel Research Centre in 1984. In 1985 USAID, through the Energy Commodities and Equipment Project Agreement, provided funds for the purchase of state-of-the-art laboratory equipment for the FRC. Through two purchase cycles, USAID has provided approximately US$ 6 million for this equipment.

Based on this involvement, USAID is interested in assessing the current level of capability of the FRC. This assessment will help identify the technical assistance and training needs required to improve FRC's institutional capabilities and that will enable it to take on required new roles if Pakistan is to increase its use of indigenous coal.

This assessment is based on interviews and observations made by the Assessment Team during visits to the FRC, other PCSIR laboratories, and with private sector companies that have utilized FRC's services. This Executive Summary briefly discusses the Evaluation, the Crosscutting Assessments, and Recommendations called for in the Work Statement.

B. FRC PERFORMANCE EVALUATION

The performance evaluation was carried out utilizing the Guidelines for Institutional Assessment, Water and Wastewater Institutions, Washington (WASH) Technical Report No. 37. The Assessment Team modified the guidelines, as appropriate, to make them applicable to a research institute rather than the originally intended water and wastewater institutions.

Based on the WASH 37 guidelines, nine performance categories were evaluated. An order of priority of the categories was established by the Team taking into account the unique characteristics of the FRC.

Order of Priority	Performance Category	Rating
First	Technical capability	Medium
	Leadership	High
	Developing and maintaining staff	High
Second	Organizational autonomy	High
	Management and administration	High
Third	Interactions with key external institutions	High
	Organizational culture	High
	Commercial orientation	Medium
	Consumer orientation	Medium

The ratings shown above were determined by consensus among the Team members. No performance category was rated low. For the category definitions and indicators of high performance for each category, the reader is directed to the body of the report.

C. CROSSCUTTING ASSESSMENTS

After preparing the performance evaluation, the Team developed a series of eleven crosscutting assessments. These assessments are based on information requested in the

Work Statement. Coordination With Other Donor Agencies was not required by the work statement but the Team felt it would be a useful addition to the study.

The crosscutting assessments are:

1. Relationship of PCSIR with FRC
2. FRC's Role in Promoting Development of Coal
3. FRC's Role in Technology Transfer
4. FRC's Capability to Maintain and Operate AID Funded Laboratory
5. Status of FRC's Planning
6. Adequacy of FRC Budget
7. Coordination with Other Donor Agencies
8. FRC In-house Construction Capabilities
9. FRC Maintenance Capabilities
10. Needed Hardware and Equipment
11. Overall Assessment of FRC Capabilities

For each assessment, the Team provides a background statement and follows with observations on each subject.

The Assessment Team has concluded that the FRC has unique capabilities that are not duplicated by other Pakistani institutions. Senior management is of a high caliber and, as a result, the FRC is conducting research of great importance to Pakistan. However, as for any institution, improvements can be made and the shortcomings noted in the report should not detract from this overall conclusion.

It is within the above context that the Assessment Team has attempted to make constructive observations and recommendations.

D. RECOMMENDATIONS

Six recommendations were made by the Assessment Team. They are summarized below:

1. Methods and Options for Providing Needed Equipment

The Team recommends that a detailed assessment by an experienced research chemist be made of the FRC's need for additional equipment, spares, and consumables. If such an assessment cannot be accommodated, the Team recommends that USAID support Section A of the equipment list currently under consideration for the third tranche, with some modifications. The Team estimates that this modified equipment list would cost approximately US$ 875,000.

2. Methods and Options for Providing Needed Personnel Skills

To enable the FRC to fully utilize the highly technical equipment provided by USAID, the Team recommends that the FRC begin an integrated training program directed toward the professional staff, electronic engineers, and technicians.

The Team also recommends that a long-term training program be established with the help of a U.S. expert located at the FRC for several months.

3. Technical Program Changes to Strengthen the FRC

The Team recommends that the FRC focus and streamline the technical programs planned or underway and that these programs be incorporated into a multi-year, institutional research plan.

In view of the overwhelming importance of protecting Pakistan's environment while increasing coal utilization in Pakistan, the Team recommends that the FRC take on a new role focusing on environmental projects. If the FRC is to play a role in clean coal

technology transfer the Team recommends strengthening FRC capabilities in a number of areas important to clean-coal technology.

4. Budgetary Changes to Strengthen the FRC

FRC's present budget is considered to be "bare bones" at best, and is deficient in a number of important areas. If the FRC is to reach its full potential, additional funding of approximately Rs 1,920,000/year is needed. (Approximately a 58% addition to the present budget) Details of how the funds would be used are included in the report.

The Team also examined the potential budget impact of adding a new environmental role for the FRC. A first order estimate for this role would require an expenditure of approximately US$ 65,000 for the purchase of new equipment and recurring costs of about Rs 90,000/month.

5. Organizational and Management Changes to Strengthen the FRC

The Team recommends two minor changes in the administrative functions of the FRC: (1) establish technology development and coal science task forces to develop multi-disciplinary programs in support of clean-coal utilization and, (2) clarify the role of the Common Services Division which currently is responsible for a number of unrelated activities.

6. Administrative Changes to Strengthen the FRC

The Team recommends two minor changes in the administrative functions of the FRC: (1) to move the procurement function from one of the research divisions to the Administration Office and, (2) to automate the administrative functions leading to a management information system that could be used for both administrative and research information.

List of Abbreviations and Acronyms

B.S.	Bachelor of Science Degree
Btu	British Thermal Unit
C	Carbon
CP	Coal Preparation
CSO	Chief Scientific Officer
ECE	Energy Commodities and Equipment
E&E	Office of Energy and Environment, USAID
EP&D	Energy Planning and Development
FBC	Fluidized Bed Combustor
FRC	Fuel Research Centre, PCSIR
FULREC	Fuel and Leather Research Centre, PCSIR
FY	Fiscal Year
GEA	General Energy Advisor
GOP	Government of Pakistan
GSP	Geological Survey of Pakistan
H	Hydrogen
HDIP	Hydrocarbon Development Institute of Pakistan
IGCC	Integrated Gasification Combined Cycle
M.S.	Master of Science Degree
MTOE	Million Tons of Oil Equivalent
MW	Megawatts
N	Nitrogen
NMR	Nuclear Magnetic Resonance
No.	Number
p.	Page
PAK-Swiss	Pakistan/Switzerland Institute
PC	Personal Computer
PCC	Pulverized Coal Combustion
PCCP	Pakistan Clean Coal Program
PCSIR	Pakistan Council of Scientific and Industrial Research
Ph.D.	Doctor of Philosophy Degree
PMDC	Pakistan Mineral Development Corporation
PSO	Principal Scientific Officer
R&D	Research and Development
Rs	Rupees, Pakistan

List of Abbreviations and Acronyms (cont.)

S	Sulphur
SITE	Sind Industrial Trading Estate
SO	Scientific Officer
SSO	Senior Scientific Officer
STEDEC	Scientific and Technological Development Corporation
US	United States of America
USAID	United States Agency for International Development
USDOE	United States Department of Energy
USGS	United States Geological Survey
WAPDA	Water and Power Development Authority
WASH	Washington

TABLE OF CONTENTS

I. INTRODUCTION 1

A. Background 1
B. Importance of Coal within Pakistan's Energy Sector 4
C. Assessment Methodology 6

II. PERFORMANCE CATEGORIES EVALUATED 8

A. Use of Performance Categories and Worksheets 8
B. Evaluations 9
1. Technical Capability 9
2. Leadership 11
3. Developing and Maintaining Staff 12
4. Organizational Autonomy 13
5. Management and Administration 14
6. Interaction with Key External Institutions 15
7. Organizational Culture 17
8. Commercial Orientation 17
9. Consumer Orientation 19

III. CROSSCUTTING ASSESSMENTS 21

A. Relationship of PCSIR with FRC 21
B. FRC's Role in Promoting the Development of Coal 22
C. FRC's Role in Technology Transfer 23
D. FRC's Capability to Maintain and Operate AID-Funded Laboratory 25
E. Status of FRC's Planning 27
F. Adequacy of FRC Budget 29
G. Coordination with Other Donor Agencies 30
H. FRC Maintenance Capability 31
I. FRC In-House Construction (Fabrication) Capabilities 32
J. Hardware and Equipment Needs 33
K. Overall Assessment of FRC Capabilities 35

TABLE OF CONTENTS (cont.)

IV. RECOMMENDATIONS 36

A. Methods and Options for Providing Needed Equipment 36
B. Methods and Options for Providing Needed Personnel Skills 37
C. Technical Program Changes to Strengthen the FRC 39
D. Budgetary Changes to Strengthen the FRC 39
E. Organization and Management Changes to Strengthen the FRC 41
F. Administrative Changed to Strengthen the FRC 41

APPENDICES
A. A Prototype Pakistan Clean Coal Program
B. Persons Contacted by the Evaluation Team
C. Work Statement
D. Team Worksheets for the Evaluation of Indicators of High Performance
E. Recent Publications of the Fuel Research Centre, PCSIR
F. List of Equipment, Fuel Research Centre, PCSIR

I. INTRODUCTION

A. BACKGROUND

History of Pakistan Council of Scientific and Industrial Research (PCSIR) and Fuel Research Centre (FRC): In 1949, the Department of Scientific and Industrial Research was created under the Ministry of Industries in order to establish regional laboratories for research in pure and applied fields related to the utilization of Pakistan's material resources. In April 1953, the Department of Scientific and Industrial Research was reorganized into the Pakistan Council for Scientific and Industrial Research (PCSIR) as a corporate body registered under the Societies Act XXI 1860. The chronology of the organization and evolution of PCSIR, the FRC, and their predecessors is:

- 1949 Establishment of the Department of Scientific and Industrial Research.
- 1953 A nucleus for fuel research established as part of the Central Laboratories (now Karachi Laboratories) of the Pakistan Council of Scientific and Industrial Research (PCSIR).
- 1955 Pilot Plant Research Station set up in the Sind Industrial Trading Estate (SITE) for coal desulfurization studies.
- 1957 Full-fledged Fuel Research Division set up as part of Central Laboratories, PCSIR, Karachi.
- 1970 Fuel Research Division reorganized as part of the Fuel and Leather Research Centre (FULREC).
- 1981 FULREC divided into two independent divisions for leather and fuel research.
- 1984 Fuel Research Division upgraded as an independent Fuel Research Centre (FRC) and shifted to a temporary site at PCSIR Central Laboratories campus, Karachi.
- 1985 USAID starts support of FRC to purchase state-of-the-art laboratory equipment.
- 1988 Fuel Research Centre shifted to new buildings on the PCSIR Laboratories campus.

USAID Support of FRC: USAID support to the Government of Pakistan (GOP) in the energy sector began in the 1950s when USAID provided technical assistance to the Geological Survey of Pakistan (GSP), and in the early 1960s financed a coal fired power plant in Quetta. In 1983 AID started the multifaceted Energy Planning and Development Project that included the Lakhra project and the Coal Resource Assessment Project which had as their objective increasing the use of Pakistan's indigenous coal resources. In addition to these projects, USAID initiated a Energy Commodities and Equipment Project Agreement (ECE) that supported all the energy projects

It was through the ECE that USAID provided approximately US$ 6 million for the purchase of state-of-the-art laboratory equipment for the FRC. Based on this involvement, USAID is interested in assessing the current level of capability of the FRC. Such an assessment will help identify the technical assistance and training needs for building the institutional capability of the FRC to required international standards.

Present Organization of the FRC: The principal objectives of the FRC are to develop technologies for the potential utilization of the indigenous fuel resources of Pakistan and to develop new promising advances related to fuel science. To pursue these objectives the FRC has been organized into four divisions:

- Coal Conversion and Combustion Division
- Analytical Division
- Alternate Fuels Division
- Common Services Division

Each division is headed by a division chief who reports to the director of the FRC. The operating budget for the FRC for FY 1988/89 is approximately Rs 3,480,000. Approximately 90 percent of the budget is salary or other fixed charges. The remaining 10 percent is used to purchase durable goods, make repairs, maintain equipment, and support the R&D activities. The adequacy of the budget, and in particular this last 10 percent, is discussed later in the report.

1988/89 Program of the FRC: The divisions are pursuing a wide variety of research and engineering programs which, in some cases, cross-cut divisional boundaries in that projects assigned to one division utilize personnel from several divisions or equipment maintained by one division supports another division's research. The 1988/89 research activities listed for each of the divisions are:

Coal Conversion and Combustion Division

- Production of processed coal briquettes
- Coal-oil/coal-water slurries
- Fluidized bed combustion
- Development of coal cleaning technologies
- Microbial desulfurization of coal
- Humic acids from coal
- Supercritical solvent extraction of Pakistani coals
- Solvent extraction of Pakistani coals
- Coal gasification
- Phenolization of coal for structural studies

Analytical Division

- Average structural determination of Sind coal
- Structural characterization of the Badin crude oil
- Identification of biological markers in Pakistani coals
- Characterization/isolation of minerals present in Pakistani coals
- Trace metal analyses in Pakistani coals
- Structural studies of various compounds by x-ray diffraction

Alternate Fuels Division

- Pilot plant studies on coal briquetting and pyrolysis of bagasse
- Diesel oil substitutes from plants
- Development of technology for the fabrication of fuel cells

Common Services Division

- Repair and maintenance of instruments
- Coal-fired hot water heater
- Design/development and fabrication of an acetylene safety generator
- Design and development of domestic cooking stoves

B. IMPORTANCE OF COAL WITHIN PAKISTAN'S ENERGY SECTOR

Pakistan's indigenous thermal energy sources, with the exception of solar energy, are limited: moderate supplies of natural gas, limited supplies of petroleum, and based on current and planned consumption, significant supplies of coal. Other energy sources, such as fuel wood, bagasse, and animal waste, are generally limited to domestic uses or within specific industries (for example, sugar refining). Hydroelectric generating plants provide approximately 43 percent (2900 MW) of Pakistan's total generating capacity. The only coal-fired plant operating within Pakistan is a 15 MW plant in Quetta. The balance of the electrical generating capacity is provided by oil (largely imported) and gas (domestic).

During the Sixth Five Year Plan (covering the period 1983-1988), the energy supply in Pakistan increased from 18.7 to 24.6 Million Tons of Oil Equivalent (MTOE) and the supply at the end of the Seventh Plan (1988-1993) is projected to be 51.0 MTOE, with most of the increases coming from natural gas.

The current shortfall in electrical generating capacity in Pakistan is estimated to be 1800-2000 MW with the deficit projected to increase to more than 8000 MW by the year 2000. The options for averting this shortfall are:

OPTION	RESULT
1. Increase use of imported oil	Remaining foreign exchange probably inadequate to support industrial and economic growth.
2. Imported coal	Remaining foreign exchange probably inadequate to support industrial and economic growth; generates jobs in other countries, but not in Pakistan.
3. Increase use of domestic gas	Consumes limited and valuable reserves that can deprive other sectors of Pakistan's economy of a resource for which there are no other near-term options.
4. Increase hydro-electric capacity	Lowest cost option but Pakistan's already high reliance on hydroelectric power will leave it vulnerable to drought; associated technical problems may be difficult to overcome.
5. Increase use of domestic coal	No loss of foreign exchange; allows growth in all sectors of Pakistan's economy; generates jobs in Pakistan; utilizes a presently under-utilized resource.

Pakistan's population is rapidly increasing as a result of increased immigration (primarily from Afghanistan) as well as a high indigenous birth rate. To prevent a lowering of the standard of living, Pakistan must promote industrial and economic growth and create new jobs at least commensurate with the increase in population. Industrial and economic growth cannot occur without substantial increases in the availability of electric power. Failure to provide the needed growth in power will undoubtedly result in disruptions in the economy and possible social unrest.

Pakistan's current reliance on imported energy – 40 percent of its foreign-exchange earnings are used for imported energy – is causing a severe hardship to the nation in maintaining a reasonable standard of living for its people. Pakistan's foreign exchange earnings should be utilized to support and encourage industrial and economic growth. Utilizing imported coal in place of imported oil would not substantially change the foreign exchange picture and the jobs that would be created would not be in Pakistan. Domestic gas is a viable short-term option but would consume a limited and valuable resource which should be preserved for those uses for which there are no alternative options. Additional hydroelectric capacity is being planned but long delays have been encountered in implementing new capacity expansion. (For example, Kalabagh Dam has been under consideration since the mid-1960s; feasibility studies have been completed for more than 5 years). The hydroelectric option also would leave Pakistan's economy vulnerable to drought. A country with Pakistan's climate should have sufficient alternative generating capacity so that, in times of drought, severe economic disruption can be prevented when difficult decisions would have to be made to use the water for either power or irrigation.

The use of domestic coal for power generation appears to be the most attractive near-term option that will:

- minimize the loss of foreign exchange
- allow growth in all sectors of Pakistan's economy
- generate jobs in Pakistan
- utilize a presently under-developed resource

The use of coal in Pakistan can benefit from the technology that has been developed, principally in the U.S. under the U.S. Department of Energy (USDOE) Clean Coal Program, thereby providing an environmentally acceptable method of utilizing low grade coal. Furthermore, improvements in the currently antiquated mining industry could be made so that the conditions under which the miners have to work would be raised to modern standards of safety and health. (See Appendix A for a brief description of a prototype Pakistani clean coal program).

C. ASSESSMENT METHODOLOGY

Through participation in an evaluation of the USAID Energy Planning and Development Project in Pakistan in mid-1988, the Team leader was familiar with the FRC and the problems associated with expanding the use of Pakistan's indigenous coal resources. In preparation for this evaluation, meetings were held with USAID/Washington staff to discuss the objectives. Discussions also were held with Dr. Frederick O. Simon, U.S. Geological Survey (USGS) Office of International Geology, and Dr. William C. Peters, U.S. Department of Energy (DOE)/Pittsburgh Energy Technology Center, who were familiar with the FRC. Dr. Simon joined the Team in Pakistan, and Dr. Peters also visited Pakistan while the Team was in-country and contributed to the evaluation. In addition, a meeting was held in Washington at DOE to obtain background on the U.S. Clean Coal Program and the possibilities of developing a U.S./Pakistan clean coal technology transfer.

Upon arrival in Pakistan, the Team met with USAID/Islamabad staff for further background information and to develop a contact list and preliminary schedule. An initial meeting was held with the new Chairman, PCSIR before leaving Islamabad. (The Team was subsequently invited to a dinner by the Chairman in Karachi also attended by members of his senior staff). The Team then left for Karachi to begin the assessment of the FRC and returned to Islamabad via Lahore, where they visited the PCSIR Lahore Laboratories. Individuals contacted by the Team are listed in the Appendix B. A draft report was

prepared and circulated upon returning to Islamabad so that the Team could receive and respond to initial comments by USAID before returning to the United States.

For the assessment of the FRC the Team used the Guidelines for Institutional Assessment, Water and Wastewater Institutions, WASH Technical Report No. 37 (Pre-Field Test Draft, March 1986), modified as appropriate by the Assessment Team for the assessment of a research organization, in contrast to the originally intended water and wastewater institutions. The guidelines are based on pre-identified institutional performance categories discussed in part II of this report. Key indicators of performance for each category were analyzed and judged on the basis of interviews and observations at FRC as well as with public and private sector institutions for which FRC has provided services.

Based on the analysis of the key indicators, the Team then developed a series of crosscutting assessments discussed in part III of this report. Following these assessments, the Team then prepared recommendations requested in the Statement of Work. (A copy of the Work Statement is included in Appendix C).

After an initial review of the draft assessment by USAID/Islamabad, the Team returned to the U.S. The comments received after a further review of the draft by USAID and GOP, resulted in the completion and submission of this final report.

II. PERFORMANCE CATEGORIES EVALUATED

A. USE OF PERFORMANCE CATEGORIES AND WORKSHEETS

The performance categories and indicators listed below represent competency standards against which the FRC was evaluated. Each performance category was defined within the context of a research institution operating in Pakistan and of the constraints under which a typical institution in the developing world might be operating. WASH Technical Report No. 37 definitions were used as guidelines and modified to be appropriate to a research organization such as the FRC. The definition states why the performance category is an indicator of performance and is followed by an evaluation of that category. Indicators of high performance for each category are used verbatim from the WASH Technical Report No. 37 or modified, if appropriate. In some instances, they were deleted when found to be inapplicable to a research institute.

During the analysis phase, the performance categories were reviewed and an order of priority was assigned to each category. Based on this analysis, the order of priority established by the evaluation Team for the FRC is:

ORDER OF PRIORITY	PERFORMANCE CATEGORY
First	Technical capability Leadership Developing and maintaining staff
Second	Organizational autonomy Management and administration
Third	Interactions with key external institutions Organizational culture Commercial orientation Consumer orientation

All Team members participated in the data gathering for all nine performance categories. After initial interviews and Team discussions and evaluations, a number of key FRC staff members were interviewed a second time for additional information to resolve differences

in interpretation among Team members and additional staff also were interviewed at that time. All ratings and conclusions were reached by consensus among all Team members. Individual ratings by each Team member (worksheets) for the key indicators for high performance can be found in Appendix D.

B. EVALUATIONS

For each performance category, the FRC was awarded an overall rating of high, medium, or low. Based on these overall ratings, recommendations for the improvement of FRC were determined. Although the specific recommendations are given later in this report (see Section IV), comments and general recommendations are included, where appropriate, in the discussion of each performance category.

1. Technical Capability

Definition

Technical capability is the measure of the FRC's overall capability and competence to perform research and other technical tasks. The quality of products produced in bench and pilot scale operations, the ability to complete intended projects in a reasonable time, and the degree to which the public and private sectors adopt technologies developed at the FRC are factors in evaluating an institution such as the FRC.

Evaluation

The FRC is rated medium in technical capability. Although the professional staff have a good educational foundation and they evidence a strong interest in learning and expanding their capabilities, the need for additional training is great. Many of the technical staff have little or no formal training on the recently purchased equipment, perhaps with the exception of a few days instruction given by the factory representative who installed the equipment. The technical staff demonstrate a strong interest in improving their technical base, and

there is strong management support for additional training/cross-training on existing instrumentation.

The FRC is using or adapting appropriate technologies for analytical purposes but there is a tendency to rely on sophisticated high technology approaches, and not verify results using first principles. By following these approaches, it is not clear, for example, if results are cross checked.

The coal briquetting studies being conducted at FRC are an example of successful practical research to improve technology for local conditions and needs, but, may be a somewhat unique opportunity.

The Team had the opportunity to review a number of the technical papers reporting on the results of measurements obtained utilizing the recently-acquired laboratory equipment. (See Appendix E for a listing of FRC publications) The papers describe the results of these measurements but do not adequately discuss the purpose of the measurements or the significance of the results. Likewise, there was seldom any mention of additional planned or needed research.

Comments

The Team noted that the professional staff would benefit from training in three areas: 1) operational and interpretation skills related to the new equipment purchased with USAID assistance, 2) education in modern technology related to fuel (especially coal) utilization, and 3) training in project planning and management. The first area can be accomplished through short-term fellowships at U.S. institutions and/or short-term visits to the FRC by experts from the United States. The second area is more difficult to address and will require long-term education at U.S. institutions and laboratories and long term assignments to FRC of one or more experts with broad experience in coal science [here, coal science generally relates to coal combustion, beneficiation, etc.], and coal analytical chemistry,

which includes both physical and chemical testing. The third area could be a complementary activity undertaken by the experts assigned for the second training area.

2. Leadership

Definition

Leadership is the ability of managers within the FRC to inspire and challenge their staff to understand its mission, be committed to that mission, and dedicated to its success in Pakistan. Leadership is characterized by management's skill in articulating the FRC mission, providing motivation to the staff, encouraging achievement of goals, giving technological guidance, and assessing fairly the perfo mance of employees. Effective leaders are able to balance future long-term goals with short-term objectives and day-to-day operations.

Evaluation

The FRC is rated high in leadership because its managers are able to articulate its goals clearly, are knowledgeable, and actively promoting its objectives. The recent *Workshop on Smokeless Coal Briquettes in Pakistan* sponsored by the FRC, 5-7 February 1989, in Karachi, successfully demonstrated leadership and competence to a wide audience.

Clear performance standards are used, personnel are evaluated annually, and staff are informed of their overall performance with emphasis placed on the quality and quantity of research results relative to the task.

Comments

The need for some improvement in the ability to set and balance short- and long-term goals was noted. The FRC top management has carried out effectively the staff performance evaluation. It was reported that in recent years not a single staff performance

evaluation submitted by the FRC to the PCSIR for final approval has been returned for reconsideration, whereas, we understand this is not true for other PCSIR laboratories.

3. Developing and Maintaining Staff

Definition

Developing and maintaining FRC staff includes those activities that recruit new staff, provide professional development, assure job satisfaction, and provide adequate wages and benefits in order to retain competent personnel. Formal and informal training programs at universities and other institutions (both foreign and domestic), on-the-job, and job rotation (cross-training) also are included. Effective institutions retain staff by providing sufficient incentives such as adequate pay, benefits, opportunities for promotion, and professional development.

Evaluation

The FRC is rated high in its ability to develop and maintain staff. Turnover of staff is extremely low; in addition, many new employees have chosen to come to the FRC from other scientific institutions throughout Pakistan and, in one case, from abroad. There is an active on-the-job program training program to assist each scientist to learn to work with several of the recently purchased instruments.

Three members of the FRC staff have been nominated for training in the U.S. Three staff members from other PCSIR laboratories also have been nominated for U.S. training and FRC management anticipates these people will ask for assignment to the FRC upon returning to Pakistan.

A weekly seminar program provides the opportunity for the scientific staff to discuss their work with their colleagues and provides younger scientists the opportunity to learn from the senior staff as well as gain experience making formal presentations. Employee

comments concerning the FRC as a place to work ranged from "good" to "the best place in Pakistan."

Because the FRC is a government agency, pay and benefits are generally dictated by law. Pay and especially benefits are attractive. There is an excellent employee evaluation system in place with each employee being formally rated each year; informal discussions concerning job performance occur as required.

Comments

Extensive comments on professional development through in-country and U.S. training will be found in the section on recommendations.

4. Organizational Autonomy

Definition

Organizational autonomy was defined by the Team to be the degree to which the FRC is independent from the PCSIR or other governmental bodies. While not unrestrained, some independence must exist so that the FRC can conduct its research program and meet its institutional responsibilities in an effective manner. Organizational autonomy is characterized by the ability to make decisions on budget, salaries, hiring, staffing levels and other personnel matters, setting fees for services, long-range planning, and establishment of organizational goals.

Evaluation

The FRC is rated high in organizational autonomy primarily because it is able to propose and establish its own research program. Occasionally some research is dictated from higher authorities because of its importance to the nation. Compared with other scientific institutions in Pakistan, the FRC has been very effective in obtaining capital budgets and

operating budgets. The FRC sets its organizational policies and goals and changes them when necessary to meet new long- and short-term objectives of the FRC, the PCSIR, and the Government of Pakistan. Revenues generated from services provided to the private sector and other government institutions generally remain with the FRC and are used for the improvement of the laboratory.

Comments

None.

5. Management and Administration

Definition

Management of a research institution such as the FRC should have as a primary objective the development of a work climate that minimizes bureaucratic procedures, permits staff creativity, and promotes high quality research and development. A successfully functioning research center must be able to support the key researchers and technical staff by providing needed resources and a supportive infrastructure. Senior managers provide leadership and, at the same time, encourage junior staff to be active and creative.

Administrative systems should be as unobtrusive as possible while exerting enough discipline so that staff clearly understand and adhere to the institutional policies and procedures.

Evaluation

Management skills and capabilities. The FRC is rated high, provisionally, in management skills and capabilities at the Division Director staff level. Below the Division Director level the management skills and capabilities are somewhat inconsistent and, therefore, must be rated medium. The high rating for Division Directors is provisional because the incumbents in two of the four divisions are recent appointees and have a short management track-

record at the FRC. However, the Team believes, based on their past performance, that it is highly likely that they will continue to be successful. FRC managers appear to have an easy, informal management style that encourages the support of junior staff. They have defined research responsibilities but appear to be free to collaborate and support work in other divisions.

Some second-level managers do not, at present, appear to have the skills and management experience to move to higher positions of authority. If FRC responsibilities and work should expand, the FRC has insufficient numbers of good research-oriented managers – a deficiency that would effect its ability to carry out high quality research.

Administrative systems. The Team rates this aspect of the performance category high. Administrative systems dealing with budgeting, accounting, procurement, personnel and maintenance are in place and are similar to those used throughout government institutions in Pakistan; they are judged to be effective. The present director of the administrative office is very experienced and knowledgeable. The Team did not have the opportunity to determine if a successor is being groomed. If not, the FRC could experience difficulties in the future when the current Administrative Officer retires (approximately 2 years).

Comments

A management information system, as implemented in U.S. laboratories, does not exist. (See Recommendation F).

6. Interaction with Key External Institutions

Definition

The essential characteristic of this category is FRC's ability to positively and strategically influence those institutions which affect its financial, political, and legal ability to perform its research and engineering programs. High performance is characterized by the ability to

effectively influence, adopt and develop strategies to deal with these external entities to achieve the goals and objectives of the FRC. Key external institutions affecting the FRC fall into two categories:

a) Public sector agencies such as Water and Power Development Authority (WAPDA), Geological Survey of Pakistan (GSP), Hydrocarbon Development Institute of Pakistan (HDIP), and Pakistan Mineral Development Corporation (PMDC) that use FRC analytical, research, pilot plant capabilities, and other branches of PCSIR; and

b) Private sector customers using FRC analytical services.

Evaluation

The FRC is rated high in its interaction with key external institutions because top management stays well informed about external policy, financial, and regulatory issues. FRC has held several seminars, conferences, and other workshops to gain public and government support. Two workshops within the past year, including one that was attended by the Prime Minister, have been held at the FRC and there are numerous articles in the widely distributed monthly PCSIR newsletter. Management actively seeks relationships with public and private coal exploration, utilization, and mining institutions within Pakistan. The FRC has been consulted by these institutions seeking advice on technical problems.

Comments

The FRC would benefit from developing a marketing strategy to provide analytic services to the private sector. The equipment recently purchased with assistance from USAID has greatly increased the FRC's capability to support private sector activities, but use of the FRC's capabilities by the private sector is limited. Better coordination and cooperation with the H.E.J. Research Institute of Chemistry would be beneficial to both organizations.

7. Organizational Culture

Definition

Organizational culture within the FRC is taken to be the set of formal and informal guidelines which guide and direct everyday behavior and actions. Cultural beliefs are often unstated but are manifested by a sense of organizational pride, a clear sense of mission, and adaptation to the introduction of new technology.

Evaluation

The FRC is rated high in organizational culture. All of the managers interviewed exhibited a great deal of enthusiasm for and pride in the FRC and its facilities. They stated that, because of its modern equipment, the FRC is a prestigious place to work in Pakistan. In addition, a strong desire was expressed to make the FRC more than a showpiece. The offices, laboratories, and outside grounds are well maintained and clean, supporting the image of institutional pride.

Comments

None.

8. Commercial Orientation

Definition

Commercial orientation of FRC operations applies to those activities undertaken by the FRC for the benefit of private sector companies. In these cases, FRC exhibits the characteristics of a private sector laboratory, placing importance on cost recovery and cost effectiveness. However, full cost recovery is not an absolute requirement for the FRC when providing services for the private sector, nor should it be. In as much as only a small

percentage (5 percent or less) of the total FRC expenses are covered by work from the private sector, the WASH Technical Report No. 37 definitions and indicators of high performance were not particularly relevant to this category. Financial self sufficiency, the key output measure called for by WASH 37, is not an appropriate objective for the FRC.

Evaluation

With the above considerations in mind, the Team has given the FRC a grade of medium for this performance category, recognizing that this is a difficult category to grade. The constraints noted mitigate against the FRC charging full cost, even for private sector clients. The Team noted that the FRC and the Scientific and Technological Development Corporation (STEDEC) have attempted to carefully identify the cost components of the pilot coal briquetting project and for the test marketing now underway have arrived at a price for the briquettes that recovers partial expenses for the FRC. Cost-competitiveness of the briquettes has been an overriding consideration in the development of this product, and evidence collected during the evaluation leads the Team to conclude that the FRC would continue this approach in future projects.

Examples of the type of services provided (not intended to be a comprehensive listing) to the private sector are:

- Analysis for total sulfur content of coal;
- Proximate analysis (moisture, ash, volatile matter, fixed carbon) of coal;
- Measurement of heating value (calorific value) of coal;
- API gravity analysis for crude oil.

The charge for determining the sulfur content of a coal sample is Rs 250. Although the full cost of analysis is not recovered, it does include the cost of consumables, analyst's salary, sample preparation, and some overhead. This pricing approach is typical of the services offered to the private sector. Prices do not include amortization of plant and capital equipment. Prices listed on the FRC price schedule approximate the fees charged by private U.S. laboratories.

Comments

Charges for services provided to other government agencies, including PCSIR laboratories, are somewhat arbitrary. Where charges are levied, the cost to the requesting agency appears to be driven by the agency's ability to pay. In any case, this cost is determined jointly by the FRC and the requesting agency. If an agency indicates that funds are not available to reimburse the FRC, the FRC will undertake the work at no charge to the requesting agency.

The above practice is partially driven by the conditions precedent determined by USAID. A formal agreement exists stating that the FRC will charge USAID-sponsored projects only the cost of the consumables used. However, there is an unwritten agreement that full costs, including salaries, overhead, etc., will not be charged agencies conducting non-USAID supported programs for work that the FRC carries out using equipment purchased with USAID assistance.

As the use of Pakistani coal increases, thus creating greater demands on FRC analytical services by the private sector and government agencies, FRC should develop a uniform pricing policy for private sector work, and consider including an overhead charge for equipment replacement and maintenance.

9. Consumer Orientation

Definition

The primary activity conducted by the FRC is research; therefore the WASH Technical Report No. 37 definition of organizing and directing the services of the institution towards the consumer is not applicable. Likewise, most of the indicators of high performance are not pertinent. Research, by definition, has a low quotient of consumer orientation, but has an intrinsic value whether or not a potential customer has been identified. FRC does, however, serve two very different customers in addition to carrying out its primary research

functions: the private sector and government agencies. The following evaluation applies to the services supplied to those two customers.

Evaluation

The Team rates the FRC medium in consumer orientation. Emphasis has been placed on being responsive to its clients with special emphasis on providing high quality, reliable analyses. Of the work performed for clients, approximately 70 percent is for the private sector and 30 percent for other government agencies. Discussions with these clients confirms the emphasis on reliability of results. Some clients voiced dissatisfaction with the speed with which the results were obtained but also acknowledged that the FRC provided fast turn-around times for special requests. Professional and technical staff are aware of the importance of providing high quality service to their clients. The Director serves as the primary point of contact with FRC clients and appears to maintain a wide ranging and productive relationship with existing and potential clients. Tours, seminars, and other types of outreach activities are frequently undertaken at the FRC to demonstrate and advertise the capabilities of the FRC and its reputation seems secure among PCSIR and other Pakistani laboratories.

Comments

None.

III. CROSSCUTTING ASSESSMENTS

As requested in the work statement, a series of assessments was undertaken by the Evaluation Team. Unlike the foregoing performance evaluation which focused on specific tasks and responsibilities, these assessments investigate working relationships among organizations, role definitions, capacity for organizational growth and general capabilities – issues that cut across many responsibilities and tasks. A total of eleven crosscutting assessments are discussed below.

A. RELATIONSHIP OF PCSIR WITH FRC

Background

The FRC is one of the semi-autonomous centres of the PCSIR; the other centres are the Karachi, Lahore, and Peshawar Laboratories, the National Physical and Standards Laboratory, the Leather Research Centre, the Pak-Swiss Training Centre and the Solar Energy Centre. Each of the laboratories of the PCSIR is organized into divisions with specific objectives in research, training, and maintenance.

The Director of the FRC is responsible for program conception, planning, implementation, and satisfactory completion of the fuel research activities of the organization. Long-range (5-year) planning of the FRC is in place and is amplified and/or revised and submitted to the PCSIR every five years.

Mechanisms exist for the creation of specific, new activities, as opportunities arise, for projects not foreseen in the Five-Year Plan. Staff members within the FRC can initiate a fuel-related research project, bearing in mind that the main objective of PCSIR's research program is applied research that can ultimately yield benefits that can be transferable to the public and private sectors. A proposal is prepared which includes a description of the research, its objectives, budget, and a plan of work. The Director of FRC approves the effort, if appropriate, and establishes the funding requirements. Small projects (up to Rs

50,000) can be approved at the FRC Director's level and supported by an in-house discretionary fund; larger project proposals must be submitted to the PCSIR.

FRC proposals are submitted to members of the Governing Body of the PCSIR, (Member Science, Member Finance, and Member Technology) for review, transmittal, concurrence, and submission to the Chairman of the PCSIR in Islamabad for final approval. The Chairman of the PCSIR can approve projects not exceeding Rs 5 million. Projects requiring more than Rs 5 million must be approved by the Minister of Science and Technology.

Observations

The FRC appears to have a good mechanism for interacting with members and staff of the PCSIR parent organization. Contact is often on a daily basis by telephone and occasionally by personal visits. Both the Member Scientific and Member Technology are based in Karachi so personal contact between the FRC Director and these PCSIR members is not difficult. With the exception of Karachi Laboratories, contacts between the FRC and other PCSIR laboratories is primarily by telephone or correspondence.

Even though the mechanisms for interaction from the FRC to the PCSIR appears to be functional, it is too early to judge its effectiveness on a personal basis inasmuch as several senior members, including the Chairman of the PCSIR, have been newly appointed to their positions.

B. FRC'S ROLE IN PROMOTING THE DEVELOPMENT OF COAL

Background

Almost all nations, whether industrialized or in the process of being industrialized, have private and public agencies that play a role in coal development. Examples of these types of agencies are given below. The public/private designation is a reflection of the Team's opinion of what should exist and not what actually exists in most countries.

Agency type	Public or Private	Role
Geological Survey	Public	Exploration; source of data on resources.
Mining Company	Private	Development and production.
Energy Technology Centre	Public	Technology development; technology transfer; source of data on coal utilization (beneficiation, combustion, etc.)
Energy and/or Planning Ministry	Public	Plans, advocates, and assists public and private sector agencies to obtain necessary government support to perform their role in coal development.
Electric Company	Private	Generates electric power; distributes power to users.

Observations

The FRC is clearly in the category of an "Energy Technology Centre" and therefore should fill the role of providing data on coal utilization including technologies appropriate for use in Pakistan. The FRC is pursuing research and should be providing advice to the public and private sectors of Pakistan on the best technologies available and the best technologies to use given the quality of Pakistan's coal resources. The FRC's role should be to provide unimpeachable data and not necessarily to advocate or lobby in favor of one energy technology over another. In the Team's opinion, the FRC is correctly positioned to provide coal utilization data and advice but is poorly informed on the latest technologies available, especially those under development by the U.S. Department of Energy's Clean Coal Program.

C. FRC'S ROLE IN TECHNOLOGY TRANSFER

Background

The Seventh Five Year Plan (covering the period 1988-1993) recognizes that natural gas reserves are limited, that Pakistan will remain an oil importing nation, and that the country's shortfall in electrical generating capacity should be made up to a significant extent

from its coal resources. To do this in an efficient and environmentally safe way, Pakistan will have to absorb technology from developed countries and that technology will have to be distributed within Pakistan.

There are two distinctly different aspects to technology transfer that must be considered - technology transfer from the developed countries to Pakistan; and technology transfer within Pakistan, particularly to the private sector.

Observations

When considering transfer of coal technology from the industrialized countries to Pakistan, two time periods must be recognized: 1) short-term (less than five years) and 2) long-term (five to ten years). The short-term requires accepting what has already been developed in industrialized countries and basing decisions on which technology to use on a cost/Btu basis and the availability of financing. Pakistan, with its current 2000 MW deficit and projected 8000 MW deficit by the year 2000, can do little else in the short term. Therefore, the technology that needs to be transferred is knowledge of the proper operation and maintenance of whatever type plant(s) is constructed. Since this is the domain of WAPDA and, to a lesser degree, the private sector, the FRC should have only a limited and as yet undefined role to play.

The options, however, are quite different over the long-term. There is time to develop, within Pakistan, a cadre of trained Pakistani scientists and engineers knowledgeable in all types of clean-coal technology. Having this expertise permits more options for determining which technologies using Pakistani coals are best for Pakistan.

The FRC can serve as one of the major conduits for technology transfer to Pakistan for long-term research-oriented, high technology fields and for the subsequent transfer to the private and public sectors. The FRC can serve this role for coal technology and coal-related disciplines. The FRC's work in coal briquettes is a first step in this type of technology transfer.

D. FRC'S CAPABILITY TO MAINTAIN AND OPERATE AID-FUNDED LABORATORY

Background

In April 1988, the FRC inaugurated a new laboratory facility primarily to house the analytical and coal research equipment purchased through the USAID/ECE Project. The FRC laboratory can become a world class institution and the newly-purchased equipment gives the FRC staff the opportunity to conduct research that can compete with similar activities in developed countries. In addition this laboratory provides the FRC with the opportunity to develop scientific and engineering collaboration with centers of coal research and technology development in the U.S. and other developed countries.

The FRC laboratory equipment can be classified into analytical and research equipment. The analytical equipment has the full capability to characterize coal and coal-related process streams, chemically as well as physically. The research equipment and instrumentation provides the FRC with the capability to:

- determine the fundamental structure of coal and coal related fuels,
- conduct basic studies into the conversion of coal to liquid fuels and gas, and
- to provide geologists with information for the interpretation of depositional environments.

All of the equipment is highly automated with complex, computerized readouts and represents state-of-the-art technology from the United States. Operation and maintenance requires sophisticated training even in highly-developed countries such as the U.S. and such training is not readily available in Pakistan at this time. For even routine maintenance, modern digital test equipment must be available to the maintenance engineer/technician.

Observations

Laboratory Operation. Although most senior-level FRC scientists and engineers are proficient in their fields of academic study, some are not fully aware of the capabilities of

the USAID equipment or with the most recent research developments and coal science work in the United States.

A few of the FRC scientists have specialized in one piece of equipment or analytical technique and have mastered it to the point that reproducible results are now obtained on a routine basis. In addition, classical coal analysis tasks, i.e., sulfur determination, have been delegated to a few technicians who perform routine measurements. Shortages in foreign exchange and PCSIR budget constraints have restricted travel and training of FRC scientists so that improvements in the operational aspects of the Laboratory equipment have been self-taught. Most of the equipment has now been mastered (except for the x-ray diffractometer and Nuclear Magnetic Resonance device); the progress made is a credit to the FRC Director and his senior staff.

Application of the equipment to coal and coal related products and by-products in a manner consistent with the levels of sophistication and accuracy of the equipment is not yet evident. The commensurate care and planning to separate organic and inorganic operations, as well as quality control to avoid contamination and test protocols for incorrect results needs to be improved.

It is difficult to assess the level of operational activity of all of the equipment. Certainly the standard coal analysis equipment is used regularly, however, certain other pieces sit idle for long periods of time while the knowledgeable operator works on other tasks or projects.

Laboratory Maintenance. The laboratory maintenance staff consists of one solid-state physicist who has a Ph.D. and four junior-level engineers all working in the Common Services Division. Maintenance of the USAID laboratory equipment has not been a problem to date because of new equipment warranties and infrequent use. However, as soon as vendor support has expired, the maintenance of the equipment will fall upon this group of five maintenance engineers.

Currently the maintenance engineers are engaged primarily in electrician service (house-wiring), trouble-shooting, and electrical utilities distribution and installation. No training in solid-state, digital circuitry and trouble-shooting has been provided at the FRC. The solid-state and digital test equipment required for maintenance and trouble-shooting of the automated instrumentation is not available on-site. Furthermore, a tour of the PCSIR centre's electronics maintenance shops in both Karachi, and Lahore revealed that such equipment or trouble-shooting capability is not available in the PCSIR organization.

In an effort to upgrade the FRC electronics maintenance capability, the senior solid-state physicist has been submitted by the PCSIR as a candidate to USAID for training. However, the training requested is specifically related to the x-ray diffractometer and not to generic solid-state devices and digital circuit diagnosis and repair.

A discussion with the Co-director of the similarly instrumented H.E.J. Research Institute of Chemistry, University of Karachi, confirmed that training for maintenance of the new equipment is not available presently in-country. At the H.E.J. Institute, in addition to foreign training on the specific instrumentation, professional recognition was involved in developing the maintenance staff. The effective equipment maintenance staff at the Institute has two different technician grades:

- The prime user or operator of each piece of equipment ensures it is operating correctly on a daily basis and can carry out preliminary trouble shooting.
- The highly-skilled, highly-trained digital equipment maintenance engineer repairs the equipment as his main task, but he also can operate the equipment as a backup to the prime operator.

A similar system does not exist at the FRC, but it would be a good model to emulate.

E. STATUS OF FRC'S PLANNING

Background

The FRC planning cycle, as part of PCSIR, coincides with the five-year planning cycle of

the GOP, hence the current plan is for the five-year period 1988-1993. The corresponding coal component of the GOP Seventh Five-Year Plan sets the strategic plan as follows:

- Develop coal mining as an industry
- Create a demand for coal (other than the existing demand for making bricks)
- Build a number of coal-fired power plants so that private producers will have a visible and viable long-term market, and
- Assist coal producers in the delineation of necessary development plans.

Although the strategy outlined above is very broad, important issues, such as environmental concerns and institutional improvements of agencies involved with developing indigenous energy resources and coal technology, are not specifically addressed.

The Five-Year Plan of the PCSIR, dated July 1988, lists the following coal-related research topics:

- Coal briquettes
- Coal oil and coal water slurry fuels
- Fluidized bed combustion
- Coal gasification
- Microbial desulfurization of coal
- Chemicals from coal
- Classification of Pakistan's coal resources
- Study of minerals in coal

Most, if not all, of these projects are planned to be carried out at the FRC. Thus, the final product and current status of the FRC planning are best represented and documented in this PCSIR planning document.

Observations

After interviews with the senior staff of the FRC, the Team determined that the development of plans focuses on the identification of projects of interest to individual researchers. There appears to be little integration of projects into technology development programs. Major areas, such as coal combustion, environmental clean up, and control technologies by coal processing to more convenient fuel forms are not included as items in

the planning agenda. Individual, stand-alone, projects are approved by the Director and submitted to the PCSIR, Member Technology, for incorporation into the PCSIR planning document. The Team was not shown any project task breakdowns, milestone charts, or evidence of integration during the assessment. In addition, it seems that the FRC does not publish its own five-year planning document.

In a meeting with PCSIR senior staff, i.e., Member Technology and Member Science, the plans for the FRC as a coal technology transfer centre for clean coal technologies was alluded to but without specific plans. The need for a Pakistan Clean Coal Program is recognized but the requirements for a Clean Coal Centre at the FRC are not well-defined nor understood. Hence, the actual planning for a Clean Coal Program is projected to occur sometime in the future.

Planning must address the resources required for each task and project. Since financial resources are limited, the FRC assigns manpower to a number of projects/tasks simultaneously so that people can shift from task to task or project to project in a very flexible manner. While this may be an effective approach for conducting the work of a research organization, it should not preclude the development of an overall management plan for the FRC. The Team is not aware of the existence or plans for the development of an institutional management plan for the FRC, nor plans for its development.

F. ADEQUACY OF FRC BUDGET

Background

In 1987-88 the FRC operating budget from the PCSIR amounted to Rs 3,402,900. This amount was approximately 2.7% of the PCSIR budget. Approximately ninety percent of the FRC budget is devoted to fixed charges with the remaining funds being expended for the purchase of durable goods, repairs, maintenance, and miscellaneous items. The 1988-89 budget is projected to be approximately Rs 3,480,000.

Observations

Initial budget allocations from the PCSIR to the FRC are made annually, on 1 July. This allocation covers salaries, consumables, plant maintenance, and research and development work. In addition, supplementary funds have been given for the development of the coal briquetting project. The Director of the FRC has a small discretionary fund and the PCSIR has some cushion to provide additional funds.

Considering the sophisticated equipment now in-house, the adequacy of the FRC budget for equipment maintenance is minimal, at best.

G. COORDINATION WITH OTHER DONOR AGENCIES

Background

At present other donor agencies have not provided funds for the FRC and the FRC looks only to the USAID to provide support beyond that given by its parent organization, PCSIR. This relationship has mutual advantages and few disadvantages. The advantages are:

- identification of the U.S. with helping one of Pakistan's most prestigious research institutes.
- ability to influence important research that reinforces U.S. long-term objectives for Pakistan.
- strengthening of ties with a recipient for the introduction of U.S. technology in the fuels/energy sector.

The disadvantage is that long-term funding (up to five years) and application of other resources will be necessary to assure the FRC's ability to carry out high quality research and expand its capabilities.

Observations

If the disadvantages are considered to outweigh the advantages, or if the long-term funding burden must be reduced, steps should be taken to interest other donors in providing partial support. This is probably a good time to seek such support because another donor agency(ies) would be able to influence the FRC's research agenda, and support the overall objectives of the donors in Pakistan.

During the Team visit to the PCSIR Centre in Lahore, the Centre's Director General mentioned that the Japanese are proposing to provide PCSIR with US$ 29 million to buy additional equipment. How much, if any, of these funds might go to the FRC was not known.

H. FRC MAINTENANCE CAPABILITY

Background

With assistance from USAID, the FRC has recently purchased some of the most sophisticated analytical instrumentation available anywhere in the world. Expenditures to date exceed US$ 6 million. Without exception, this equipment is highly-automated and computerized, and complex. It will eventually require service and will be expensive to maintain. Maintenance of sophisticated equipment is difficult under the best of conditions, extremely trying even in highly developed countries such as the U.S., and will probably be the FRC's most time-consuming and frustrating problem.

Observations

FRC's ability to maintain their equipment is extremely limited. Without substantial training of staff (and/or hiring additional electronic technicians) and providing the necessary foreign exchange to purchase circuit boards and other necessary spares, it is the Team's opinion

(and also the opinion of PCSIR management) that the equipment will cease to operate soon after the warranties expire.

In a previous assessment of the FRC, one member of the present Team made the recommendation that the FRC maintain the air conditioning in the rooms containing the new equipment on a 24-hour per day, 7-days per week basis. This recommendation is currently being ignored by the FRC and, given the high humidity and temperature in Karachi, is tantamount to soaking the equipment in water on a regular basis. If the FRC refuses to maintain the equipment in an air conditioned atmosphere, no amount of maintenance will be sufficient. (After leaving Pakistan, the Team was informed that the FRC is now running tne air conditioning "round the clock" and will continue to do so in the future).

I. FRC IN-HOUSE CONSTRUCTION (FABRICATION) CAPABILITIES

Background

FRC workshop facilities that could be used to build small, pilot plants, or bench scale experiments are limited. At present, fabrication needs are small and those that cannot be satisfied on-site are contracted to the private sector.

The coal-briquetting pilot plant, currently operating on-site, combines equipment fabricated overseas together with some ancillary equipment built in-country. Although the staff feels confident it can support the proposed pilot plant scale-up (from 2 tons/day to 50 tons/day) that will be managed by STEDEC, this may strain their current capabilities.

The Fluidized Bed Combustor (FBC) now on-site was built in the PCSIR Lahore laboratories and transported to the FRC. Minimum modifications have been made to the FBC since its arrival. Problems have been encountered in operating the FBC, and, in its present condition, it does not represent a true, experimental pilot plant.

Observations

If the FRC is to continue to undertake pilot-scale activities, its shop equipment must be improved and additional training provided for its technicians and mechanics. Use can be made of the PCSIR Karachi laboratories' workshops but these workshops also have limited capabilities. The Pak/Swiss Institute could also provide assistance and has better facilities than either FRC or the PCSIR laboratories.

It was not possible to assess the ability of the private sector to supply fabrication and maintenance assistance. This capacity may exist, but must be assessed separately.

J. HARDWARE AND EQUIPMENT NEEDS

Background

In two, separate, USAID-supported purchases totaling more than US$ 6 million, the FRC purchased the following equipment:

Equipment	Application
Atomic absorption spectrometer	Analysis of solutions for inorganic elements. Determination of major, minor, trace elements in coal ash.
Inductively coupled plasma spectrometer	Analysis of solutions for inorganic elements. Determination of major, minor, trace elements in coal ash.
X-ray fluorescence spectrometer	Analysis of solids for inorganic elements. Determination of major, minor, trace elements in coal ash.
CHN elemental analyzer	Analysis of coal (or other solid materials) for C, H, and N.
Sulfur analyzer	Analysis of coal (or other solid materials) for total S; procedures can be modified to determine forms of S.
Proximate analyzer	Determine moisture, ash, fixed carbon in coal.

Equipment	Application
Calorimeter	Determine heating value of coal or other organic materials.
Dilatometer	Measures plastic properties of coal.
Ash-fusion furnace	Measures fusion temperatures of coal ash.
Hardgrove grindability determinator	Measures energy input necessary to pulverize coal.
Nuclear magnetic resonance	Structural characterization of fuels.
Fourier-transform infrared spectrometer	Structural characterization of fuels.
Gas chromatograph	Qualitative and quantitative determination of organic compounds.
Gas chromatograph/mass spectrometer	Qualitative and quantitative determination of organic compounds.
Thermal analyzer	Measures weight loss and phase changes as a function of temperature.
High-pressure liquid chromatograph	Separates organic substrates and measures concentrations.
X-ray diffractometer	Crystal structure determinations.
Pollution monitoring equipment	Stack-gas sampling.

Observations

The FRC has requested additional equipment and accessories (listed in Appendix F), divided into "Section A: List of Spares, Accessories, and Supplementary Items for Equipment Already Procured;" and "Section B: List of Supplementary Items." FRC is unable to fully utilize the equipment already purchased and under present circumstances, this condition will not change for the next several years. Examples of these deficiencies are discussed in Recommendation D.

K. OVERALL ASSESSMENT OF FRC CAPABILITIES

Background

The background for the following observations on the overall capabilities of the FRC is contained in the preceding sections of this report.

Observations

The Evaluation Team has concluded that the FRC has unique capabilities that are not duplicated by other Pakistani institutions. Senior management is of a high caliber and, as a result, the FRC is conducting research of great importance to Pakistan. The shortcomings noted in other parts of this report, and the recommendations that follow, should not detract from this initial observation.

However, as for any institution, improvements can be made, and it is within this context that the Evaluation Team has attempted to make constructive observations and recommendations. Such recommendations are especially important in view of the possibility that the FRC may be asked to take on additional, new responsibilities.

If the FRC is to reach its full potential – and the Evaluation Team believes this will be limited only by the resources placed at its disposal – USAID and PCSIR must reach agreement on how to proceed to the next plateau of FRC capability. And, in fact, actions are needed to maintain the FRC at its present level of achievement. To avoid oversimplifying the actions needed, the reader is referred back to the body of the report for detailed discussions.

IV. RECOMMENDATIONS

Based on the Team's evaluation of the FRC's current capabilities, a series of recommendations are made following the general guidance of the work statement.

A. METHODS AND OPTIONS FOR PROVIDING NEEDED EQUIPMENT

- The Team recommends, as a first priority, that an experienced chemist from a U.S. coal laboratory should visit the FRC, for a period of 2-3 months, to review the status of the equipment, spares, and consumables already purchased in cooperation with USAID. This length of time is needed to fully understand FRC operating conditions, the on-going research and future requirements. The expert selected should be familiar with the equipment listed in Section III-J, above. After this review, the expert should recommend, in conjunction with FRC, any additional equipment that is needed.

- If USAID cannot accommodate the above recommendation to have a U.S. expert visit the FRC, then the Team recommends USAID support the FRC request for Section A of the equipment list (see Appendix F). Section B should not be supported at this time.

  The request for nitrogen and helium liquefaction plants now listed in Section A as subitems 11.5 and 11.6 under item 12 should not be supported. In place of the liquefaction plants, USAID should support FRC in purchasing liquid nitrogen and helium from H.E.J. Institute of Chemistry, Karachi, and the purchase of adequate dewars for transporting liquid nitrogen and helium from the Institute to the FRC.

  The Team estimates that equipment recommended in Section A, without the liquefaction plant but with the recommended dewars, will cost approximately US$ 875,000.

USAID should be aware that, in order to keep the Nuclear Magnetic Resonance (NMR) equipment operational, repeated importation of helium and nitrogen gas is required. Without a constant supply, the NMR will cease to be operational: if allowed to heat above a few degrees Kelvin, the NMR will require additional maintenance and possible recalibration by the manufacturer.

B. METHODS AND OPTIONS FOR PROVIDING NEEDED PERSONNEL SKILLS

To enable the FRC to fully utilize the highly sophisticated equipment provided by USAID the Team strongly recommends that the FRC begin an integrated training program that combines in-country training and training in the United States. This training should be directed towards technicians who will operate the sophisticated laboratory equipment on a routine basis, electronic engineers who can both operate and maintain this equipment and professional staff who can analyze and interpret the scientific results and disseminate it to the user community at large.

- In-country training for FRC technicians and electronic engineers can be achieved in several ways:
  - -- Use of outside contractors for intensive short courses and refresher courses as needed.
  - -- In-house training by previously trained scientific staff.
  - -- Establishment of an on-going maintenance agreement with U.S. contractors and/or vendors with FRC maintenance personnel observing and working closely with the U.S. contractors.
- In addition to the in-country training above, training in the U.S. must be provided for a few selected electronic engineers. A recommended program would combine 6-months of solid-state electronics training in a commercially run course, and 3-6 months training at the vendor or manufacturer of specific laboratory equipment.

- In-country training for the professional scientific staff has several avenues which should be examined:

  -- Short-term technical visits by U.S. experts of no less than 2-3 months in duration.
  -- Long-term technical support and in-country residence by U.S. personnel for periods of up to several years.
  -- Exposure of FRC staff to other coal related activities in Pakistan for a better "hands-on" assessment of practical problems.

- Training in the U.S. needs to be made available for both the academic and technological development of the scientific staff of the FRC.

  For academic training several options are available:

  -- Enrollment in specialized courses at selected universities for a 1-year minimum period in a non-matriculated degree program.
  -- Pursuit of a professional degree at the B.S., M.S. and Ph.D. levels in fuel related technologies.
  -- Post-doctoral work in various universities.
  -- Development of a collaborative research project with a U.S. university investigator.

  For technology training in specific areas of coal-related research several mechanisms exist:

  -- Assignment to a U.S. government laboratory for a 6-12 month period.
  -- Involvement with a private, not-for-profit, U.S. laboratory.
  -- Participation in a collaborative project with a U.S. government laboratory investigator.
  -- Tenure with a private company or consortium of companies.

- The Team recommends that a long-term training program be established that will take into account present and future FRC roles and combines the options discussed above. To develop such a program will require a U.S. expert to be located at the FRC for several months. It is possible that the expert, identified in the first recommendation above, could also develop a training program; however, the total time in-country to do both tasks would have to be extended to 4-6 months.

C. TECHNICAL PROGRAM CHANGES TO STRENGTHEN THE FRC

- The Team recommends that the FRC focus and streamline the technical programs planned or underway, and that these programs be incorporated into a multi-year, institutional management plan that would support national objectives for coal utilization. USAID could support the development of such a plan by providing U.S. expert(s) to work directly at the FRC.

  In view of the overwhelming importance of protecting the environment while increasing coal utilization in Pakistan, the Team recommends that the FRC take on a new role focusing on environmental projects such as:

  -- Characterization and control of coal combustion emissions (flue gas clean up)
  -- Monitoring and modeling of pollution
  -- Environmental assessment reviews of power plant designs
  -- Environmental engineering assessments of increased use of coal in Pakistan

  Although this proposed new role would require some programmatic redirection of FRC research, much of the existing analytical equipment and engineering capability could be used. For example, efforts to research long-term power generation options such as fuel cells, might be better directed toward increased emphasis on removing sulphur from Pakistani coals based on well-researched coal beneficiation studies.

- If the FRC is to play a role in clean coal technology transfer the Team recommends strengthening FRC capabilities in the following areas:

  -- Management of the technology transfer process
  -- Project management and technical task integration
  -- Report preparation and technical presentations
  -- Bench-scale test stand design, operation, and scale-up
  -- Test rig instrumentation and data analysis
  -- Pilot plant design, operation, and maintenance

D. BUDGETARY CHANGES TO STRENGTHEN THE FRC

FRC's present budget can be considered "bare bones", at best. Although the Director has a small discretionary fund, money for important continuing needs such as consumables, staff travel, and plant maintenance is already lacking. If the FRC is to reach its full potential, these needs must be met. The Team recommends that USAID and the Chairman, PCSIR, meet to discuss these shortcomings and develop a plan to increase available funding to the FRC.

To address the perceived budget shortfall, the Team reviewed the FRC budget with the Director. Based on these discussions the following suggestions are made:

- FRC's present budget, excluding the non-development budget and foreign exchange purchases amounts to approximately Rs 290,000 per month. This should be increased by Rs 110,000 per month to assure full operation of equipment, travel, etc., including purchases of needed liquid hydrogen and liquid nitrogen.

- Foreign exchange funds earmarked for the library should be increased from Rs 75,000/year to Rs 125,000/year.

- Funds for chemicals, spare parts, etc, currently at a level of Rs 50,000/year should increase to Rs 50,000 per month.

The total of all the above budget increases amounts to Rs 1,920,000/year.

The Team also examined the potential budget impact of adding a new role to the FRC along the lines discussed in Recommendation 3 above, a near-term, minimum level, environmental project. This was more difficult to estimate; however, the Team believes that the following elements of such a project are accurate, to a first order:

- Seven additional staff would be required. These are an environmental scientist/project leader, an atmospheric chemist, an inorganic chemist, a data analyst/system analyst, and three technicians. Total salary for these new positions would be approximately Rs 65,000/month.

- New equipment to support the project, both in the field and laboratory would cost approximately US$ 65,000 (one time cost), plus Rs 25,000/month for consumables and spare parts.

E. ORGANIZATION AND MANAGEMENT CHANGES TO STRENGTHEN THE FRC

The Team recommends that FRC management make the following organizational changes:

- Establish technology development and coal science task forces that cut across present organizational boundaries to establish strong, multi disciplinary programs in support of clean coal utilization.

- Clarify the role of the Common Services Division. At present this division has responsibility for a wide spectrum of unrelated activities.

F. ADMINISTRATIVE CHANGES TO STRENGTHEN THE FRC

Although the Team did not spend a great amount of time evaluating the FRC administrative process, the following brief recommendations are made:

- The procurement function, currently the responsibility of one of the Research Divisions, might be better placed in the Administration office. The Team recognizes the need for technical input for some of the procurements, but this could be supplied by the Division Director requesting the procurement.

Automation of some, if not all, of the administrative functions on a PC-type computer. This would also lead to a Management Information System that is presently lacking for both administrative and research information.

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APPENDIX A

A PROTOTYPE PAKISTAN CLEAN COAL PROGRAM

APPENDIX A

A PROTOTYPE PAKISTANI CLEAN COAL PROGRAM

A complete prototype Pakistan Clean Coal Program (PCCP) should include the goals to be addressed, the specific objectives to be achieved, the deficiencies in both hardware and personnel that need to be upgraded, training and internship requirements, technology and development projects to be undertaken, institutional collaboration, milestones, and budget requirements. However, much of this is beyond the scope of this study and normally would be part of the scope of work for a project design study. Therefore, the discussion here is limited to broad generalizations and suggested approaches, based in part on the U.S. Clean Coal Program managed by the USDOE.

At present there is little or no use of coal in Pakistan for power generation. Therefore, the country is unique and fortunate in that it can develop coal usage in a way that avoids many of the past problems that have been faced by the industrialized countries. In as much as coal is a dirty fuel, relative to oil, gas or hydro-power, a major emphasis must be placed on resolving environmental concerns if it is to be utilized. Appropriate technology development projects and technology transfer linkages between Pakistan and US counterparts can avert or mitigate acid precipitation, smog, problems associated with nitrogen oxides, and the unhealthful effects of atmospheric particulates. In a more global view, world environmental concerns such as ozone-layer depletion and the greenhouse effect would simultaneously be addressed, thus avoiding potential criticism of rapid and expanded electric power generation development based on coal-fired power plants.

The expectations are that, at some point in the not too distant future, Pakistan will have adopted environmental standards of its own. A PCCP would contribute to the technical basis for this environmental policy so that cost-effective compliance with the standards could be immediately implemented. The identification of PCCP technologies, their relationship to the U.S. clean coal projects, their transfer to Pakistan, and their adaptation to Pakistan's economic and cultural conditions must be assigned to both a U.S. institution and a Pakistani institution or institutions with the capability to pursue Pakistan's goals and objectives for electric power generation. Satisfying such requirements involves:

- Developing the skill levels of personnel;
- Understanding the impact of the technology adaptation on the economy; and
- Developing the ability to manage the technology transfer process.

It has been previously noted, and is emphasized again here, that Pakistan has almost no indigenous experience in electric power generation using coal. With this observation in mind, a four component technical program tailored to Pakistan's needs could be designed: (1) technologies for coal-fired power generation, (2) convenient fuel forms, (3) conversion of coal to make useful fuel forms, and (4) special support studies.

4

In the first component the most likely candidate technologies for coal-fired power generation in Pakistan are:

- Fluidized-bed combustion (FBC)
  - bubbling-bed combustion
  - circulating bed
- Coal preparation or beneficiation (CP).

These technologies are facets of the large U.S. Clean Coal Technology Demonstration Program.

To utilize these technologies, a PCCP would have to address and provide for:

- bench scale and pilot plant installations
- supporting analytical facilities
- computational and data analysis equipment
- information exchange and dissemination
- quality control and credibility requirements of potential users
- a trained staff capable of monitoring and evaluating competing world developments, addressing the adaptation requirements in Pakistan, and managing technology transfer activities.

The second area to be addressed by a PCCP could be called "convenient-fuel forms" – for example, smokeless briquettes. This area overlaps the coal-fired power generation but also addresses such important Pakistan problems as deforestation and fuelwood consumption. Technology developments also would include substitution for imported oil-based fuels (cooking kerosene). Candidate technologies would be:

- coal preparation and beneficiation
- coal-oil and coal-water slurries
- smokeless briquettes and pellets.

Complete emission characterization and quantification of these convenient-fuel forms would be a major component of a PCCP. This area might differ in degree, if not in technical detail, with the PCCP items listed above under power generation.

The third area to be addressed by a PCCP would be the longer-term conversion of coal to more useful fuel forms such as substitute natural gas via gasification. Candidate projects are:

- gasifiers
  - fixed bed
  - fluidized bed
- hot-gas cleanup
- underground coal gasification of steeply dipping beds
- integrated gasification combined cycle (IGCC).

Because methanol can be produced from the gasification of coal, a substitute for imported petroleum-based transportation fuels, such as diesel and petrol, would be an integral part of this component of a PCCP. Benefits would include balance of payments relief and reduced transportation-sector-generated atmospheric pollution.

The activities included in the three areas discussed above, consisting of research and the fabrication, testing, and analyses of bench scale and pilot plant experiments, should be carried out at the same institution. The FRC would be a candidate to do this if given the needed resources.

Finally, the fourth area of a PCCP would involve overall modeling and risk and cost analysis studies which can be put together under the general heading of special support studies. Candidate projects are:

- Environmental modeling and extrapolation to the year 2000 for various technology scenarios;
- Comparative cost estimates of alternative technology options.

Activities in this area might be more appropriately carried out by an organization such as the Energy Wing of the Ministry of Planning and Development. However, regardless of where these activities reside, if not at the FRC, there will be a need to assure that performing organizations work together, closely.

APPENDIX B

PERSONS CONTACTED BY THE EVALUATION TEAM

APPENDIX B

PERSONS CONTACTED BY THE EVALUATION TEAM

In Washington:

Ichord, Robert	USAID	Technical/Asia
Archer, Robert	USAID	Technical/Asia
Bliss, Charles	USAID	Energy Advisor
Cover, Peter	USDOE	International Programs
Miller, Lowell	USDOE	Director, Clean Coal Technology

In Islamabad:

Johnston, David T.	USAID	Chief/E&E
Malik, Masood	USAID	GEA/EP&D
Asrarullah	USAID	Program Manager
Khan, Aftab	USAID	Program Assistant
Adams, Gary	USAID	Deputy Chief
Huber, Douglas	USAID	Coal Advisor
Albertin, Wally	USAID	Envinromental Advisor
Iqbal, Qamar	PCSIR	Chairman

In Karachi:

Ahmad, Nisar	FRC	Director
Hasan, S. Khaqan	FRC	Div. Dir. - P.S.O.
Usmani, J.N.	FRC	Div. Dir. - P.S.O.
Ul-Hasan, Misbah	FRC	Div. Dir. - P.S.O.
Raza, M. Zahid	FRC	Div. Dir. - P.S.O.
Memon, G.M.	FRC	S.S.O.
Mir, Surriaya	FRC	S.S.O.
Moghal, G.R.	FRC	S.S.O.
Shah, Shahabuddin Kamal	FRC	P.S.O.
Hussain, S. Ali	FRC	S.S.O.
Khan, M. Shafiq	FRC	S.O.
Ali, Ismat	FRC	Senior Engineer
Shah, S.M. Raza	FRC	Junior Engineer
Pervez, Raees	FRC	Junior Engineer
Pervez, Kausar Aslam	FRC	Technical Officer
Mohammad	FRC	Technician
Rizvi, Sayed Sadiq Ali	PAK/SWISS	Director
Rehman, Atta-Ur	HEJ Institute	Co-Director
Ahmed Aminuddin	Amin Bros.	Director
Paracha, Saifullah A.	Paracha Sugar Co.	President
Khan, Shafiq Ahmad	PCSIR	Member Seience

PERSONS CONTACTED BY THE EVALUATION TEAM (cont.)

In Karachi:

Shaikh, Naseeruddin	PCSIR	Member Technology
Qureshi, Izhar Husain	PCSIR	C.S.O.
Hai, S.M. Abdul	PCSIR	Secretary
Khan, Aziz A.	STEDEC	Managing Director
Ali, Ashraf	STEDEC	Technical Expert
Rizvi, Dr.	PCSIR/Karachi Centre	Centre Director

In Lahore:

Shah, F.H.	PCSIR	Director General

APPENDIX C

STATEMENT OF WORK

INSTITUTIONAL ASSESSMENT OF FUEL RESEARCH CENTRE OF PAKISTAN
COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

PIO/T 391-0478-3-70426

UNITED STATES OF AMERICA
AGENCY FOR INTERNATIONAL DEVELOPMENT

Advisory or Assistance Services:
Yes _____ No X

Country of Performance: Pakistan

Indefinite Quantity Contract: PDC-5730-I-03-6109-00, Delivery Order No. 3

NEGOTIATED PURSUANT TO THE FOREIGN ASSISTANCE ACT OF 1961, AS AMENDED, AND EXECUTIVE ORDER 11223

CONTRACTOR (Name and Address): CBY Associates, Inc. 5039 Cathedral Ave., NW Washington, DC 20016 TIN: 85-03-06178 DUNS NO. 116-20-8554	4a. ISSUING OFFICE: Agency for International Development SER/OP/OS/ANE Washington, D.C. 20523 4b. ADMINISTRATION OFFICE: Agency for International Development USAID/Pakistan Washington, D.C. 20520-8100
PROJECT OFFICE: T. David Johnston Office of Energy & Environment USAID/Pakistan Washington, D.C. 20520-8100	6. SUBMIT VOUCHERS TO: Controller USAID/Islamabad, Pakistan Department of State Washington, D.C. 20520-8100
EFFECTIVE DATE: Same date as in Block 11. B.	8. ESTIMATED COMPLETION DATE: July 14, 1989

ACCOUNTING AND APPROPRIATION DATA:

Amount Obligated: $50,132.00
Ceiling Price: $50,132.00
Appropriation No.: 72-117/81037

PIO/T No.: 391-0478-3-70426
Project No.: 391-0478
Budget Plan Code: QES7-87-27391-KG-13

The United States of America, represented by the Contracting Officer signing this Order, and the Contractor agree that: (a) this Order is issued pursuant to the Contract specified in Block 2 above and (b) the entire Contract between the parties hereto consist of this Delivery Order and the Contract specified in Block 2 above.

NAME OF CONTRACTOR: CBY Associates, Inc.	11b. UNITED STATES OF AMERICA AGENCY FOR INTERNATIONAL DEVELOPMENT
ignature of authorized individual) Sharon L. Yenney	BY: (Contracting Officer)
OR PRINTED NAME: Sharon L. Yenney	TYPED OR PRINTED NAME: Judith D. Johnson (apl)
: VICE PRESIDENT	TITLE: CONTRACTING OFFICER
4/13/89	DATE: 4/13/89

51

BACKGROUND

Pakistan is deficient in energy to meet its domestic and industrial needs. Energy needs are met be indigenous oil, gas, hydelpower, burning of biomass and large scale import of petroleum products and kerosene. Firewood is produced by indiscriminate felling of trees from already scanty forest cover.

Coal occurs in all the provinces of Pakistan. Its reserves are of the order of 5 billion tons, but its share in the energy scenario of the country is hardly 7 percent. Increasing the utilization of coal for power generation and, industry under environmentally acceptable conditions is a major concern of the Government of Pakistan

Government of Pakistan has laid stress on the exploration and development of coal resources in its Sixth and Seventh Five Year Development Plans (1983-1993). Increased use of coal will alleviate the energy deficiency, save scarce foreign exchange, provide job opportunities and reduce the pressure of deforestation in the country.

Pakistan Council of Scientific and Industrial Research (PCSIR) is the major scientific and technological institution created by the Government of Pakistan to provide advice to the Government, business and industry on appropriate technology and other ministries. Its principal research laboratories are at Karachi, Lahore, Islamabad, Peshawar and Hyderabad.

The Fuel Research Center (FRC) at Karachi is an integral part of the PCSIR system. The FRC serves as the national center for research and development in fossil fuels and for the transfer of coal utilization technologies to the public and private sectors in Pakistan. It is now housed in a newly constructed building financed by the Government of Pakistan. USAID has provided modern laboratory equipment for the Fuel Research Center. The equipment for chemical and physical analysis provided by USAID is considered highly sophisticated and should give FRC scientists the capability to produce research results that can compete with those of similar research activities anywhere in the world.

FRC has 44 scientists and engineers on its staff including 11 Ph. D's. and 17 M. Sc's. The FRC personnel have been engaged in analyzing coal samples for Government agencies as well as private sector coal companies. As an initial step towards using the newly acquired equipment, the FRC staff is involved in the analysis of coal samples being produced by the current drilling program of the Geological Survey of Pakistan (GSP) under the Coal REsource Assessment Program (COAL REAP) of USAID. The immediate intent is to transfer primary

responsibilities to the COAL REAP analytical work from US contract laboratories to the FRC facilities.

However, for long-term usefulness of FRC to the nation, a potential longer-term program of FRC activities has been identified which places major emphasis on coal development in Pakistan during the period of the Seventh Five Year Plan (1988-1993). The PCSIR/FRC would play a major role in transfer of environmentally-sound coal utilization technologies, such as those being identified and evaluated by the Clean Coal Program of the United States Department of Energy (USDOE). The objective is to permit the use of coal in an efficient and environmentally safe way to produce power, thereby reducing the consumption of petroleum products. Primary FRC attention will relate to generation of coal-based electricity and the replacement of fuel oil in the manufacture of cement.

In the field of applied research, the FRC has made impressive progress since it became an independent center in 1984. It has produced an uncarbonized coal briquette that appears to be marketable. The FRC has plans to determine the environmental acceptability of the briquettes by comparing the volatile chemical compounds emitted during combustion with those emitted by fuel wood, wood charcoal and carbonized briquettes. They are also experimenting with a PCSIR designed and built fluidized-bed combustor.

USAID is interested in assessing the current level of capability of the FRC facility, management, staff in the field of coal utilization and development technology. Such an assessment will help identify the technical assistance and training needs for building the institutional capability of the FRC to required international standards.

ARTICLE I - TITLE

Energy Planning and Development Project (Project No. 391-0478).

ARTICLE II - OBJECTIVE

The purpose of this assessment is to provide USAID with the following information:

a. An overall assessment of the FRC's capabilities in meeting the envisaged short and long term programs.

b. The relationship of PCSIR with the FRC in terms PCSIR management technical assistance, and financial support for FRC programs.

c. The competence of FRC to play a major role in the transfer of appropriate coal utilization technologies to Pakistan including USDOE Clean Coal Programs, and coal-water slurry fuels preparation as a possible fuel for cement kilns.

d. The capability of FRC to operate and maintain AID-funded laboratory and other scientific equipment over the next 5-7 years.

e. The status of FRC work planning over the next 5-7 years.

f. The adequacy of the FRC budget to conduct its planned program.

ARTICLE III - STATEMENT OF WORK

The specific tasks to be accomplished are as specified below:

1. The team shall assess the FRC institution under the following categories:

a. Organizational Autonomy. How far is FRC independent to conduct its affairs and meet its responsibilities?

b. Leadership. Do the senior people of the institution have the ability to inspire others to understand the institution's mission and make commitments to achieve that goal?

c. Management and Administration. Is the institution organized and managed to get the most our of the human and other resources required for achieving its goals?

d. Commercial Orientation. Are the planned actions cost effective? Does FRC have mechanisms in place which will control costs and optimize use of donor funding?

e. Consumer Orientation. Is it geared to serve the consumers as its primary function and react to consumer's reactions?

f. Technical Capability. Are the employees competent to conduct the technical worked required to carry our the responsibilities of the institution (FRC)?

g. Developing and Maintaining Staff. Does the FRC develop and maintain staff by regular recruitment procedures? Does it provide opportunities to grow

professionally and keep them satisfied by providing adequate compensation?

h. Organizational Culture. Has the FRC developed an effective organizational culture which translates into a clear sense of mission and identity?

i. Interaction with Key External Institutions. Does the FRC have the capability to influence positively those institutions whose cooperation and assistance is vital to its performance?

2. The team will interview the FRC personnel to help identify experiences, skills, attitudes, ets., likely to affect the quality and quantity of work performed. Attention should be given to conditions of management that either promote or discourage initiative, creativity, and productivity on the part of scientific and technical personnel.

3. The team shall specify the additional hardware, employee performance standards, additional personnel skills and experiences that would be needed in order to achieve PCSIR/FRC objectives and goals.

4. The team shall prepare in-depth written recommendations as to methods and options for providing the hardware and personnel skills to PCSIR/FRC. Training needs should be identified including: in-country training; training in the United State, post graduate university education. The team will also be required to comment upon the in-house construction capabilities of the FRC, the need for purchase hardware & equipment and the FRC's maintenance capabilities.

5. The team shall assess the potential importance of coal within Pakistan's economy and energy sector. Within this context the team will: assess the role and importance of the FRC in catalyzing and promoting the development of coal as called for in the Seventh 8 year plan as an environmentally and economically sound energy source; specify how a highly-capable FRC will contribute to coal development; estimate levels of the economic and energy sector benefits which could be achieved from GOP and AID investment in the FRC (This proposed analysis would be illustrative and subjective, a formal benefit-cost analysis would not be required).

In connection with performance of the above mentioned tasks, the persons interviewed, major documents and sources of information used for the assessment are of be documented in an annex to the final report. Data analysis by individual team

members, the team as a hole, and the synthesis and weighting of performance categories is to be documented in the final report.

The scope of work shall include but not be limited to the following:

1. Inspection of the physical facilities of the FRC.

2. Interviews with management, technical and support personnel of the FRC.

3. Interviews with relevant staff and management associated directly with the FRC.

4. Identification of the management, hardware and staffing needs for the FRC to meet prospective program requirements and to assure effective technology transfer.

5. Interviews with public and private sector companies to which the FRC has provided services to study the FRC's interaction with external institutions.

6. Prioritized recommendations for additional technical and capital assistance for the FRC.

7. Written recommendations for budgetary, administrative, managerial, organizational, technical and other changes which would strengthen the FRC as an institution and enhance its capability to carry out an effective research and technology transfer program.

ARTICLE IV - REPORTS

Upon completion of the work the contractor shall submit the final report in draft for review and comments by USAID/FRC. The contractor shall be prepared to submit and present this report orally, and to consider any PCSIR/FRC comments or proposed revisions. He shall submit twenty copies of the final report two weeks after USAID approval of the revised draft final report.

ARTICLE V - RELATIONSHIPS AND RESPONSIBILITIES

Technical Directions during the performance of this delivery order will be provided by T. David Johnston, Office of Energy & Environment, pursuant to Section F.3 of the contract.

APPENDIX D

TEAM WORKSHEETS FOR THE EVALUATION OF INDICATORS OF HIGH PERFORMANCE

Each member of the Team completed rating sheets for the key indicators for high performance. In this Appendix, copies of the rating sheets are attached for D. Beattie, R. Kovach, and F. Simon.

APPENDIX D

TEAM WORKSHEETS FOR THE EVALUATION OF INDICATORS OF HIGH PERFORMANCE

Ratings by D. Beattie

TECHNICAL CAPABILITY

INDICATORS OF HIGH PERFORMANCE

1. Consistently makes sound technical decisions and effectively serves management by conducting technical studies and planning as requested.

Very Low — Medium — Very High

2. Ensures effective control of the quality of the end product and all other technical operations.

Very Low — Medium — Very High

3. Successfully completes projects which meet their intended objectives in a timely manner, within budget.

Very Low — Medium — Very High

4. Ensures that technical tasks at all levels are completed properly.

Very Low — Medium — Very High

5. Develops and maintains staff with adequate technical skills to perform needed services; promotes broader knowledge of aspects of technology other than individual's specific area of expertise.

Very Low — Medium — Very High

6. Uses or adapts technology which is suitable for the specific needs of the institution and avoids temptation to use more exciting--but not appropriate--technologies learned by staff who were trained in other settings.

Very Low — Medium — Very High

7. Maintains levels of in-house technical skills adequate for its routine technical responsibilities and sub-contracts to outside specialists those tasks which are either beyond its own capabilities or necessary to meet peak needs.

Very Low — Medium — Very High

Rating by D. Beattie

8. Conducts practical research and experiments to improve existing uses of technology for local conditions and needs.

Very Low — Medium — Very High

9. Technical staff demonstrate a strong interest in technical learning and keep up with new information in the field.

Very Low — Medium — Very High

Rating by D. Beattie

LEADERSHIP

INDICATORS OF HIGH PERFORMANCE

1. Provides clear sense of mission; articulate mission; involves people with mission so they get sense of ownership of mission; gets people excited about mission, believing in it.

Very Low — Medium — Very High

2. Serves as positive role model (e.g., honest, hardworking, balances people needs with organizational needs, believes in hard work, enthusiastic).

Very Low — Medium — Very High

3. Has a sufficient level of operational knowledge to inspire trust.

Very Low — Medium — Very High

4. Works hard and works overtime as required; gets out in the field or visits other offices; is visible to the rank and file.

Very Low — Medium — Very High

5. Demonstrates competence, is visible interested in work.

Very Low — Medium — Very High

6. Is oriented toward producing results which move work toward meeting goals.

Very Low — Medium — Very High

7. Identifies clear performance standards and is strict but fair; gives positive and negative feedback where due; disciplines where necessary based on performance.

Very Low — Medium — Very High

8. Listens as well as instructs.

Very Low — Medium — Very High

Rating by D. Beattie

9. Active, has "we can do it" attitude; assertively makes decisions, moves things.

Very Low — Medium — Very High

10. Maintains sense of balance between future vision and everyday operational matters ("keeping nose to the grindstone and eyes to the hills").

Very Low — Medium — Very High

11. Demonstrates personal integrity (i.e., does not claim false overtime, take money, or cut corners for personal gain); instills sense of integrity in others.

Very Low — Medium — Very High

12. Shows sense of dynamism and energy in everyday contact with others.

Very Low — Medium — Very High

13. Sets positive problem solving environment (i.e., creates sense that uncovering problems is desirable, and that creative approaches to their solution are effective).

Very Low — Medium — Very High

14. Continuously guides technical staff on need to ensure that levels of technology used by the institution are those which are most suitable in terms of simplicity of operation and maintenance, and monitors activities in this regard.

Very Low — Medium — Very High

Rating by D. Beattie

DEVELOPING AND MAINTAINING STAFF

INDICATORS OF HIGH PERFORMANCE

1. Mechanisms exist and are utilized to promote skill transfer.

   - Organized skill transfer training programs (such as seminars or demonstrations) are designed and used to meet institutional goals.

   Very Low — Medium — Very High

   - There is an informal process (such as internship) to effectively transfer skills.

   Very Low — Medium — Very High

2. A clear process for determining skill needs exists and is the basis for designing training programs.

   Very Low — Medium — Very High

3. Managers are actively involved in skill transfer, regularly acting in a training capacity as a supervisor or through delivery of courses.

   Very Low — Medium — Very High

4. Personnel express an interest in learning new ways of doing things.

   Very Low — Medium — Very High

5. A system exists for developing competent managers and supervisors.

   Very Low — Medium — Very High

6. The institution provides adequate incentives to maintain staff.

   - Salary levels are adequate to maintain personnel.

   Very Low — Medium — Very High

Rating by D. Beattie

- Employee benefits (pension, vacation time, sick leave, insurance) are an important part of the overall compensation package and together with salaries provide adequate incentives to maintain staff.

Very Low — Medium — Very High

- Employee turnover is at an acceptably low level.

Very Low — Medium — Very High

7. A clear system exists for hiring qualified personnel and firing or disciplining personnel when necessary.

Very Low — Medium — Very High

8. Employees demonstrate good morale and openly state that the institution is a good place to work.

Very Low — Medium — Very High

9. Active systems are in place for providing ongoing formal and informal feedback to personnel about job performance.

Very Low — Medium — Very High

10. Employees feel involved in and informed about the institution's activities.

Very Low — Medium — Very High

Rating by D. Beattie

ORGANIZATIONAL AUTONOMY

INDICATORS OF HIGH PERFORMANCE

1. Sets own organizational policies and goals and changes them as necessary to provide guidance and direction in achieving the objectives of the institution.

Very Low — Medium — Very High

2. Conducts such studies as may be necessary and carries out long-term planning to meet the expected demands on the institution; approves and acts on such studies and plans, including the construction of recommended facilities.

Very Low — Medium — Very High

3. Prepares annual capital and operating budgets consonant with needs and available revenues; is successful in obtaining approval for the budgets.

Very Low — Medium — Very High

4. Maintains control over all revenues generated and collected.

Very Low — Medium — Very High

5. Establishes and maintains staffing levels sufficient to meet needs.

Very Low — Medium — Very High

6. Employs, discharges, disciplines, and promotes personnel within established and approved guidelines adequate to institutional needs.

Very Low — Medium — Very High

7. Establishes levels of employee compensation, including salaries and benefits, sufficient to attract and maintain capable staff.

Very Low — Medium — Very High

Rating by D. Beattie

MANAGEMENT AND ADMINISTRATION

INDICATORS OF HIGH PERFORMANCE

Management Skills and Capabilities

1. Managers have a clear sense of their own and other's roles and responsibilities. They communicate roles and expectations clearly to others and involve them in the process of defining their roles and responsibilities.

Very Low — Medium — Very High

2. The mission of the organization exists and is clear and understood by all managers.

Very Low — Medium — Very High

3. When asked, staff are able clearly to describe their responsibilities.

Very Low — Medium — Very High

4. Managers know how to plan and delegate to get work tasks accomplished (tasks are allocated to the right people). Work planning is done with staff involvement. People have a free hand to get work done and are supported in doing it.

Very Low — Medium — Very High

5. Managers regularly set goals with staff and have a sense of priorities. Goals are limited and realistic and mesh with organizational missions and priorities.

Very Low — Medium — Very High

6. Departmental/organizational objectives are clear and understood at many levels.

Very Low — Medium — Very High

7. People are held accountable for getting work done.

Very Low — Medium — Very High

8. Follow-through on task assignments is done consistently.

Very Low — Medium — Very High

9. There is good communication within and among all levels; information is shared openly.

Very Low — Medium — Very High

10. Managers set and use performance indicators (standards) to evaluate work performance. They are understood at appropriate levels.

Very Low — Medium — Very High

11. Managers maintains a climate of teamwork and cooperation among the staff.

Very Low — Medium — Very High

12. Communication flows freely within and among departments at all levels.

Very Low — Medium — Very High

13. Managers at all levels use and are well informed about the administrative systems.

Very Low — Medium — Very High

Management Administrative Systems

14. Administrative systems for the following functions have been developed and are regularly used. (Note: rate each system for effectiveness.)

a) Budgeting

Very Low — Medium — Very High

b) Commercial

Very Low — Medium — Very High

Rating by D. Beattie

c) Accounting

Very Low — Medium — Very High

d) Procurement

Very Low — Medium — Very High

e) Management Information

Very Low — Medium — Very High

f) Personnel

Very Low — Medium — Very High

g) Maintenance Management System

Very Low — Medium — Very High

h) Stores, Supplies, and Inventory Control

Very Low — Medium — Very High

Rating by D. Beattie

INTERACTIONS WITH KEY EXTERNAL INSTITUTIONS

INDICATORS OF HIGH PERFORMANCE

1. Top management stays well informed about external policy, financial, and regulatory issues and actions.

Very Low — Medium — Very High

2. Management maintains direct contact with the key individuals in all important external entities.

Very Low — Medium — Very High

3. Specific strategies are formulated to influence policies, legislation, and other activities to obtain necessary approvals and resources.

Very Low — Medium — Very High

4. Programs are developed to influence the public in support of institutional goals.

Very Low — Medium — Very High

5. Management creatively adapts to obstacles (e.g., supplements inadequate salaries with other kinds of incentives).

Very Low — Medium — Very High

Rating by D. Beattie

ORGANIZATIONAL CULTURE

INDICATORS OF HIGH PERFORMANCE

1. An observable team spirit exists among the staff.

Very Low — Medium — Very High

2. People express a sense of ownership and pride about working that is communicated by such statements as "this is a good place to work."

Very Low — Medium — Very High

3. Employees are able to articulate the history and legends of the organization in positive ways.

Very Low — Medium — Very High

4. Continuity in the organizational culture is maintained (even with staff turnover at high or low organizational levels).

Very Low — Medium — Very High

5. Staff place a value on maintaining the physical plant (offices, treatment plants, grounds) of the organization. Facilities look clean, well maintained, and attractive.

Very Low — Medium — Very High

6. Power and status are defined as something the entire organization shares in varying degrees, especially the status associated with doing a good job.

Very Low — Medium — Very High

Rating by D. Beattie

COMMERCIAL ORIENTATION

INDICATORS OF HIGH PERFORMANCE

1. Maintains yearly balance between expenditures and revenues. Revenues may be partly drawn from subsidies which are phased out according to a planned schedule.

Very Low — Medium — Very High

2 Requires economic and financial feasibility for its projects and other institutional activities.

Very Low — Medium — Very High

3. Staff actions of the institution are guided by cost effectiveness as well as quality standards for work performed for the private sector.

Very Low — Medium — Very High

4. Takes into account cost effectiveness when individuals and groups plan and organize work that has near-term potential commercial application.

Very Low — Medium — Very High

5. Monitors expenditures against approved budgets.

Very Low — Medium — Very High

6. Maintains attitude of consumer orientation throughout the institution and is responsive to client needs and requests.

Very Low — Medium — Very High

7. Maintains clear, auditable financial records.

Very Low — Medium — Very High

8. Staff has a commercial orientation and thinks of their service function as a business when dealing with the private sector.

Very Low — Medium — Very High

Rating by D. Beattie

CONSUMER ORIENTATION

INDICATORS OF HIGH PERFORMANCE

1. Staff at every level demonstrate they are oriented toward serving suctomers; when observed, their decisions and actions are clearly driven by what is best for the customer.

Very Low — Medium — Very High

2. There are mechanisms for customers to interact with key areas of the institution over important matters.

Very Low — Medium — Very High

3. There are identifiable, ongoing, and effective measures to educate customers about institutional services and requirements.

Very Low — Medium — Very High

4. There are concerted efforts made to project a positive image of the institution to customers.

Very Low — Medium — Very High

APPENDIX D

TEAM WORKSHEETS FOR THE EVALUATION OF INDICATORS OF HIGH PERFORMANCE

Ratings by R. Kovach

TECHNICAL CAPABILITY

INDICATORS OF HIGH PERFORMANCE

1. Consistently makes sound technical decisions and effectively serves management by conducting technical studies and planning as requested.

Very Low — Medium — Very High

2. Ensures effective control of the quality of the end product and all other technical operations.

Very Low — Medium — Very High

3. Successfully completes projects which meet their intended objectives in a timely manner, within budget.

Very Low — Medium — Very High

4. Ensures that technical tasks at all levels are completed properly.

Very Low — Medium — Very High

5. Develops and maintains staff with adequate technical skills to perform needed services; promotes broader knowledge of aspects of technology other than individual's specific area of expertise.

Very Low — Medium — Very High

6. Uses or adapts technology which is suitable for the specific needs of the institution and avoids temptation to use more exciting--but not appropriate--technologies learned by staff who were trained in other settings.

Very Low — Medium — Very High

7. Maintains levels of in-house technical skills adequate for its routine technical responsibilities and sub-contracts to outside specialists those tasks which are either beyond its own capabilities or necessary to meet peak needs.

Very Low — Medium — Very High

8. Conducts practical research and experiments to improve existing uses of technology for local conditions and needs.

Very Low — Medium — Very High

9. Technical staff demonstrate a strong interest in technical learning and keep up with new information in the field.

Very Low — Medium — Very High

Ratings by R. Kovach

LEADERSHIP

INDICATORS OF HIGH PERFORMANCE

1. Provides clear sense of mission; articulate mission; involves people with mission so they get sense of ownership of mission; gets people excited about mission, believing in it.

Very Low — Medium — Very High

2. Serves as positive role model (e.g., honest, hardworking, balances people needs with organizational needs, believes in hard work, enthusiastic).

Very Low — Medium — Very High

3. Has a sufficient level of operational knowledge to inspire trust.

Very Low — Medium — Very High

4. Works hard and works overtime as required; gets out in the field or visits other offices; is visible to the rank and file.

Very Low — Medium — Very High

5. Demonstrates competence, is visible interested in work.

Very Low — Medium — Very High

6. Is oriented toward producing results which move work toward meeting goals.

Very Low — Medium — Very High

7. Identifies clear performance standards and is strict but fair; gives positive and negative feedback where due; disciplines where necessary based on performance.

Very Low — Medium — Very High

8. Listens as well as instructs.

Very Low — Medium — Very High

9. Active, has "we can do it" attitude; assertively makes decisions, moves things.

Very Low — Medium — Very High

10. Maintains sense of balance between future vision and everyday operational matters ("keeping nose to the grindstone and eyes to the hills").

Very Low — Medium — Very High

11. Demonstrates personal integrity (i.e., does not claim false overtime, take money, or cut corners for personal gain); instills sense of integrity in others.

Very Low — Medium — Very High

12. Shows sense of dynamism and energy in everyday contact with others.

Very Low — Medium — Very High

13. Sets positive problem solving environment (i.e., creates sense that uncovering problems is desirable, and that creative approaches to their solution are effective).

Very Low — Medium — Very High

14. Continuously guides technical staff on need to ensure that levels of technology used by the institution are those which are most suitable in terms of simplicity of operation and maintenance, and monitors activities in this regard.

Very Low — Medium — Very High

Ratings by R. Kovach

DEVELOPING AND MAINTAINING STAFF

INDICATORS OF HIGH PERFORMANCE

1. Mechanisms exist and are utilized to promote skill transfer.

   - Organized skill transfer training programs (such as seminars or demonstrations) are designed and used to meet institutional goals.

   Very Low — Medium — Very High

   - There is an informal process (such as internship) to effectively transfer skills.

   Very Low — Medium — Very High

2. A clear process for determining skill needs exists and is the basis for designing training programs.

   Very Low — Medium — Very High

3. Managers are actively involved in skill transfer, regularly acting in a training capacity as a supervisor or through delivery of courses.

   Very Low — Medium — Very High

4. Personnel express an interest in learning new ways of doing things.

   Very Low — Medium — Very High

5. A system exists for developing competent managers and supervisors.

   Very Low — Medium — Very High

6. The institution provides adequate incentives to maintain staff.

   - Salary levels are adequate to maintain personnel.

   Very Low — Medium — Very High

   - Employee benefits (pension, vacation time, sick leave, insurance) are an important part of the overall compensation package and together with salaries provide adequate incentives to maintain staff.

   Very Low — Medium — Very High

Ratings by R. Kovach

- Employee turnover is at an acceptably low level.

Very Low — Medium — Very High

7. A clear system exists for hiring qualified personnel and firing or disciplining personnel when necessary.

Very Low — Medium — Very High

8. Employees demonstrate good morale and openly state that the institution is a good place to work.

Very Low — Medium — Very High

9. Active systems are in place for providing ongoing formal and informal feedback to personnel about job performance.

Very Low — Medium — Very High

10. Employees feel involved in and informed about the institution's activities.

Very Low — Medium — Very High

Ratings by R. Kovach

ORGANIZATIONAL AUTONOMY

INDICATORS OF HIGH PERFORMANCE

1. Sets own organizational policies and goals and changes them as necessary to provide guidance and direction in achieving the objectives of the institution.

Very Low — Medium — Very High

2. Conducts such studies as may be necessary and carries out long-term planning to meet the expected demands on the institution; approves and acts on such studies and plans, including the construction of recommended facilities.

Very Low — Medium — Very High

3. Prepares annual capital and operating budgets consonant with needs and available revenues; is successful in obtaining approval for the budgets.

Very Low — Medium — Very High

4. Maintains control over all revenues generated and collected.

Very Low — Medium — Very High

5. Establishes and maintains staffing levels sufficient to meet needs.

Very Low — Mwsium — Very High

6. Employs, discharges, disciplines, and promotes personnel within established and approved guidelines adequate to institutional needs.

Very Low — Medium — Very High

7. Establishes levels of employee compensation, including salaries and benefits, sufficient to attract and maintain capable staff.

Very Low — Medium — Very High

Ratings by R. Kovach

MANAGEMENT AND ADMINISTRATION

INDICATORS OF HIGH PERFORMANCE

Management Skills and Capabilities

1. Managers have a clear sense of their own and other's roles and responsibilities. They communicate roles and expectations clearly to others and involve them in the process of defining their roles and responsibilities.

Very Low — Medium — Very High

2. The mission of the organization exists and is clear and understood by all managers.

Very Low — Medium — Very High

3. When asked, staff are able clearly to describe their responsibilities.

Very Low — Medium — Very High

4. Managers know how to plan and delegate to get work tasks accomplished (tasks are allocated to the right people). Work planning is done with staff involvement. People have a free hand to get work done and are supported in doing it.

Very Low — Medium — Very High

5. Managers regularly set goals with staff and have a sense of priorities. Goals are limited and realistic and mesh with organizational missions and priorities.

Very Low — Medium — Very High

6. Departmental/organizational objectives are clear and understood at many levels.

Very Low — Medium — Very High

7. People are held accountable for getting work done.

Very Low — Medium — Very High

8. Follow-through on task assignments is done consistently.

Very Low — Medium — Very High

Ratings by R. Kovach

9. There is good communication within and among all levels; information is shared openly.

Very Low — Medium — Very High

10. Managers set and use performance indicators (standards) to evaluate work performance. They are understood at appropriate levels.

Very Low — Medium — Very High

11. Managers maintains a climate of teamwork and cooperation among the staff.

Very Low — Medium — Very High

12. Communication flows freely within and among departments at all levels.

Very Low — Medium — Very High

13. Managers at all levels use and are well informed about the administrative systems.

Very Low — Medium — Very High

Management Administrative Systems

14. Administrative systems for the following functions have been developed and are regularly used. (Note: rate each system for effectiveness.)

a) Budgeting

Very Low — Medium — Very High

b) Commercial

Very Low — Medium — Very High

c) Accounting

Very Low — Medium — Very High

d) Procurement

Very Low — Medium — Very High

e) Management Information

Very Low — Medium — Very High

Ratings by R. Kovach

f) Personnel

Very Low — Medium — Very High

g) Maintenance Management System

Very Low — Medium — Very High

h) Stores, Supplies, and Inventory Control

Very Low — Medium — Very High

Ratings by R. Kovach

INTERACTIONS WITH KEY EXTERNAL INSTITUTIONS

INDICATORS OF HIGH PERFORMANCE

1. Top management stays well informed about external policy, financial, and regulatory issues and actions.

Very Low — Medium — Very High

2. Management maintains direct contact with the key individuals in all important external entities.

Very Low — Medium — Very High

3. Specific strategies are formulated to influence policies, legislation, and other activities to obtain necessary approvals and resources.

Very Low — Medium — Very High

4. Programs are developed to influence the public in support of institutional goals.

Very Low — Medium — Very High

5. Management creatively adapts to obstacles (e.g., supplements inadequate salaries with other kinds of incentives).

Very Low — Medium — Very High

Ratings by R. Kovach

ORGANIZATIONAL CULTURE

INDICATORS OF HIGH PERFORMANCE

1. An observable team spirit exists among the staff.

Very Low — Medium — Very High

2. People express a sense of ownership and pride about working that is communicated by such statements as "this is a good place to work."

Very Low — Medium — Very High

3. Employees are able to articulate the history and legends of the organization in positive ways.

Very Low — Medium — Very High

4. Continuity in the organizational culture is maintained (even with staff turnover at high or low organizational levels).

Very Low — Medium — Very High

5. Staff place a value on maintaining the physical plant (offices, treatment plants, grounds) of the organization. Facilities look clean, well maintained, and attractive.

Very Low — Medium — Very High

6. Power and status are defined as something the entire organization shares in varying degrees, especially the status associated with doing a good job.

Very Low — Medium — Very High

Ratings by R. Kovach

COMMERCIAL ORIENTATION

INDICATORS OF HIGH PERFORMANCE

1. Maintains yearly balance between expenditures and revenues. Revenues may be partly drawn from subsidies which are phased out according to a planned schedule.

Very Low — Medium — Very High

2. Requires economic and financial feasibility for its projects and other institutional activities.

Very Low — Medium — Very High

3. Staff actions of the institution are guided by cost effectiveness as well as quality standards for work performed for the private sector.

Very Low — Medium — Very High

4. Takes into account cost effectiveness when individuals and groups plan and organize work that has near-term potential commercial application.

Very Low — Medium — Very High

5. Monitors expenditures against approved budgets.

Very Low — Medium — Very High

6. Maintains attitude of consumer orientation throughout the institution and is responsive to client needs and requests.

Very Low — Medium — Very High

7. Maintains clear, auditable financial records.

Very Low — Medium — Very High

8. Staff has a commercial orientation and thinks of their service function as a business when dealing with the private sector.

Very Low — Medium — Very High

Ratings by R. Kovach

CONSUMER ORIENTATION

INDICATORS OF HIGH PERFORMANCE

1. Staff at every level demonstrate they are oriented toward serving suctomers; when observed, their decisions and actions are clearly driven by what ir best for the customer.

Very Low — Medium ♦ — Very High

2. There are mechanisms for customers to interact with key areas of the institution over important matters.

Very Low — Medium — Very High ♦

3. There are identifiable, ongoing, and effective measures to educate customers about institutional services and requirements.

Very Low — Medium — Very High ♦

4. There are concerted efforts made to project a positive image of the institution to customers.

Very Low — Medium — Very High ♦

APPENDIX D

TEAM WORKSHEETS FOR THE EVALUATION OF INDICATORS OF HIGH PERFORMANCE

Ratings by F. Simon

TECHNICAL CAPABILITY

INDICATORS OF HIGH PERFORMANCE

1. Consistently makes sound technical decisions and effectively serves management by conducting technical studies and planning as requested.

Very Low — Medium — Very High

2. Ensures effective control of the quality of the end product and all other technical operations.

Very Low — Medium — Very High

3. Successfully completes projects which meet their intended objectives in a timely manner, within budget.

Very Low — Medium — Very High

4. Ensures that technical tasks at all levels are completed properly.

Very Low — Medium — Very High

5. Develops and maintains staff with adequate technical skills to perform needed services; promotes broader knowledge of aspects of technology other than individual's specific area of expertise.

Very Low — Medium — Very High

6. Uses or adapts technology which is suitable for the specific needs of the institution and avoids temptation to use more exciting--but not appropriate--technologies learned by staff who were trained in other settings.

Very Low — Medium — Very High

7. Maintains levels of in-house technical skills adequate for its routine technical responsibilities and sub-contracts to outside specialists those tasks which are either beyond its own capabilities or necessary to meet peak needs.

Very Low — Medium — Very High

Rating by F. Simon

8. Conducts practical research and experiments to improve existing uses of technology for local conditions and needs.

Very Low — Medium — Very High

9. Technical staff demonstrate a strong interest in technical learning and keep up with new information in the field.

Very Low — Medium — Very High

Rating by F. Simon

LEADERSHIP

INDICATORS OF HIGH PERFORMANCE

1. Provides clear sense of mission; articulate mission; involves people with mission so they get sense of ownership of mission; gets people excited about mission, believing in it.

Very Low — Medium — Very High

2. Serves as positive role model (e.g., honest, hardworking, balances people needs with organizational needs, believes in hard work, enthusiastic).

Very Low — Medium — Very High

3. Has a sufficient level of operational knowledge to inspire trust.

Very Low — Medium — Very High

4. Works hard and works overtime as required; gets out in the field or visits other offices; is visible to the rank and file.

Very Low — Medium — Very High

5. Demonstrates competence, is visible interested in work.

Very Low — Medium — Very High

6. Is oriented toward producing results which move work toward meeting goals.

Very Low — Medium — Very High

7. Identifies clear performance standards and is strict but fair; gives positive and negative feedback where due; disciplines where necessary based on performance.

Very Low — Medium — Very High

8. Listens as well as instructs.

Very Low — Medium — Very High

9. Active, has "we can do it" attitude; assertively makes decisions, moves things.

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10. Maintains sense of balance between future vision and everyday operational matters ("keeping nose to the grindstone and eyes to the hills").

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11. Demonstrates personal integrity (i.e., does not claim false overtime, take money, or cut corners for personal gain); instills sense of integrity in others.

Very Low — Medium — Very High

12. Shows sense of dynamism and energy in everyday contact with others.

Very Low — Medium — Very High

13. Sets positive problem solving environment (i.e., creates sense that uncovering problems is desirable, and that creative approaches to their solution are effective).

Very Low — Medium — Very High

14. Continuously guides technical staff on need to ensure that levels of technology used by the institution are those which are most suitable in terms of simplicity of operation and maintenance, and monitors activities in this regard.

Very Low — Medium — Very High

Rating by F. Simon

DEVELOPING AND MAINTAINING STAFF

INDICATORS OF HIGH PERFORMANCE

1. Mechanisms exist and are utilized to promote skill transfer.

   - Organized skill transfer training programs (such as seminars or demonstrations) are designed and used to meet institutional goals.

   Very Low — Medium — Very High

   - There is an informal process (such as internship) to effectively transfer skills.

   Very Low — Medium — Very High

2. A clear process for determining skill needs exists and is the basis for designing training programs.

   Very Low — Medium — Very High

3. Managers are actively involved in skill transfer, regularly acting in a training capacity as a supervisor or through delivery of courses.

   Very Low — Medium — Very High

4. Personnel express an interest in learning new ways of doing things.

   Very Low — Medium — Very High

5. A system exists for developing competent managers and supervisors.

   Very Low — Medium — Very High

6. The institution provides adequate incentives to maintain staff.

   - Salary levels are adequate to maintain personnel.

   Very Low — Medium — Very High

   - Employee benefits (pension, vacation time, sick leave, insurance) are an important part of the overall compensation package and together with salaries provide adequate incentives to maintain staff.

   Very Low — Medium — Very High

Rating by F. Simon

- Employee turnover is at an acceptably low level.

Very Low — Medium — Very High

7. A clear system exists for hiring qualified personnel and firing or disciplining personnel when necessary.

Very Low — Medium — Very High

8. Employees demonstrate good morale and openly state that the institution is a good place to work.

Very Low — Medium — Very High

9. Active systems are in place for providing ongoing formal and informal feedback to personnel about job performance.

Very Low — Medium — Very High

10. Employees feel involved in and informed about the institution's activities.

Very Low — Medium — Very High

ORGANIZATIONAL AUTONOMY

INDICATORS OF HIGH PERFORMANCE

1. Sets own organizational policies and goals and changes them as necessary to provide guidance and direction in achieving the objectives of the institution.

Very Low — Medium — Very High

2. Conducts such studies as may be necessary and carries out long-term planning to meet the expected demands on the institution; approves and acts on such studies and plans, including the construction of recommended facilities.

Very Low — Medium — Very High

3. Prepares annual capital and operating budgets consonant with needs and available revenues; is successful in obtaining approval for the budgets.

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4. Maintains control over all revenues generated and collected.

Very Low — Medium — Very High

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6. Employs, discharges, disciplines, and promotes personnel within established and approved guidelines adequate to institutional needs.

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MANAGEMENT AND ADMINISTRATION

INDICATORS OF HIGH PERFORMANCE

Management Skills and Capabilities

1. Managers have a clear sense of their own and other's roles and responsibilities. They communicate roles and expectations clearly to others and involve them in the process of defining their roles and responsibilities.

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Very Low — Medium — Very High

3. When asked, staff are able clearly to describe their responsibilities.

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e) Management Information

Very Low — Medium — Very High

Rating by F. Simon

f) Personnel

Very Low — Medium — Very High

g) Maintenance Management System

Very Low — Medium — Very High

h) Stores, Supplies, and Inventory Control

Very Low — Medium — Very High

Rating by F. Simon

INTERACTIONS WITH KEY EXTERNAL INSTITUTIONS

INDICATORS OF HIGH PERFORMANCE

1. Top management stays well informed about external policy, financial, and regulatory issues and actions.

Very Low — Medium — Very High

2. Management maintains direct contact with the key individuals in all important external entities.

Very Low — Medium — Very High

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Very Low — Medium — Very High

4. Programs are developed to influence the public in support of institutional goals.

Very Low — Medium — Very High

5. Management creatively adapts to obstacles (e.g., supplements inadequate salaries with other kinds of incentives).

Very Low — Medium — Very High

Rating by F. Simon

ORGANIZATIONAL CULTURE

INDICATORS OF HIGH PERFORMANCE

1. An observable team spirit exists among the staff.

Very Low — Medium — Very High

2. People express a sense of ownership and pride about working that is communicated by such statements as "this is a good place to work."

Very Low — Medium — Very High

3. Employees are able to articulate the history and legends of the organization in positive ways.

Very Low — Medium — Very High

4. Continuity in the organizational culture is maintained (even with staff turnover at high or low organizational levels).

Very Low — Medium — Very High

5. Staff place a value on maintaining the physical plant (offices, treatment plants, grounds) of the organization. Facilities look clean, well maintained, and attractive.

Very Low — Medium — Very High

6. Power and status are defined as something the entire organization shares in varying degrees, especially the status associated with doing a good job.

Very Low — Medium — Very High

Rating by F. Simon

COMMERCIAL ORIENTATION

INDICATORS OF HIGH PERFORMANCE

1. Maintains yearly balance between expenditures and revenues. Revenues may be partly drawn from subsidies which are phased out according to a planned schedule.

Very Low — Medium — Very High

2. Requires economic and financial feasibility for its projects and other institutional activities.

Very Low — Medium — Very High

3. Staff actions of the institution are guided by cost effectiveness as well as quality standards for work performed for the private sector.

Very Low — Medium — Very High

4. Takes into account cost effectiveness when individuals and groups plan and organize work that has near-term potential commercial application.

Very Low — Medium — Very High

5. Monitors expenditures against approved budgets.

Very Low — Medium — Very High

6. Maintains attitude of consumer orientation throughout the institution and is responsive to client needs and requests.

Very Low — Medium — Very High

7. Maintains clear, auditable financial records.

Very Low — Medium — Very High

8. Staff has a commercial orientation and thinks of their service function as a business when dealing with the private sector.

Very Low — Medium — Very High

Rating by F. Simon

CONSUMER ORIENTATION

INDICATORS OF HIGH PERFORMANCE

1. Staff at every level demonstrate they are oriented toward serving suctomers; when observed, their decisions and actions are clearly driven by what is best for the customer.

Very Low — Medium — Very High

2. There are mechanisms for customers to interact with key areas of the institution over important matters.

Very Low — Medium — Very High

3. There are identifiable, ongoing, and effective measures to educate customers about institutional services and requirements.

Very Low — Medium — Very High

4. There are concerted efforts made to project a positive image of the institution to customers.

Very Low — Medium — Very High

APPENDIX E

FUEL RESEARCH CENTRE, PCSIR
KARACHI - 39

PUBLICATIONS OF THE LAST TWO YEARS

APPENDIX E

FUEL RESEARCH CENTRE, PCSIR
KARACHI - 39

PUBLICATIONS OF THE LAST TWO YEARS

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APPENDIX F

FUEL RESEARCH CENTRE, PCSIR
KARACHI - 39

A. List of spares, accessories and supplementary ietmes for equipment already procured (priority items).

B. List of supplementary items.

NOTE: The information in this Appendix F was supplied, as shown, by USAID Pakistan. Parts of the table do not follow a numerical sequence, eg. item numbers in S.No: 6 are shown as 5.1-5.8.

APPENDIX F

FUEL RESEARCH CENTRE, PCSIR
KARACHI - 39

SECTION A

LIST OF SPARES, ACCESSORIES AND SUPPLEMENTARY ITEMS FOR EQUIPMENT ALREADY PROCURED (PRIORITY ITEMS)

S.No:	Tranche/Lot/Item No.	Description of Items	Quantity	Approx. Price $	Description and Justification
1.	I/II/8	Accessories and Spares for PARR-1241 Bomb Calorimeter		8,000.00	Essential parts for Bomb Calorimeter used for determining heating value of coal, coke, biomass and other organic compounds
	1.1	Microprocessor, Controller	One No.		
	1.2	Pellet Pross	One No.		
	1.3	Thermometer 24°C to 30°C 100 Div/0°C, PARR 117 R with certificate.	Six Nos.		
2.	I/II/12	Accessories for LECO-MAC 400 Proximate Analyzer Model 786-700	-	15,000.00	Essential parts for Proximate Analyzer used for determining moisture, ash, and volatile matter in coal, coke, biomass and organic compounds.
	2.1	Power Supply	One No.		
	2.2	Crucibles (780-093)	100 Nos.		
	2.3	Lids (780-094)	50 Nos.		
	2.4	Turntable, Metallic (497)	One No.		
	2.5	Turntable holder (780-052)	One No.		
	2.6	Furnace No. 2	One No.		
3.	I/I/4	Accessories and Spares for HPLC - Hydrocarbon Group Analyser	-	35,000.00	Essential parts for HPLC used for estimation and characterization of extracts, conversion and emission products etc. from coal, other individual organic and petroleum products etc. It is a very useful instrument for organic and
	3.1	IC/PAK, Anion Guard Column (P/N 07354)	Six Nos.		

S.No:	Tranche/Lot/Item No.	Description of Items	Quantity	Approx. Price $	Description and Justification
3. (cont.)	3.2	a) IC-PAK, Anion Guard Column (P/N 07357)	8 Nos.		inorganic polutents studies as well.
		b) IC-PAK, Cation Guard Column (P/N 07356)	8 Nos.		
	3.3	Concentrator (for ppb determn)(P/N 07358)	10 PK		
	3.4	a) Analytical Preparative Cartridges/Columns	10 Nos.		
		b) Precolumn Inserts/Guard Columns	20 Nos.		
	3.5	Standards and PIC Reagents	20 Nos.		
	3.6	a) Filtering and Calrification Kit with vacuum Pumps	One No.		
	3.7	Recorder Chart Paper	20 PK		
	3.8	Syringes and other accessories	20 Nos.		
	3.9	a) Column Temperature control kit	One No.		
		b) GCP Caliboration kit and standards	One No.		
		c) Repeating Constant Volume Attachment	One No.		
4.	I/II/19	Accessories and Spares for KEVEX - 700 X-Ray Fluorescence Spectrometer	-	35,000.00	Essential parts and accessories for maintenance and efficient utilization of XRF spectrometer for analysis of coal, coke, ashes, minerals, ores, etc.
	4.1	Dewar Flasks for Liquid Nitrogen Capacity 25 Litr.	One No.		
	4.2	Dewar Flasks for Liquid Nitrogen Capacity 10 Litr	One No.		
	4.3	8000 Spex Mixer Mill (P/N 8000-230) Complete with accessories	One No.		
	4.4	Accessories Sample Mounting only (for Spex-Carver Model M;25 Ton Manual Hydraulic press)	One Set		

S.No:	Tranche/Lot/Item No.	Description of Items	Quantity	Approx. Price $	Description and Justification
4. (cont.)	4.5	Liquid Sample Preparation Kit	One No.		
	4.6	Standards for Coal, Coke Mineral, etc. Micsellaneous samples	One No.		
	4.7	Power supply cards, etc.	One each		
5.	II/I/6	Accessories for X-Ray Diffractometer, R3M/V Polycrystalline Materials, Wide Angle Goniometer, Tube Shield, X-Ray Generator, Fine Focus X-ray Tube, Scintillation Detector, Rate Meter, Radiation Enclosure, Controller with Microprocessor CPU, Micro VMS-base Data Collection Software, Chilling Unit etc.	Set	110,000.00	Accessories of X-Ray Diffractometer R3M/V used for structural studies and analytical work on coal products and all other organic compounds.
6.	I/I/2	Accessories and Spares for ICP (Perkin Elmer Plasma II Emission Spectrometer)		50,000.00	Essentialparts for efficient running of ICP Spectrometer used for determination of elements in pollutants, coal, coal products, minerals, ores etc.
	5.1	Attachment for solid sample analysis complete with spares and optionals.			
	5.2	Accessories complete including cards/boards for professional computer No. 7700 and for printer No. PR 310.			
	5.3	Accessories for cool flow "Refrigerated Recirculator" CFT-33 complete.			
	5.4	Accessories for Auto Sampler AS-51 complete.			

S.No:	Tranche/Lot/Item No.	Description of Items	Quantity	Approx. Price $	Description and Justification
6. (cont.)	5.5	Accessories for TRIYAC "A" Dual Stage Rotary Vane Pump.			
	5.6	Demountable Torach Assembly, Peristaltic Pump Supplier, Power Amplifier Tubes & RF Generator Cables.			
	5.7	Water Filter, Aqua-Pure AP 210 3 with extra 12 Cartridges, Standard Soluation Kit - 6 (six).			
	5.8	Fusion Apparatus for sample for ICP-XRF-AA. ETC.			
7.	II/I/1	Accessories and Spares for GC/MS.	-	50,000.00	Parts essential for efficient use of GC/MS used for structural studies, characterization of products of combustion pollutants, extracts, etc. from coal, briquettes and all other organic compounds.
		Chemical ionization and packed column options and spare parts (such as fused silica capillary columns, ferrules, filters etc.			
8.	I/I/6	Accessories and Spares for DTA & TGS-2	-	10,000.00	Part essential for STA & TGS used for identification and estimation of mineral entities present in coal, minerals, ores and studying the thermal effect on coal and other material.
		Furnace (Heater); sample tube and thermocouple; Pt & alumina liners; sample cup; alumina vital assay; O-Rings; Plotter pen.			
		Hangdown wire and TGS-2 stirrup kit; O-rings; Furnace tube; Pt shield small tube.			

S.No:	Tranche/Lot/Item No.	Description of Items	Quantity	Approx. Price $	Description and Justification
9.	I/I/3	Accessories and Spares for A.A.Spectrophotometer Lamps for A.A. spectro-photometer; Ag. Al, B, Ir. Os, Pb, Pd, Pt, Rb, Rh, Ru, Sn, Th, Zn. Standard for A.A. spectro-photometer; (salt or Solution 1000 mg/L) of the following elements: Al. As, Au, B, Be, Bi, Cd, Ca, Co, Cr, Cu, Ba, Fe, Ga, Ge, Hg, Lr, K, La, Li, Mg, Mn, Mo, Na, Ni, P, Pb, Pt, Rh, Ru, Sb, Ru, Sh, Si, Sn, Sr, Ti, Th, Tl, V, Zr, Zn.	Set	10,000.00	Parts essential for A.A. Spectrometer used for elemental analysis of coal, coal briquettes, coke, ashes, minerals according to ASTM.
10.	I/I/7	Accessories and spares for FT-Infrared (Model Perkin Elmer 1800)		35,000.00	Parts essential for efficient and expanded use of FT/IR spectrometer used for characterization of coal, coal briquettes pollutants, and all other organic compounds.
	9.1	Air bags and other accessories for FT/IR	One No.		
	9.2	Beam Spliter for FT/IR	One No.		
	9.3	Softwares for FT-IR including SEARCH-3, CDS-3 and QUANT-3, Programmes	One No.		
	9.6	Plasma Asher	One No.		
11.	I/I/5	Accessories and Spares for GC Clumns for energy analysis flue gas analysis and hydrocarbon analysis, standard gas samples, gas purification units.	Set	10,000.00	Parts essential for GC used for analysis of flue gases, Fuel gases, pollutants, etc.

S.No:	Tranche/Lot/Item No.		Description of Items	Quantity	Approx. Price $	Description and Justification
12.	I/I/4		Accessories for NMR-Spectrometer (varian VXR-300)	-	650,000.00	NMR Spectrometer costing $665,000.00 could not be installed due to non-availability of liquid helium. The liquification plants, helium and other accessories are therefore, essential for bringing the NMR Spectrometer into operation.
		11.1	Deuterated Solvents	500 ml each		
		11.2	Liquid Nitrogen Dewar Container 50 litre capacity	One No.		
		11.3	Liquid Helium, Air Transportable Dewar container 50 litre capacity	One No.		
		11.4	Saddler Spectra for NMR (Proton & C13	One		
		11.5	Liquid Nitrogen Plant	One		
		11.6	Liquid Helium Plant	One		
		11.7	Autoclave, suitable for high pressure (400 atm) and high temperature (500°C) solvent extraction of coals capacity 5 litres with all temperature and pressure monitoring accessories and spares parts.			
13.	I/II/20		Accessories and Spares for Dilatometer Model D-34 (standard instrument Inc.)	Set	20,000.00	Parts essential for efficient use of dilatometer for coal study.
		12.1	Printer Ribbon (12)			
		12.2	Power Supply (220 Volts; 3KVA)			
		12.3	Dilatometer Tube (6), Arnu Piston (6) Mold Release (12)			
		12.4	CPU Cards, A/D cards, Inter face cards, Enconder cards			
		12.5	Furnace W/Core, LVDT W/Cable Transfer arm			
		12.6	Display panel			

S.No:	Tranche/Lot/Item No.	Description of Items	Quantity	Approx. Price $	Description and Justification
14.	II/II/11	Accessories and Spares for coal petrographic system, including Metallurigical microscope for R&D for pollution, petrography etc. complete with camera and CRT etc. attachment.	One Set	25,000.00	The petrographic equipment used for studies on coal has been procured & installed. But this is incomplete without Petrographic microscope. Therefore, its provision is absolutely essential.
15.	II/IV	Accessories for Briquetting Machine.		115,000.00	
	14.1	Smoke Test Equipment	One No.		
	14.2	Dual Crushing Rolls 12"x12" Sepor	One No.		
	14.3	Laboratory Toothed-Disc Mill complete with extra milling disks for wet grinding.	One No.		
16.		Instruments for Combustion monitoring control and research, consisting of Acid Dewpoint meters, Oxygen analyzers, Carbon Monoxide monitored, flame scans, Land/ CERL Fluxprobes, Land Combustion Inc., USA	Two sets	50,000.00	Parts essential for monitoring of emissions from FBC, etc.

S.No:	Tranche/Lot/Item No.	Description of Items	Quantity	Approx. Price $	Description and Justification
17.		Portable gas analysers for CO2, CO, S°2, H2, CH4, H2S, N2, O2, saturated and unsaturated gases.	One each	100,000.00	-do-
18.		Electronics instruments, Maintenance and repair kit including such as Oscilloscope, circuit tester microprocessor Lab. & Power supply, multimeter test tools, etc.		150,000.00	Essential for repair and maintenance of already procured equipment.
		TOTAL :		1,478,000.00	

SECTION 'B'

LIST OF SUPPLEMENTARY ITEMS

S.No:	Description of Items	Quantity	Approx. Price $	Description and Justification
1.	Rotary fine crusher and sampler complete with optional, Sepor, U.S.A.	One No.	20,000.00	The equipment that could not be procured under IInd tranche are essential and complementary to the existing facilities. The addition of these equipment would make FRC more effective and efficient.
2.	Model UV/VIS/NIR double beam grating. Grating double monochromator spectrophotometer including the following data message accessory, RS 232C accessory, computer average of transients accessory, integrator sphere etc. Perkin Elmer Corp. U.S.A.	One No.	50,000.00	
3.	Thermal insulation testing equipment, dynatech model complete, including creep testing machine and electrochemical polarization system.		100,000.00	
4.	Pressure and flow indication measurements units optional, Sepor, U.S.A.	3 Sets	3,000.00	
5.	Microfiche Reader/printer Belle & Hovell Model ABR 610	One No.	10,000.00	
6.	Gas Calorimeter, automatic, gases with C.V. 250,1000 Btu/cuft.	One No.	20,000.00	
7.	Solid Carbon Dioxide Maker	One No.	10,000.00	

S.No:	Tranche/Lot/Item No. Description of Items	Quantity	Approx. Price $	Description and Justification
8.	DIGISORB 2600 for automatic surface area and pore structure analysis 220-250 volts AC complete with all accessories including the following teleprinter assembly recommended spares and suppliers. Micrometrities Instrument Corp. U.S.A.	One No.	140,000.00	
9.	Centrifugal molecular distillation equipment, the lab-5, Cap. 0-5 lb/hr complete with accessories including the following centrifugal molecular high vacuum still, control centre CVC products, U.S.A.	One No.	50,000.00	The equipment that could be purchased under IInd tranche are essential and complementary to the existing facilities. The addition of these equipments would make FRC more effective and efficient.
10.	Scanning electron microscope, complete with camera other accessories and spark erosion machine etc.	One No.	300,000.00	
11.	Corrosion study equipment Potentiostat ST 72; Potentiogalvano Scan PGS 81; Voltage Scan Generator VSG 83; Salt Srpay cabinet; Cortest Autoclave; Furnace ROF 100/10		300,000.00	
12.	Pulse Chemisorb 2700 complete with accessories	One No.	10,000.00	
13.	Emission Spectrograph, complete with accessories		200,000.00	
14.	Mercury photometer, complete with accessories and optionals	One No.	15,000.00	
15.	Accessories for Forth Flotation Apparatus 15.1. Contact Anglometer, complete with accessories	One No.	10,000.00	
	TOTAL		1,238,000.00	
	GRAND TOTAL		2,716,000.00	