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DEPARTMENT OF STATE
AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D.C. 20523

PROJECT PAPER
PAKISTAN - RURAL ELECTRIFICATION
391-0473

AUGUST 1982

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AGENCY FOR INTERNATIONAL DEVELOPMENT

PROJECT DATA SHEET

1. TRANSACTION CODE: A (A = Add, C = Change, D = Delete) — Amendment Number: ____ — DOCUMENT CODE: 3

2. COUNTRY/ENTITY: Pakistan

3. PROJECT NUMBER: 391-0473

4. BUREAU/OFFICE: Asia [04]

5. PROJECT TITLE (maximum 40 characters): Rural Electrification

6. PROJECT ASSISTANCE COMPLETION DATE (PACD): MM 09 DD 30 YY 88

7. ESTIMATED DATE OF OBLIGATION (Under 'B.' below, enter 1, 2, 3, or 4)
A. Initial FY 82 B. Quarter 4 C. Final FY 86

8. COSTS ($000 OR EQUIVALENT $1 = 12.16)

A. FUNDING SOURCE	FIRST FY 82 B. FX	C. L/C	D. Total	LIFE OF PROJECT E. FX	F. L/C	G. Total
AID Appropriated Total	6,666	1,334	8,000	103,858	51,142	155,000
(Grant) ESF	(6,666)	(1,334)	(8,000)	(43,000)	(-)	(43,000)
(Loan) ESF	(-)	(-)	(-)	(60,858)	(51,142)	(112,000)
Other U.S. 1. U.S. Owned Rupees	-	-	-	-	14,474	14,474
Other U.S. 2.						
Host Country	-	1,913	1,913	-	136,069	136,069
Other Donor(s) ADB	-	-	-	60,500	-	60,500
TOTALS	6,666	3,247	9,913	164,358	201,685	366,043

9. SCHEDULE OF AID FUNDING ($000)

A. APPROPRIATION	B. PRIMARY PURPOSE CODE	C. PRIMARY TECH. CODE 1. Grant	2. Loan	D. OBLIGATIONS TO DATE 1. Grant	2. Loan	E. AMOUNT APPROVED THIS ACTION 1. Grant	2. Loan	F. LIFE OF PROJECT 1. Grant	2. Loan
(1) ESF	250	062	062	-	-	43,000	112,000	43,000	112,000
(2)									
(3)									
(4)									
TOTALS				-	-	43,000	112,000	43,000	112,000

10. SECONDARY TECHNICAL CODES (maximum 6 codes of 3 positions each)

11. SECONDARY PURPOSE CODE

12. SPECIAL CONCERNS CODES (maximum 7 codes of 4 positions each)

A. Code	BRW	BS					
B. Amount	62,000	62,000					

13. PROJECT PURPOSE (maximum 480 characters)

To assist the Government of Pakistan (GOP) to expand reliable electric service to Pakistan's rural population for productive and social uses, to improve the rural poor's access to that service, and to assist the GOP overcome a shortfall in electric power generation capacity.

14. SCHEDULED EVALUATIONS
Interim MM 03 YY 84 — MM 03 YY 86 — Final MM 03 YY 88

15. SOURCE/ORIGIN OF GOODS AND SERVICES
[X] 000 [ ] 941 [X] Local [ ] Other (Specify) ____

16. AMENDMENTS/NATURE OF CHANGE PROPOSED (This is page 1 of a ____ page PP Amendment.)

17. APPROVED BY
Signature: Donor M. Lion — Donor M. Lion
Title: Director, USAID/Pakistan
Date Signed: MM 08 DD 01 YY 82

18. DATE DOCUMENT RECEIVED IN AID/W, OR FOR AID/W DOCUMENTS, DATE OF DISTRIBUTION
MM 08 DD 06 YY 82

RURAL ELECTRIFICATION

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LIST OF ABBREVIATIONS

ADB	Asian Development Bank
ADP	Automated Data Processing
AEB	Area Electricity Board
AID	Agency for International Development
BAR	Borrower's Authorized Representative
EHV	Extra High Voltage
ESF	Economic Support Fund
GMD	General Manager for Distribution
IBRD	International Bank for Reconstruction and Development (World Bank)
KESC	Karachi Electric Supply Corporation, Ltd.
KM	Kilometer
KW	Kilowatt
KWH	Kilowatt hour
LC	Local Cost
MW	Megawatt
NRECA	National Rural Electric Co-operative Association
PACD	Project Assistance Completion Date
PFY	Pakistan Fiscal Year
PMM	Peat, Marwick & Mitchell & Co.
REO	Rural Electrification Office
USDA	United States Department of Agriculture
WAPDA	Water and Power Development Authority

GLOSSARY OF TERMS

Bulk Power Express Way: 500 KV Transmission Lines.

Capacitor: electric energy storage device.

Capacitor Bank: an assembly at one location of a group of capacitors and all necessary accessories, such as switching equipment, protective equipment, and controls.

Circle Office: a subdivision office serving a section of the area within the jurisdiction of an Area Electricity Board. The Circle Office is responsible for all distribution activities such as constructing new lines, installing new services, reading meters, issuing and collecting bills and for maintaining consumer relations.

Circuit: a two or three conductor arrangement to provide a path for moving electricity from one point to another.

Conductor: a wire (solid or stranded) designed to carry an electrical current.

Connection: the joint of one conductor to another either by use of a permanently fixed connector, by wrapping, or by a temporary contact by means of a switch.

Connector: a device for joining one conductor to another, usually a compression fitting which is permanently fixed to both conductors.

Cross-arm: a horizontal member (usually wood or steel) attached to a pole, post, tower or other structures and equipped with means for supporting the conductors.

Demand: the summation of all loads connected to the power system at any given point in time.

Diversity Factor: a ratio for a given power system of actual connected loads to the sum of all loads which could be connected at a given time.

Electric Power Switch: a device for opening and closing or for changing the connection of a circuit.

Energy Losses: Electrical Energy inputs for which there is no output record. Often expressed as the difference between KWH generated and KWH sold. Such losses are composed of two types: technical and non-technical (sometimes called administrative losses) Technical losses are the KWH lost in moving electricity from one location to another due to "friction" encountered in the conductor (resulting in heating of the conductor). Administrative losses are those unaccounted for KWH which are due to theft, misread meters, faulty meters, etc.

Feeder : in WAPDA's system, a 11,000 volt distribution circuit from a substation to an area of load.

Firm Capacity : the sum of all generating plant capacity with deduction for de-rating of units to take into consideration unit age, deterioration, low reservoir levels, units under maintenance plus the amount of the largest generator in case it might fail during operation with the expectation that not more than one unit not scheduled for maintenance would fail at a given time.

Generator: a machine that converts mechanical energy into electrical energy.

Installed Capacity: the sum of all "name plate" or nominal ratings of all power generating units installed.

Insulator: a device intended to support electrical conductors or equipment and insulate these conductors or equipment from ground or other conductors or equipment.

Load: the quantity of electrical energy being consumed by a device at a given time, usually expressed in kilowatts.

Load Factor: the ratio of average power demand to maximum power demand either for a system or for a sub-system.

Load Shedding: the act of deliberately disconnecting the loads in a section of a power system to avoid overloading power generators.

Peak Demand: the maximum demand experienced during a given period of time.

Plant Factor: ratio of the total units actually sent out by a plant during a period of operation to the number of units that would have been sent out had the plant been operated at maximum capacity throughout that period.

Power Factor: the ratio of KW to KVA passing through a circuit at any given time.

Primary: a 11,000 volt electricity distribution line.

Secondary: 230/400 volt electricity distribution line.

Service Drop: the overhead conductors between the electric supply line and the building or structure being served.

Substation (Distribution, Gridstation): an installation for receiving power at one voltage, converting it to a lower voltage and dispatching it to various centers over feeders.

Transformers: a device for raising or lowering electrical energy from one voltage to another voltage.

Transmission Line: a circuit carrying electrical energy at high voltage.

Transmission Loss: the power loss in transmission between one point and another. It is measured as the difference between the net power passing the first point and the second.

Voltage: a measure of the electromotive force (or "pressure") which moves electricity over a circuit or conductor.

Watt: a measure of electrical energy.

Kilowatt: 1000 watts

Kilowatt hour: usually expressed as KWh, it is the unit used to measure electric energy consumption and generation. One Kilowatt-hour of electric energy is required to light a 100 watt bulb for 10 hours or a 10 watt bulb for 100 hours.

PREFATORY NOTE

As part of the preparation of this project paper, a four-person design team devoted several weeks in the spring of 1982 to extensive and intensive data gathering, field trips, interviews, analysis, and drafting. The team was unusually dedicated and thorough. Without its comprehensive, unsparing effort, this project paper would simply not have been produced.

The basic project design and strategy are the result of the team's work. The identification of the project's five components and the careful attention to the relationship between distribution and power generation, which the project design systematically addresses, are examples of the team's key contribution to the development and conceptualization of this project. Another critical input was the economic analysis which forms the basis of the economic assessments presented in this paper.

Since the team's departure, additional data were gathered. A few new uncertainties emerged as to the GOP's plans and financial arrangements related to power generation and rural electrification goals. Two short-term consultants were asked to prepare a more detailed training plan. These and other developments required some relatively modest design changes, within the context of the basic concepts and approach proposed by the design team.

USAID/Pakistan here acknowledges its special debt to the work of the project design team.

I. SUMMARY AND RECOMMENDATIONS

A. Recommendations

1. Funding

USAID/Pakistan recommends that an ESF loan of $112 million, an ESF grant of $43 million, and Rs 176 million (or the equivalent of approximately $14.5 million)[1/] in U.S. owned rupees be authorized for the Rural Electrification Project, which has a Project Assistance Completion Date (PACD) of September 30, 1988. The dollar funds will be obligated as follows:

Fiscal Year	ESF Grant	ESF Loan
	(In $ millions)	
1982	8	-
1983	23	27
1984	-	25
1985	4	23
1986	8	37
Total	43	112

2. Geographic Code

The project authorization should specify that, except as A.I.D. may otherwise agree in writing:

a. Goods and services financed by A.I.D. under this Project shall have their source and origin in countries included in A.I.D. Geographic Code 000 or Pakistan.

b. Ocean shipping for all commodities financed by A.I.D. under this Project shall be only on flag vessels of the United States or Pakistan.

3. Waiver

It is recommended that a source/origin waiver from A.I.D. Geographic Code 000 to Code 935 be approved by the Assistant Administrator for Asia to permit the procurement of twenty-five right-hand drive four-door sedans, two right-hand drive station wagons, and two right-hand drive utility vehicles. A copy of the waiver request is included as Annex I.

1/ At the exchange rate of $1.00 = Rs 12.16 as of July 19, 1982.

B. Summary Project Description

This Project is designed to assist the Government of Pakistan (GOP) to expand reliable electric service to a greater number of Pakistan's rural population for productive and social uses, to improve the rural poor's access to that service, and to assist the GOP in overcoming a shortfall in electric power generating capacity. Initially, the Project will focus on the development of a National Rural Electrification Master Plan and on the serious and costly institutional, technological and power generation capacity shortfall problems. Once the National Rural Electrification Master Plan has been developed and approved and effective steps are taken to resolve the more serious of the above-mentioned problems, funds will be provided to expand the rural electric distribution system and to connect irrigation pumps, agro-industries, and other rural customers.

The Project consists of five distinct but closely linked and interdependent components. The focus of the first component is institutional improvement. The second component involves distribution function training and technology transfer. The third and fourth components will deal with the generation capacity shortfall problem. The third component will attack the problem by reducing energy losses so that existing power generation capacity and other facilities can be more efficiently used for productive purposes. The fourth component will attack the problem by financing additional generation capacity. The fifth component directly responds to A.I.D.'s commitment to the GOP to assist it to extend additional electric lines into rural areas and to connect new customers.

The proposed allocation of funds to the five components is as follows:

Component	Project Dollars ($)	U.S. Owned Rupees (Rs)
	(In millions)	
Institutional Improvement	10.0	50.8
Distribution Function Training	10.8	99.3
Distribution System Energy Loss Reduction	26.3	12.0
Power Generation	52.0	-
Rural Distribution System Expansion	55.9	13.9
Total	155.0	176.0

2/ An additional $15 million has been earmarked for this project in FY 1984 under the Agricultural Commodities and Equipment Project (391-0468) to import transformers, capacitors, meters and other equipment to connect irrigation tubewell pumps and other rural customers.

C. Summary Findings

This project is ready for implementation and is considered socially, financially, and economically sound, and administratively and technically feasible.

D. Project Checklists and Mission Director's Certifications

1. The project meets all applicable statutory criteria. Appropriate checklists are included in Annex B.

2. Two certifications signed by the USAID/Paksitan Mission Director are included in Annex C: (a) a FAA 611(e) certification which certifies that the GOP has the capability to implement and maintain the project; and, (b) a FAA 612(b) certification to permit the disbursement of dollars in lieu of U.S. owned rupees to finance local costs.

E. APAC Concerns and Design Guidelines

The project concerns and design guidelines which were raised at the APAC review of the PID (See Annex A), and where they are addressed in the Project Paper are as follows:

1. Institutional Concerns

What changes are needed in the current institutional framework at WAPDA to ensure that rural electrification is given the priority it should have so that the A.I.D.-financed project is efficiently implemented? See component 1, Institutional Improvement and component 2, Distribution Function Training in Section III, Detailed Project Description.

2. Electric Rate Subsidies

What is the current status of electric rate subsidies now being allowed certain customers, particularly tubewells, and how will these impact on the financial viability of the rural electrification system? An important activity under the Institutional Improvement component will be a comprehensive review of rate subsidies being allowed certain customers and a rationalization of these subsidies on the basis of the review. The Mission has already undertaken a preliminary analysis of the recurrent costs of this project (See Annex T) and will pursue this study in the context of the review of rates and the development of a National Rural Electrification Master Plan.

3. Energy Impact

What are the sources of energy for power generation and what will be the likely impact of the introduction of electricity on rural energy balances? See component 3, Distribution System Energy Loss Reduction and component 4, Power Generation in Section III, Detailed Project Description.

4. Economic Analysis

What are the projected growth trends for the productive and social uses of electricity? Should incentive or support packages be built into the project? The Project Design Team recommended that incentive packages are not necessary at this time. This subject and the productive and social uses of electricity will be reviewed and growth trends examined during the course of the development of the National Rural Electrification Master Plan, which is described in component 1 of Section III, Detailed Project Description. See also the Economic Analysis in Section V. D.

5. Implementation Arrangements

What are the staffing needs for implementing this program at the Mission level? See Section IV, Implementation Plan.

6. Gas Turbine Procurement

See component 4 of Section III, Detailed Project Description, and Section IV, Implementation Plan.

7. Environmental Assessment

See Section V, Environmental Analysis.

8. A.I.D. Policy Directions

Three of A.I.D.'s policy emphases are at the very core of the Institutional Improvement and Training components: institutional development; human resources development; and, host government policy change receptivity. Another policy emphasis, technology transfer, is an integral part of the "sister utility program" and of the energy loss reduction, distribution system expansion, and power generation components. The emphasis on private sector involvement is evident in many project activities. U.S. private industry will be supplying most of the commodities and services under the project. Pakistani private firms

also will be supplying a significant amount of commodities and some of the technical assistance. U.S. private utilities will be participating in the "sister utility program". Development of private agro-industry and commercial enterprise in rural areas will be fostered by the provision of reliable efficient power.

F. Project Issues

1. How will this project deal with the existing and prospective serious power generation shortfall?

The project will assist WAPDA to:

a. develop a National Rural Electrification Master Plan that integrates rural electrification and other distribution system expansion with overall power system expansion, including power generation;

b. develop and implement a distribution system energy loss reduction program. This program has short-term benefits which are equivalent to adding new generation capacity. Energy now lost will be delivered to customers, and load shedding will be reduced; and,

c. install 400 MW of power generation capacity in partial support of Phase I of the Guddu Combined Cycle Gas Turbine Facility.

In addition, new connections to be made under this project will be postponed until the power generation shortfall has been mitigated.

2. Are the GOP and WAPDA receptive to changes in policies and procedures that will permit WAPDA to operate as a modern utility with management and staff actions based on industry standards relating to efficiency, financial soundness, and economic use of resources?

There are a number of substantive indications that both WAPDA and the GOP are committed to policy reform. These include actions being taken to develop a comprehensive National Rural Electrification Master Plan, revise the criteria for staffing power distribution field offices, reduce energy losses, and improve procurement and inventory management practices. Also indicative is the recent establishment in WAPDA of a Career Development Office. WAPDA has requested A.I.D. assistance in all of these and related activities.

The credibility of WAPDA's requests has been reinforced by forceful statements to the Mission by the Chairman, the Member Power and other senior WAPDA officials that training and the upgrading of its staff is WAPDA's highest priority. Numerous directives and actions taken in the Training and Career Development Offices further confirm the top management's strong commitment to change.

3. Given the large number of projects being planned and implemented by WAPDA and the indicated need for institutional improvement, how can WAPDA be expected to implement this project in a timely and efficient manner?

Most of WAPDA's current and planned projects are of the large infrastructure type that are the responsibility of the Water Wing and the Power Generation and Transmission Offices of the Power Wing. The only exception is the Rural Electrification Program which is the responsibility of the General Manager of Distribution. This project supports WAPDA's Rural Electrification Program, and the General Manager of Distribution will be responsible for implementation of all project activities, except for the Power Generation component.

In addition to the energy loss reduction and system expansion activities, this project is designed to improve the overall performance of the Office of the General Manager of Distribution (GMD) and other administrative units of WAPDA that share GMD responsibility for power distribution and rural electrification activities. Some of the project's activities fall in areas where WAPDA has demonstrated effective and capable performance, and it is reasonable to expect that such performance will continue. Other project activities directly address other important areas and needs. The project, if successful, will make major contributions in policy, institutional development, technology transfer and management and will therefore enhance WAPDA's ability to implement not only this project but other power distribution activities and rural electrification projects.

4. Does an A.I.D. contribution to the financing of Phase I of the Guddu Combined Cycle Gas Turbine Facility constitute "commingling" within the meaning of Section 620(h) of the Foreign Assistance Act of 1961, as amended, in light of the fact that the U.S.S.R. and Czechoslovakia have contributed funding for earlier stages of the Guddu Power Generation Complex? If so, would this project be approved as "in the best interests of the United States"?

Although there has been U.S.S.R. and Czechoslovakian funding for earlier stages of the Guddu Power Generation Complex,

the Mission is of the opinion that this participation should not constitute "commingling" as contemplated in Section 620(h) of the Foreign Assistance Act of 1961, as amended, or, if it is determined that there is commingling, there are substantial reasons for the Administrator to approve the project in the "best interests of the United States". The issue of "commingling" has accordingly been presented to the AA/Asia for a determinination. The transmittal memorandum and supporting legal analysis by the Regional Legal Advisor (RLA) are included as Annex R.

G. Contributors to the Project Paper

The following individuals contributed to the development of this project:

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II. BACKGROUND

A. USG-GOP Negotiations

1. Overview

The United States and the Government of Pakistan are embarked on a renewed and strengthened effort to increase their economic and development cooperation. This effort was marked by high level U.S. - GOP consultations in 1981 which culminated in the negotiation of a $3.2 billion package of military and economic assistance which the U.S. will seek to provide to Pakistan between FY 1982 and FY 1987.

The economic assistance component was designed not only to maximize its development impact but also to produce as favorable balance of payments effects as possible. The balance of payments objective reflects two critical purposes of the agreed upon economic assistance: (a) to ameliorate the burden created by Pakistan's increased military expenditures; and, (b) to reduce the constraints on development which balance of payments strains generate. In this manner, the economic, development, and security interests of both nations are interrelated and supported.

The U.S. Economic Assistance Negotiating Team, headed by the A.I.D. Administrator, visited Pakistan in August 1981 to discuss the details of the economic portion of the military/economic package with the Government of Pakistan. These negotiations were successfully completed, and agreement was reached on the FY 1982 ESF program and on areas of concentration for the FY 1982 through FY 1987 period.

2. Strategy

The assistance package is one of the strategic elements of the renewed and expanded USG-GOP relationship. It is one of the instruments required to achieve the U.S. and GOP's mutual goals with respect to security and economic development. The assistance package is seen as an indispensable contribution to the shaping and implementation of a new U.S.-Pakistan relationship and to the critical role in the region which the U.S. Government seeks to assist Pakistan to play. The military-security-political position of Pakistan, including the burden of a massive refugee influx, accentuates the development problem to which the proposed U.S. economic assistance package responds.

The economic assistance program is designed to help Pakistan, one of the world's largest and poorest nations,

fulfill the basic human needs of its people. At the same time, it is designed to address the country's foreign exchange needs through quick disbursing activities while laying the foundation for more rapid economic growth. The program is shaped to assure the widest possible distribution of benefits. The program agreed to by the GOP and U.S. negotiating teams will:

a. reactivate a long-term development assistance relationship, which the U.S. views as important because of Pakistan's size, poverty, strategic location, and other multi-facted U.S. interests;

b. provide balance of payments support to help address short and medium-term foreign exchange shortfalls, thereby reducing development constraints and strengthening the economy;

c. address key economic problems, which will help enable Pakistan to achieve self-sustaining growth and manage its debt burden;

d. complement and support IMF and IBRD assisted programs, and improve their overall impact; and,

e. expand resources availability for local cost financing.

It was in this context that A.I.D. agreed to allocate $200 million to support energy sector activities in Pakistan. At that point, precisely how these funds were to be allocated had not been determined. The Mission subsequently held discussions with GOP officials which resulted in the following provisional allocations: $20 million for an energy planning and renewable energy project; $25 million for an energy forestry project; and, $155 million for a rural electrification project. As requested by the GOP during the negotiations, the Rural Electrification Project Identification Document (PID) included $26 million to assist the GOP to finance part of the foreign exchange costs of an urgently needed gas turbine power generation station.

After further analysis with AID/Washington and consultant assistance, it soon became apparent that the power generation demand-supply gap that led to the GOP request for assistance with the gas turbines was greater than WAPDA had anticipated. It also became clear that A.I.D. should support rural electrification only if effective measures would be taken to mitigate the shortfall. Finally, the project paper design team and the Mission's analysis demonstrated that the gas turbine power generation facilities would cost more than originally estimated

because of inflation and design changes. Accordingly, WAPDA and the GOP have asked both A.I.D. and the Asian Development Bank (ADB) to increase funding for the Guddu Gas Turbine facility. The original request was for A.I.D. to finance 39.4 percent of the estimated foreign exchange costs of Phase I of the facility. The revised request to which this project responds is equal to 46.2 percent of the currently estimated foreign exchange costs.

B. Country Setting

1. General

The total area of Pakistan is approximately 307,000 square miles. It is comprised of four provinces : the Punjab with 26 percent of the land and 58 percent of the population; the Northwest Frontier Province (NWFP) with 13 percent of the land area and 16 percent of the population; Sind with 18 percent of the land area and 22 percent of the population; and, Baluchistan with over 43 percent of the land area and 4 percent of the population.

According to the World Bank (IBRD), Pakistan is the world's tenth most populous and twenty-fourth poorest nation, with an estimated population of 83.7 million (as of March 1981) and an estimated per capita GNP of $230 (in 1978).3/ During the mid-1970's, Pakistan's economy was characterized by a low growth rate with a weak domestic and external financial position. Efforts to improve agricultural productivity lagged, low private sector confidence resulted in a decline in investment, distortions in the relations between costs and prices became greater, and as in the case of other infrastructure, the development of indigenous energy resources lagged.

Since 1977, major policy reforms have been implemented to improve the economic picture, and the resulting progress is reflected in the approximately 6 percent GDP growth per year since that time. This improvement is the result of enhanced agricultural production, industrial sector recovery, and major increases in exports, especially cotton, rice, and textiles. This improvement notwithstanding, the economy remains characterized by low agricultural productivity resulting from lack of sufficient, timely, and appropriate use of inputs and from continuing cost-price distortions. The economy of the country is also characterized by an industrial base with obsolete capital equipment; inefficient public sector enterprises; sluggish private sector investment; and dependence on imported petroleum products (crude oil, cooking oil, and fats).

3/ At the exchange rate of US$1.00=Rs 9.90 in 1978.

Pakistan continues to suffer from chronic balance of trade deficits. The balance of payments position remains fragile and vulnerable to relatively minor changes in key variables, such as the weather, terms of trade and worker remittances.

The GOP has intensified its efforts to correct the serious structural imbalances which continue to threaten economic growth. In cooperation with the IMF, IBRD, and ADB, the GOP has undertaken a three-year structural reform program to alleviate imbalances in the economy and to promote growth in the context of relative financial stability and an improved balance of payments situation. Significant among the major domestic components of the program are : accelerated utilization of Pakistan's indigenous energy resources; improvement in agricultural production incentives and reduction in agriculture input subsidies; and, reorientation of public sector investment to emphasize quick-yielding projects and improved efficiency of public sector enterprises.

About 72 percent of Pakistan's 84 million population is rural, with 56 percent of the labor force engaged in agriculture. Agriculture is the largest sector of the economy, contributing 32 percent to the GDP (in PFY 1979/80). It contributes about two-thirds of the nation's commodity export earnings and the major share of raw materials for domestic industry. It also serves as a significant market for the products of other sectors.

Pakistan's current cultivated area, including fallow land, is about 50 million acres and is characterized by small holdings. Wheat and rice are the major food crops. Large acreages of cotton and sugar cane also are grown. The agricultural sector is plagued with serious low intensity cropping and low productivity problems. Productivity is far below potential with current yields being about one-third of the potential for all major crops. Among the factors contributing to this low productivity are inadequate dissemination of economically viable new techniques and inefficient input use. The primary causes of low intensity cropping are inadequate water supplies on portions of the land, poor drainage in some areas, and inadequate power. Inadequate water supply is a problem even though Pakistan's irrigation distribution system is the largest continuous interlinked system in the world. In the better producing areas, tubewells which provide irrigation and vertical drainage, are an important means to lower the water table and reduce the risk of salinization. Approximately half of the existing tubewells are operated by electricity.

2. The Energy Sector

The GOP has accorded high priority to the energy sector. Thirty percent of the total planned GOP expenditure over the next three years, or $2.5 billion, is planned for conventional energy exploration, production, and power development. This amount does not include planned substantial investments in forestry, which has a major impact on the energy supply. Another indication of the GOP commitment to the energy sector is its allocation of the equivalent of U.S.$3.4 billion for energy sector investments during the Fifth Plan Period (FFY 1979-1983), amounting to 22 percent of all public investments during the period. This percentage represents a substantial increase from previous years and is well above the 15 percent average figure for developing countries. About 87 percent of this planned investment has been earmarked for the power sector, with oil and gas development receiving most of the balance.

a. Energy Supply

Non-commercial fuels such as firewood, animal waste, bagasse, maize stalks and the like supply roughly 40 percent of total energy consumption, but this proportion is declining. It should be emphasized, however, that firewood remains the largest single source of non-commercial energy, constituting about 23 percent of the total energy supply and over 50 percent of the non-commercial supply. A substitute energy source such as electricity is urgently needed to halt the deleterious effect of widespread, unregulated use of trees and shrubs outside officially classified forestry areas for firewood.

The remaining 57 percent of the total energy supply is from commercial sources, according to the following percentages : natural gas (40.5 percent), petroleum products (38 percent), hydro-electricity (15.5 percent), and coal (6 percent). Two of these commercial sources, hydro power and natural gas, are important for electricity generation. Thermal power generation for electricity is the second largest consumer of natural gas (29 percent). Total recoverable reserves of natural gas are estimated at 25 trillion cubic feet, which could last more than sixty years at projected production levels. Almost all the potential supply of hydro resources for electricity generation is located on the Indus and Jhelum Rivers in Northern Pakistan. Only a small amount of fuel oil is used for electricity generation. Coal is virtually unused for this purpose at present because of its low caloric value, high ash and sulphur content, and relatively high cost of extraction. New technological developments may make coal utilization possible in the future which would mean that the power requirements of the lower Sind could be met from mine-mouth power plants.

Even though petroleum products do not play a major role in electricity generation, they are very significant to Pakistan's energy sector and to the general economy. In PFY 1980/81, oil imports represented 60 percent of total export earnings. Pakistan imports 90 percent of its petroleum requirements, 30 percent (by volume) in the form of the middle distillates, kerosene and diesel oil, since the demand for these products exceeds domestic refinery capacity. An estimated 75 percent of the kerosene is used in rural areas, primarily for lighting. This accounts for 12 percent of total oil consumption. The balance of payments situation would be improved substantially if the demand for these middle distillates were curtailed, and to this end, the GOP is intensifying its rural electrification program.

b. Energy Consumption

Since 1947, per capita energy consumption has quadrupled, and overall consumption has increased eleven-fold. Nevertheless, by international standards, commercial energy consumption is still low, with 1977 per capita consumption levels estimated at about one-tenth of the world average and one-half of the average for developing countries.

In 1978, the general consumption pattern was as follows: residential and commercial (17 percent), industry (43 percent), agriculture (10 percent), and transport (30 percent). The household sector obtained 75 percent of its energy from non-commercial sources and accounted for 80 percent of all non-commercial energy consumption, but less than 20 percent of commercial energy consumption. The household sector is steadily increasing its share of commercial energy consumption largely as a result of increased used of electricity. In contrast, the industrial sector obtained 75 percent of its energy from commerc sources and accounted for 45 percent of all commercial energy consumption, but less than 20 percent of non-commercial consumpt

Three factors are responsible for the rise in commercial energy consumption. First, the Pakistani economy, once almost entirely agrarian, has diversified. About 66 percent of the GDP and 45 percent of total employment are generated in non-agricultural and more energy-intensive activities. Second, the agricultural sector has begun to use intensive mechanization and pumped irrigation. Third, increasing urbanization has reduced access to non-commercial energy sources and produced a commercial energy consumption growth rate more rapid than would be expected by the changes in real incomes alone. These patterns are similar to those experienced in most developing countries.

The projected growth rate for total commercial energy demand in Pakistan is just over 8 percent per year.4/ Most of this increased demand will be met by increased supplies of natural gas and hydro-electricity, the consumption of which is projected to grow at annual rates of 10 percent and 11 percent, respectively. A 6 percent annual consumption growth rate for oil and oil products has been projected. This rate is below the projected growth of overall energy consumption but higher than its previous growth rate, reflecting, inter alia, the limited potential for further substitution for petroleum products in the short-term (especially for transport).

2. The Power Sector

Within the energy sector, the power or electricity sector is of crucial significance. Among the energy-consuming sectors, agriculture derives 75 percent of its energy from electricity, industry 48 percent, and households 46 percent. The agricultural and industrial sectors in 1981 consumed 23 and 38 percent, respectively, of all electricity sold and the household sector about 20 percent. The balance was sold for commercial and other uses. The consumption rate for the household sector doubled in the 1970's while that of the agriculture and industrial sectors has declined from the above average increases of the 1960's, reflecting their slower overall growth.

a. Power Generation

The power sector involves generation, transmission, and distribution. Generation is the harnessing of power for the creation of electricity from hydro (water) or thermal (steam, gas turbines and diesel) units. Generation is concerned with the planning, design, construction, operation, and maintenance of a relatively small number of large, highly technical facilities required to generate at minimum cost the electric energy demanded. Since the 1960's, generating capacity has nearly quadrupled, from just under 900 MW in 1965 to 3,225 MW in 1981, and the hydro based share of this capacity has risen from 30 percent to 57 percent. Hydro energy is even more important than these figures indicate because hydro plants require no costly fuel and comparatively little maintenance. Their major limitation is the varying availability of water. Even with that limitation, however, hydro energy accounted for 68.5 percent of the total units of electricity actually produced in PFY 1980/81. It is

4/ Based on an anticipated GDP growth rate of 5.5 percent and on an historic energy/GDP elasticity value of 1.45 percent. Between PFY 1972/73 and PFY 1979/80, a GDP growth rate of 5.0 percent was accompanied by an annual growth in total primary commercial energy consumption of 7.25 percent.

anticipated that as fuel prices increase, hydro sites which have not been developed will become increasingly attractive. Accordingly, WAPDA is proceeding with plans for several major hydro schemes.

As stated above, the bulk of hydro power is derived from the harnessing of the large potential of the Indus and Jhelum Rivers in North Pakistan, a process which began after the 1960 signing of the Indus Water Treaty between India and Pakistan and the undertaking of the $2.7 billion Indus Basin Project. That project includes two of the largest earth-rockfill storage dams in the world, one at Tarbela which in 1980 generated 45 percent of the nation's hydro power, and one at Mangla which generated 38 percent in the same year. Four generating units totalling 1,050 MW in capacity are currently being installed at Tarbela, and seven other units totalling 2,842 MW are scheduled for installation between 1988 and 1992.

The Indus Basin Project also includes 389 miles of major irrigation canals. The importance of hydro electricity to the economy of northern Pakistan is shown by the fact that 27 percent of the combined Tarbela/Mangla output is used by irrigation pumps. Accordingly, the area has developed as a major agricultural production center in the country and, indeed, in the sub-continent. The remainder of Pakistan's hydro power is generated at small sites in the hilly northern region.

This hydro generation is characterized by several phenomena. One is the seasonal variation in water flow with about 72 percent of the Indus flowing in the four months between June and September. During that time, the Tarbela reservoir fills to the top of the dam, and each of the dam's eight 175 MW generation units achieves an output of 200 MW. From October through May, however, there is little rain and little run-off. By January, irrigation demand reduces the level of water in the Tarbela reservoir so much that the output of each of the 175 MW generators is reduced to less than 60 MW. That is the origin of the large seasonal differences between generation capacity and capability and the resultant power generation shortfall. Another factor is the relatively high siltation rates which may limit the life of hydro plant reservoirs. Little is known about this factor to date, but it is estimated that the Tarbela reservoir could lose 90 percent of its storage capacity within the next fifty years and Mangla 50 percent over the same period. These limitations notwithstanding, hydro electricity is a major source of commercial energy and offers promise for further development at both existing and new sites.

Thermal electricity is generated at 22 power stations in central and southern Pakistan. Since the early 1960's, indigenous natural gas has been the main fuel. Before the petroleum price rise in 1973, reliance on oil had been increasing, but the GOP took steps to halt this trend and now natural gas is used almost exclusively. One of the 22 thermal power generating facilities is the Guddu Power Station which is located adjacent to the Indus River in the Upper Sind Province. This station currently consists of three steam power generating units (2 of 110 MW capacity and 1 of 210 MW capacity), giving an installed capacity of 430 MW. Plans exist for the expansion of the Guddu Power Station with Guddu IV (210 MW) and a Combined Cycle Gas Turbine Plant (600 MW). Additional details on the proposed expansion of the Guddu Power Station are provided in Section III - Detailed Project Description.

Pakistan currently faces an electrical supply crisis. One aspect of this crisis relates to insufficient generation capacity, which is a problem even though total installed generation capacity exceeds peak demand. This discrepancy arises from generating facilities being unable to perform at rated capacity due to age, low water levels in reservoirs (especially during February to May), and because they must be withdrawn from service for routine maintenance. To prevent overloading and damage to generators during periods when demand exceeds available capacity, entire circuits must be disconnected, otherwise known as load shedding. WAPDA disconnects those circuits having low priority loads according to established criteria, i.e., generally rotating among those feeders supplying rural areas because they seldom have important industrial loads or influential urban customers. Numerous complaints result that rural electrification does little good when electricity frequently is disconnected for approximately four hours between sundown and 11 P.M. The power system generation shortfall and resultant load shedding is an acute problem at present, and installation of new generation capacity is urgently needed. Any electrification work which involves connection of additional load must be associated with addition of generation facilities and, if losses are excessive, measures to reduce losses.

b. Power Transmission

The transmission system conveys electricity at relatively high voltages from the point of generation to substations where the voltage is reduced for delivery of energy to the distribution feeders. The transmission sub-sector plans, designs, constructs, operates, and maintains a relatively small number of high voltage transmission lines and substations required to transmit bulk energy from generating plants to grid substations. Its work also involves

expansion and rehabilitation of transmission facilities to provide an efficient high voltage network. Neglect or insufficient investment in upgrading existing lines results in costly losses of energy.

In 1947, Pakistan had only 1190 kilometers of transmission lines comprised of 66 KV, 33 KV and 11 KV lines. Today, the transmission network consists of 500 KV, 220 KV, 132 KV, and 66 KV lines which totalled 15,291 kilometers in July 1981. Currently, a major expansion program is underway to add 2700 miles of single and double circuit transmission lines and 216 grid stations. These facilities will augment the existing power system by an aggregate capacity of 4800 MVA.

The transmission subsector has an important role to play in ameliorating the electrical supply problem. The long distances over which electricity must be transmitted from place of generation to place of consumption, combined with inadequate distribution facilities, has produced high transmission and distribution losses and reduced revenues. Several measures must be taken to reduce these losses : higher voltage transmission lines to transfer large blocks of power; conversion of existing 132 KV lines to 220 KV, and 66 KV lines to 132 KV; and, additional substations to reduce the length of existing 11 KV circuits in order to increase their capability. In this respect, the findings of a recent Extra High Voltage (EHV) System study justified a 500 KV transmission system or "bulk power expressway" being built from Tarbela to the Karachi/ Hyderabad area. This system will integrate the hydro electric sources in the north with the thermal plants and major consuming markets in the center and south of the country. Such an "expressway" will permit full and more efficient use of hydro capability during the July-September high water period and will give thermal support to the system from the center and south during the February-May low water months. It also will reduce fuel expenses for spinning reserves (i.e. running standby units) and generating capacity requirements.

c. Electric Power Distribution

The power distribution subsector is the interface of the power sector with the users of electricity. During the year ending June 30, 1981, the Pakistan power sector, through its power distribution subsector5/ sold about 11 billion KWh of electric energy to 3,839,165 customers located in approximately 11,300 cities, towns and villages throughout Pakistan for an estimated Rs 5.5 billion or the equivalent of $561 million.6/

5/ These figures cover both WAPDA which accounts for 75 percent of the total power supply and the Karachi Electric Supply Corporation, Ltd (K.E.S.C.) which accounts for the remaining 25 percent.

6/ At the exchange rate of $1.00=Rs9.90 as of June 30, 1981

Despite an average annual customer growth rate of 11.8 percent during the past five years, (19.6 percent last year alone), as of June 30, 1981, there was a backlog of over 180,000 applications for service. Of that number, 9,765 and 9,627, respectively, were applications to WAPDA for industrial and irrigation tubewell connections. With an average connection rate of about 550 connections per month for each type of connection, the average new industrial and tubewell customer would have to wait almost a year and a half from the time an application is filed until service is actually provided.

While new customers suffer long delays before they are connected, most existing customers suffer prolonged scheduled interruptions (load shedding) because demand is growing faster than new power generation facilities can be placed in service. During the six-month period ending June 30, 1982, there was load shedding almost every day, often from 5:30 A.M. to 8:30 A.M. and from 5:30 P.M. to 9:00 P.M. The worst period was from February 28, 1982 through March 2, 1982 when 750 MW (more than 25 percent of the peak load) had to be disconnected.

Growth statistics indicate that the power sector in Pakistan has had difficulty keeping ahead of demand for service ever since WAPDA was formed in 1958. The additional demand created by the accelerated village (rural) electrification program that was started in 1972 and which was intensified in 1977 has tended to aggravate the problem.

d. Rural Electrification

Rural electrification or electric power distribution to rural areas, has both political and economic significance in Pakistan. Its political significance is illustrated by the term applied to it in Pakistan (Village Electrification) and by the strong governmental support it has received since 1972. Its economic significance is related to the fact that Pakistan's economy depends heavily on agriculture which in turn depends heavily on irrigation and a rapidly growing number of irrigation tubewells (over 200,000 as of June 30, 1981). These tubewells are driven either by diesel motors that operate on imported diesel fuel or by electric motors. As of June 30, 1981, 104,108 irrigation pumps were consuming 23 percent of the total electric energy sold by WAPDA. Another 550 pumps are connected every month, and the backlog of applications for connections is approximately 18 months.

Reliable statistics are not available because no distinctions are made in WAPDA's records between urban and rural connections. However, studies conducted by local consultants indicate that on the average, less than 15 percent of the total number

of potential connections in already electrified villages has actually been connected. In spite of the obvious economic burden that this low utilization of investment represents, the emphasis has continued on electrifying villages rather than on providing electricity for individuals and industries. Since June 30, 1972, the number of electrified villages has increased five-fold from 2,553 to 13,250. During the same period, the number of electrified tubewells, however, increased only about two-fold from 53,342 to 110,000.

The GOP recognizes the shortcomings of its current program and is prepared to use more economically sound selection criteria in its rural electrification program. The National Rural Electrification Master Plan that will be developed under this project will be the vehicle used to introduce these changes.

C. Institutional Setting

1. Energy Sector

There are several institutions responsible for various commercial subsectors of the energy sector. Those not directly concerned with electricity are the Ministry of Petroleum and Natural Resources, which is in charge of oil and gas; the Pakistan Mineral Development Corporation, which is in charge of coal; and, the Pakistan Atomic Energy Commission, which is in charge of nuclear power.

2. Ministry of Water and Power

This Ministry is responsible for two major subsectors of the energy sector : water and electricity. It is responsible for the 1960 Indus Basin Treaty; Indus Basin Works at the national and international level; the National Tubewell Construction Corporation, Ltd; the National Power Construction Corporation, Ltd; the Water and Power Development Authority (WAPDA); and, the Karachi Electric Supply Corporation, Ltd. (K.E.S.C.).

The organization and delineation of responsibilities in the power sector are governed primarily by two documents. The Electricity Act of 1910, as amended in 1964, governs the sector in general and enables the Government to issue licenses for generation and distribution of electric power in various areas of the country. Pursuant to this Act, K.E.S.C. was granted a license to generate and distribute power in the Karachi and Lasbella districts. The Water and Power Development Authority Act of 1958, as amended in 1959, created WAPDA as a quasi-autonomous body by transferring to it all electricity departments except K.E.S.C. WAPDA accounts for 75 percent of the total power supply and K.E.S.C. for about 25 percent.

3. Water and Power Development Authority(WAPDA)

WAPDA is headquartered in Lahore and is responsible for coordinated nationwide development of water and power resources. In these areas, it often undertakes design, construction, and operational activities for the federal and provincial governments.

WAPDA derives funds from the following sources : federal and provincial government grants and loans, proceeds from bonds issued under GOP authority, loans obtained with special or general sanction of the government, grants and loans from foreign donors, and sale of electricity.

WAPDA is organized into three "Wings". The Water Wing is responsible for : water resources planning, use, and measures to combat waterlogging and salinity and to reduce their effects; surface and ground water planning, investigation, and design; flood control; inland navigation; and, the Indus Basin settlement plan. This Wing constructs projects on behalf of the federal and provincial governments and, upon completion, turns them over to the sponsoring government body for operation. The Finance Wing is responsible for financial administration and review of the power sector, balance sheets, and personnel. The "Power Wing" is Pakistan's major "electric utility" and is responsible for construction and operation of power generation, transmission, and distribution facilities, including rural distribution.

WAPDA's governing body or board is called the "Authority". It consists of a Chairman and the Managing Directors of the three wings known as "Member Power","Member Water", and "Member Finance". All are government appointees. According to the statute creating WAPDA, the Authority was to be a policy-making institution. However, it has become overly involved in daily operations so that its members act more like senior managers making decisions of less than major importance than as Managing Directors functioning as chief executives overseeing their respective divisions. The Authority also has been characterized by rapid turnover of Members and by the absence of a reporting system to provide managers with reliable and meaningful information needed to effectively execute their responsibilities.

4. The Power Wing of WAPDA

The Member Power is assisted by six general managers responsible for different departments in the Power Wing : General Manager (Generation); General Manager (Transmission and Grid Station); General Manager (Computer); General Manager (Finance); General Manager (Distribution); and General Manager (Planning, Design and Protection). A chief engineer responsible for material inspection and

surveillance also reports directly to the Member Power. Estimates of the personnel in the Power Wing range from 77,650 to 86,000.

Since 1960, there has been a major shift in WAPDA's priorities. Initially, the focus was on large capital projects such as the Indus Basin Project, and the development of 1,200 MW in thermal generating capacity, 300 transmission grid substations, 13,000 KMS of high voltage transmission lines, and a large number of other works. In 1958, when WAPDA took over the electricity department of the GOP, its facilities totalled about 119 MW. In September 1981, its generation capacity was 3225 MW. In PFY 1980/81, WAPDA's total energy generation was 13,206 GWH. At present, there still is considerable development activity, with construction of over 1,200 MW of hydro-electric and thermal generation capacity, 1000 KM of high voltage transmission lines, and 200 transmission grid substations.

The continuing importance of infrastructure notwithstanding, the focus of WAPDA power wing activities has shifted to the power system operations of generation, transmission, distribution, and the sale of electricity to more than 3 million customers. This shift is indicated by the growing share of finances, employees, general management, and administrative work attributable to power system operations and to the increased importance of consumer and public relations activities. At the same time, however, WAPDA recognizes the need to continue implementing new infrastructure projects to install additional generation capacity to reduce the demand-supply gap and to meet the projected average annual power demand growth rate of about 11 percent.

WAPDA has attempted a few ad hoc modifications to respond to this shift in emphasis, but there still is an imbalanced focus on infrastructure and power generation and transmission at the expense of power distribution. The results are a limited emphasis on financial management, a lack of clearly stated operational objectives, and inadequate attention to the Power Wing's management and commercial operations.

5. WAPDA Power Distribution

Most of the distribution functions in WAPDA are the responsibility of the General Manager for Distribution (GMD). He is assisted at the Lahore headquarters by a Chief Commercial Manager and four Chief Engineers in charge of Stores, Commercial Operations, Design, and the recently created Rural Electrification Office (REO).

The growth in importance of the distribution function within the Power Wing is illustrated by the rapid growth in the number of electric service customers. From WAPDA's creation

in 1958 until December 1981, these customers have increased from 250,000 to almost 3,500,000. Also during the same period, the number of cities, towns and villages receiving service has grown from 600 to more than 11,000, annual revenues for electric service have grown from Rs 74 million to over Rs 5 billion and the number of employees working in the distribution function (67,000 persons) now constitutes almost 78 percent of all personnel in the Power Wing and about 70 percent of WAPDA employees.

The shift in WAPDA's emphasis from infrastructure to power system operations, combined with the growth spurt of the distribution function and the fact that this essentially commercial function has been managed by engineers, has produced severe institutional problems for the distribution function. The GMD does not have at his disposal even the basic requisites for reasonable productivity and quality workmanship. Most planning, accounting, customer records, inventory control and other administrative and data processing functions are done manually. Files are piled on tables and the floor rather than organized systematically for ready access in filing cabinets. There are insufficient numbers of typewriters and reproduction equipment, and such aids as word processors and addressograph machines are not available. Computerization of operations is not possible because of lack of equipment and trained personnel. Even though manpower is plentiful and relatively inexpensive, most of the employees are illiterate and insufficiently cognizant of the business operations to which they contribute to be able to perform effectively. Distribution line and service crews work without radios even though two-way radio communication facilities are considered indispensable for electric utilities. Also the crews have only limited numbers of vehicles, instruments, and tools and are undertrained and often untrained. According to a recent study by Peat, Marwick & Mitchell, the warehouse system, which consists of an unmanageable number of small warehouses, is inefficient. What exists of an inventory control system is totally decentralized and uncoordinated. Much of the stock in warehouses is either obsolete or unuseable, having been brought in for repair and determined to be beyond repair but kept rather than discarded or sold for scrap.

An indication of the poor institutional health of the distribution function is extreme overstaffing. The customer to distribution employee ratio is only 52 to 1 compared to 300-500 to 1 in most electric utilities, including many in developing countries. The problems associated with overstaffing are compounded by the illiteracy, low educational level, and lack of training for the staff. The need for upgrading the staff is as acute as the need to rationalize the organization of the distribution function. Until these

two needs are addressed, the present service deficiencies will not be corrected. Among the deficiencies are frequent blackouts and voltage fluctuations; very high distribution system energy losses (over 21 percent compared to the 7 percent industry norm) due to theft, faulty metering and overloaded circuits, an inordinately long time for attending to customer complaints, and a serious backlog of unattended requests for connection.

The current rate of new general/domestic connections is 22,879/month against a backlog of requests for connection of almost 6 months. For industrial and irrigation tubewell connections, the rates of connection are 526 and 496 per month, respectively, against backlogs of 18 months each. These deficiencies must be corrected before customers are assured a reliable electricity supply which would enable them to resort to kerosene and diesel only in severe emergencies. At present, substantial supplies of these distillates are kept on hand because they are needed in case of blackout.

The recently expanded and accelerated rural electrification program is being undertaken by this poorly equipped, overly and inappropriately staffed, undertrained, and poorly organized distribution function under the GMD. The GMD is assisted by the REO which coordinates ongoing WAPDA programs with foreign loans for rural electrification, and selects, formulates, appraises, and monitors the projects financed with these loans.

In implementing the rural electrification program in the provinces, the GMD is assisted by eight Chief Engineers who serve as Chairmen of the eight Area Electricity Boards (AEBs). Punjab has five AEBs and Sind, NWFP and Baluchistan each have one AEB. The eight AEBs are headquartered in Peshawar, Hyderabad, Quetta, Islamabad, Faisalabad, Gujranwala, Lahore and Multan. The board of an AEB is composed of a Chairman and three full and three part-time members. The Chairman and full-time members are WAPDA appointees. The part-time members are nominated by the provincial governments. One is a member of the provincial government and two are from the private sector. Four members of AEB boards tend to be fairly constant : Director(Design); Director (Accounts); Commercial Manager; and Deputy Director(Administration). The expertise of the two remaining members varies.

AEBs were formed in May 1981 from the then existing Electricity Regions as part of an effort to decentralize the distribution function of WAPDA. Their primary responsibility is to undertake construction of all village electrification and to coordinate directly with the provincial governments regarding final village selection.

The AEB Chairmen have been delegated a great deal of authority to exercise administrative, planning, implementation, financial, and disciplinary powers, subject to budget allocations set by WAPDA. While it is too early to assess the AEB's effectiveness, their establishment is likely to result in significant improvements in the operation and expansion of WAPDA's commercial function.

The grass roots structure for the rural electrification effort is as follows : each AEB (about 400,000 customers) is divided into three or four Circle Offices headed by Superintending Engineers. The Circle Offices are in fact small electric distribution utilities of about 120,000 consumers. Circle Offices are divided into Operations Divisions and, in rural areas, into Construction Divisions which manage rural electrification.

Operations Divisions are divided into four to six Operation Subdivisions responsible for operations, maintenance and revenue collection in their areas. In each Operations Division, there are revenue officers who read meters and prepare and distribute bills in all the Operations Subdivisions. WAPDA employees do not handle cash receipts; electricity bills are collected by branch offices of National Banks and deposited in WAPDA's account.

Construction Divisions also are divided into Subdivisions under the leadership of young engineers with the title of Subdivisional Officers. These Subdivisions are the most remote extension of WAPDA's distribution function into the rural areas.

There is a provision for horizontal expansion of this rural electrification institutional structure. Divisions expand horizontally by adding Subdivisions when a Subdivision exceeds 9,000 consumers if urban or 6,000 if rural. When the number of Subdivisions is more than six in one Operational Division, a new Operational Division is created. Finally, if the number of Operational Divisions exceeds five in one Circle Office, an additional Circle Office is formed.

6. Rural Electrification in WAPDA

Rural electrification in WAPDA is the responsibility of the recently created Rural Electrification Office (REO). The REO is headed by a Chief Engineer who reports directly to the General Manager of Distribution. He is responsible for coordinating WAPDA's current village and tubewell electrification program, for preparing a new National Rural Electrification Master Plan and for the implementation of donor-funded rural electrification activities. Each of the

Area Electricity Boards is responsible in its respective area for the design and construction of rural electrification lines and the connection of new customers.

D. Lessons Learned

1. A.I.D. Impact Evaluations

In 1979-1980, A.I.D. conducted impact evaluations of rural electrification programs it had financed in four countries : Ecuador, the Philippines, Bolivia and Costa Rica. A one-day workshop was held in Washington in August 1981 to discuss the findings of these evaluations, a number of which are relevant to Pakistan. They have significantly influenced the design of this project and will influence its implementation. They include the following :

a. Demand for Rural Electrification

i. Central Governments favor the rapid expansion of rural electrification for political reasons.

ii. Electrification of households is popular and highly valued by its users. It adds comfort, convenience and safety to rural homes. It also appears to be an important psychological symbol of modernity.

iii. Most people in electrified areas can afford to electrify their homes. This includes a substantial percentage of the rural poor.

iv. Electricity does not elicit major spontaneous development activities in poor rural areas. Other interventions such as credit, roads, and irrigation pumps must be planned, funded and coordinated to enhance the potential benefits of this new energy source.

v. Electricity has an important indirect role in agriculture through its use in industries servicing the farmer (e.g. equipment repair) or processing their crops (e.g. rice milling).

vi. The more developed an area, the greater the impact of electricity. Priority for electricity designed to enhance economic development should not be given to the poorest areas but rather to regions which are fairly well-developed and where economic potential is stymied by the lack of cheap, reliable power.

b. Organization

i. The use and success of rural electric cooperatives is dependent on the attitudes of the central government and the political traditions of the country.

ii. Cooperative organizations in rural electrification have done little to enhance participation by the rural poor.

iii. Decisions on organization by planners should center on the need for effective management. Priority should not be placed on participatory goals which are more contingent on the traditions of the country and the political attitudes of the government than on the services being delivered by a rural electrification system. A pragmatic choice should be made on what type of organization can most effectively manage an electrification system in a particular country. Social objectives of participation should be a secondary consideration.

c. Balancing Electricity Supply and Demand

i. Initial estimates of supply and demand are often inaccurate.

ii. Many of the financial problems faced by the rural electric companies and cooperatives are due to a mismatch of electricity supply and demand, especially in the early years of operation immediately following disbursement of A.I.D. funds. Rural electrification projects in general are characterized by high initial costs and underutilized capacity in the system in the years immediately following the completion of construction. Therefore, it is essential to load up the system as quickly as possible. Adding new customers is essential to realizing economic benefits and ensuring adequate revenues for the utility.

d. Financial Viability and Design Standards

i. The rapid expansion of a rural electric system may endanger its financial viability.

ii. Design of an electric system to U.S. technical standards may be inappropriate for its end-uses and too costly to maintain.

2. World Bank Experience

The World Bank has published several findings regarding its efforts in rural electrification. One finding is that there is a surprisingly wide range of household and productive uses of electricity. Moreover, the Bank has also found that load growth rates in rural areas have been between 10 and 20 percent whereas in the urban areas, 10 percent is the general case. The Bank's experience confirms the experiences of others that rural electrification projects are conceived and carried out for a mixture of economic and social aims and that the high initial cost of electrification together with low initial power demand have historically discouraged investments in rural electrification, especially in areas with low population density and low social justification. The initial per inhabitant investment costs in rural areas (between $40 to $80) are typically 2 to 3 times the initial per inhabitant costs in urban areas. However, where well designed area development plans are carried out, i.e., matching credit resources and matching infrastructure investments are available, within a ten year period, rural power systems are generally able to develop to a point where the incremental new service costs are reduced to $20 to $40 per inhabitant served. The Bank notes that during the early years of rural electric systems, subsidies are required if social aims are to be met. A common problem is that rural power systems often continue to rely on such subsidies even after demand and average load have made financial returns adequate to operate without such subsidies.

Rural electrification is becoming more attractive to the rural inhabitants and to national planners due to the continuing price increases of petroleum products. Technically standardization of electrical equipment and development of more economic design standards have helped make rural electrification more attractive in both financial and economic terms. The Bank has found that rural electric systems have a better chance of succeeding in providing adequate service when supported by a strong central organization such as WAPDA which can assist with staffing, administrative, financial and technical matters. The Bank's experience with cooperatives has been mixed.

E. Other Donor Assistance

1. Overview

The World Bank, the Asian Development Bank, West Germany, Japan, France, Canada, Great Britain, the OPEC

countries, China and the U.S. have provided and continue to provide extensive credits to WAPDA for investments in the electric power sector in Pakistan. With few exceptions, however, these credits have been and are being provided for generation, transmission, and grid stations. Prior to 1981, only two A.I.D. initiatives, the $36 million Salinity Control and Reclamation Project (SCARP) and a $12.5 million electric distribution loan authorized in 1964, have directly assisted the distribution component of rural electrification in Pakistan. All other rural electrification efforts prior to 1981 were carried out by WAPDA with its own resources. Recently, however, donors have become more aware of distribution needs, particularly in rural areas. Current donor-financed activities in rural distribution are discussed below.

2. The World Bank Family

The World Bank has provided considerable support to WAPDA through its First ($23 million in 1970), Second ($35 million in 1975), and Third ($45 million in 1979) WAPDA Power Projects in addition to its leading role in the Indus Basin Development Project (including the Mangla and Tarbela Dams and Power Houses). IBRD has, for some time, recognized the need for improvement in the fiscal, operational and management areas of WAPDA. However, despite the repeated assurances it has received from WAPDA, much remains to be done. The Bank, in its second WAPDA Power Project, provided approximately 100 person-months of technical assistance to review WAPDA operations and make recommendations for improving WAPDA's accounting systems and financial controls. Studies of the electric rate structure, accounting procedures including cost accounting and commercial procedures, and procurement and warehousing practices were undertaken among others. The findings and recommendations from these studies have received strong support from the IBRD/IDA, ADB, and A.I.D. The Institutional Development and Training components of this Project will in fact build on the work and recommendations of these studies.

IBRD, in its latest credit operation, a "Structural Adjustment Loan and Credit of May 1982", provided a loan of $60 million and a credit of SDR 71.9 million (equivalent to $80 million) with the understanding that the GOP will continue implementing specific reforms in the areas of resource allocation, agriculture input/output pricing, improved irrigation practices and energy/fuel development policies. As outlined in the World Bank's Structural Adjustment Loan (S.A.L.) documentation, in the energy and fuel areas, GOP expenditures are expected to increase an average of 23 percent for energy

and 14 percent for fuel per annum over the three-year period (PFY 1982/84) covered by the recently adopted GOP "Public Sector Development Program". In the fuel sector, the GOP is moving to reduce subsidies, provide incentives for exploration and development of indigenous fuel resources, and move toward oil and natural gas prices which would increasingly reflect international costs of oil in energy equivalents. For natural gas, the World Bank has an understanding that the GOP will make price adjustments, at least annually, which will price gas on a heating value basis to at least two-thirds of the price of bunker oil exports from Pakistan(FOB Karachi) by 1988.

In addition to the recent IBRD S.A.L., the Bank is administering a UNDP-funded study of areas throughout Pakistan with the potential for increased agricultural production if tubewell irrigation were provided. Based on the outcome of this study, the Bank and A.I.D. will explore possible areas for collaboration in providing electrification for tubewells and adjacent industries in such areas.

Irrigation studies recently carried out with support from UNDP and IBRD indicate that the management of publicly operated tubewells is inefficient. The IBRD recommended in its Revised Action Program that tubewells in sweet water areas be transferred to private owners and that the provincial governments no longer subsidize irrigation water. The GOP has approved this policy. This A.I.D. project will support activities which will impact on private tubewell installations. Privatization of tubewells in sweet water areas will also be supported under the Mission's Irrigation Systems Management Project.

In December 1979, the IBRD approved the Third WAPDA Power Project. This project is a continuation of the general expansion of the power system transmission lines (2700 miles of 220/132/66 KV single and double circuit lines, construction, expansion and/or conversion of 216 grid substations (220/132 KV and 132/66/11 KV substations) with an aggregate capacity of 4,800 MVA, a load dispatch system and other support facilities. The cost of the system expansion which is expected to be completed in 1984, is estmated between $400 and $500 million for which the Bank is providing a $45 million credit. As a result of this project, the country will be well blanketed with grid substations, high voltage lines and 11 KV feeders. The extent of this coverage is illustrated by the fact that the only areas which will be outside a 30 mile radius of the proposed substations have limited populations and are considered remote. With such a complete grid in place, it will be relatively easy to reach most villages with 11 KV feeders.

3. The Asian Development Bank (ADB)

The ADB has approved a $35 million loan to electrify 900 villages over the next two years (1982-1984). The project will be implemented directly by WAPDA without consulting engineers, construction contractors or technical assistance personnel. WAPDA will select 4,000 villages in rural areas throughout Pakistan which will be targeted for electrification in 1982-1984 and the ADB will select 900 of these for financing. ADB selection criteria include the distance from 11 KV feeders and the rate of consumer saturation. All villages selected by the ADB will fall within 1.5 miles of 11 KV feeders except in the province of Baluchistan where the distance will be 6.0 miles. ADB-financed villages in all provinces must have a minimum saturation rate at the end of the project of 15 percent for residential and commercial consumers, 50 percent for irrigation tubewells and 100 percent of community services including street lights, small industries and water supply tubewells.

WAPDA has indicated that the ADB will include in its 1983 lending program $60.5 million to support Phase I of the Guddu Combined Cycle Gas Turbine Power Generating Facility. A.I.D. will provide the balance of funds required for Phase I under the project. (See the Power Generation component in Section III) ADB has also provided numerous loans to WAPDA in support of the Tarbela and Mangla hydro projects and to KESC, the most recent of which was for the Pipri Power Station which is under construction near Karachi.

4. Government of Kuwait (GOK)

The GOK has agreed to provide a 4.0 million Kuwaiti Dinars (US $15 million) loan to WAPDA between 1982-1984 to electrify 300 villages in Baluchistan. The villages to be electrified have already been identified by WAPDA and approved by the GOK. There appear to be no specific criteria for village selection nor is there a target saturation rate. In addition, the GOP is currently negotiating with the GOK to provide partial funding for Phase II of the Guddu Combined Cycle Gas Turbine Project which is discussed later in this paper under the Power Generation component.

5. Canadian International Development Agency (CIDA)

In 1982, CIDA agreed to provide a $10 million grant over a three-year period (1983-1985) for an aluminium ingot commodity import program. The proceeds from the sales of the ingots will be used to cover the costs of building transmission and distribution lines to supply electricity to villages in Baluchistan. In addition, CIDA is providing funds to support the Tarbela Hydro Project.

6. British Overseas Development Agency(ODA)

ODA has agreed to provide a £ 5 million grant to finance rural electrification in Baluchistan.

7. Islamic Development Bank

WAPDA is currently seeking assistance from the Islamic Development Bank to helf finance, along with the Kuwait Fund, Phase II of the Guddu Combined Cycle Gas Turbine Project.

8. West German Government

During 1981/82, an evaluation of WAPDA's training facilities was made by German training consultants under the auspices of Gesellschaft fur Technische Zusammenarbeit(GTZ) the West German Agency for Technical Cooperation. Based on discussions between the German consultants, WAPDA, and the Mission, it was agreed that GTZ would improve facilities at the Faisalabad Training Institute, provide training equipment, train WAPDA personnel in the manufacturing plants in the use of German manufactured transmission, distribution and system control equipment, and provide a German technical assistance team to support overall training and upgrading of WAPDA staff in the generation and transmission sectors. The training component of this A.I.D. project is designed to complement the West German program by focusing on training for the distribution and rural electrification sectors. Both training programs will be closely coordinated during project implementation.

9. Conclusion

There has been a continuing positive dialogue among the concerned GOP offices, the technical staff of WAPDA, and all the donor agencies. There appears to be no problem of duplication and the prospect is that donor efforts will be coordinated, supportive and complementary.

F. Relationship to A.I.D. Strategy and Other A.I.D. Projects

The Agency's 1981 Energy Assistance Policy Paper identified the following three basic objectives for U.S.-financed energy programs in the Third World:

1. to assure adequate energy supplies at reasonable prices to support continued world economic growth;

2. to encourage developing countries to expand their own energy resources, both non-renewable and renewable,

without increasing the risk of nuclear proliferation; and,

3. to assist developing countries in overcoming energy related constraints to their development.

This project is compatible with all three of these objectives and those of the new bilateral economic assistance package that was negotiated in August 1981. It is one of three energy projects in the Mission's portfolio. The other two are the FY 1983 Energy Planning and Development Project and the FY 1984 Forestry Planning and Development Project. The National Rural Electrification Master Plan that will be developed under this project will draw on the recommendations of the design teams for both of these latter projects. Once the Rural Electrification Master Plan is completed, it is likely to become an invaluable reference and source of information for both of them. In addition, the selection of areas to benefit from the Rural Distribution System Expansion component of this project will be coordinated with small decentralized hydro-electric and other renewable energy activities that will be carried out under the Energy Planning and Development Project.

This Project will also have close linkages to and be supportive of several non-energy sector projects in the Mission's portfolio including:

1. The Baluchistan and Tribal Areas Development Projects, under which electric motor driven irrigation tubewells are likely to be installed and a variety of other electricity - requiring development activities implemented.

2. The Irrigation System Management Project, under which efforts will be made to rationalize the ownership and operation of irrigation tubewells.

3. The Population Welfare Planning and Primary Health Care Projects, for which electric service will be needed for rural family welfare and health centers that will be established.

4. The Agricultural Education, Research and Extension Project, where electricity will be needed for a number of facilities.

5. The Private Sector Mobilization Project which is expected to support the development of several rural industrial parks, all of which will require reliable electric service.

All the assistance provided under this project will be to the Water & Power Development Authority (WAPDA). WAPDA is

responsible for providing electric service all over Pakistan except Karachi. This project will assist WAPDA in five critical areas. To the extent that the project's goals and objectives are achieved, Pakistan's economy and almost all A.I.D.-supported development activities will benefit.

G. Project Rationale

The GOP requested support to its rural electrification program in the August 1981 GOP/USG assistance negotiations. The USG welcomed this request. It will provide an opportunity to make a major contribution to rural development which is one of the major objectives of U.S. assistance in Pakistan. It will provide an opportunity to assist the GOP in dealing with the demand-supply generation gap which constitutes a major constraint to overall economic growth and development. It will enable the U.S. to provide assistance in strengthening the institutional, technological, human resource and planning aspects of WAPDA, Pakistan's rural electrification organization. It will reinforce and contribute to the effectiveness of much of the rest of the planned $1.625 billion, six-year assistance program negotiated by the USG and GOP. Finally, it will create an opportunity for USAID/Pakistan to develop a more holistic approach to the energy sector and to support a subsector which, together with other energy assistance interventions, will yield even greater development results.

Since the August 1981 negotiations, the GOP has increased the priority it assigns to rural electrification. Targets have been increased. This project has become even more relevant, therefore, to Pakistan's development strategy. Inasmuch as the impact of this project will be, inter alia, to improve the efficiency of resources allocated to rural electrification, it represents an especially timely and strategic component of the total U.S. assistance package.

III. DETAILED PROJECT DESCRIPTION

A. Introduction

The GOP and WAPDA have taken significant steps to carry out rural electrification in accordance with the goals set forth in the GOP Fifth Five-Year Plan. WAPDA has been highly successful in marshalling assistance for an extensive village electrification program because of its demonstrated capacity to execute such work. In responding to a GOP/WAPDA request for financial assistance, the Mission, with the assistance of a project design team and numerous consultants with expertise in distribution system planning and operation, rural village electrification, power generation, power system management and technical assistance/technology transfer operations, reviewed on-going work, operational procedures, the cost-effectiveness of WAPDA distribution activities, the results of village electrification, and the policy and managerial support provided to distribution activities.

During the Mission's review of the WAPDA Power Wing operations, WAPDA officials cited the following problems: lack of trained staff; inability to retain qualified staff due to lack of career advancement incentives; need for improved staff selection procedures; growing backlog of power service applications; system load outstripping power generation capability; and, loss of energy due to overloaded distribution systems, lack of proper metering and pilferage. Both WAPDA and the Mission agreed that these problems were of sufficient priority to warrant immediate attention prior to launching a program of additional village power connections. Accordingly, initiation of rural system expansion activities under this project will be deferred until April 1985 or until the Guddu Gas Turbine units, which will be partially financed under this project, are operational. In the interim, the focus of the project will be on the development of a National Rural Electrification Master Plan, institutional improvement, training, an energy loss reduction program, and implementation of the Guddu Combined Cycle Gas Turbine Power Generation Project. The GOP and WAPDA have urgently requested the early arrival of a Technical Assistance Team (TAT) to assist with the development of the Plan and the design of programs in the above-mentioned areas.

B. Project Goal and Purpose

The overall sector goal to which this project contributes is to improve the quality of life of the rural poor. Progress toward goal achievement will be assessed

by measuring the extent to which increases in the following indicators have occurred in the rural areas as a result of the expansion of reliable electric service: (1) agricultural production and productivity especially in tubewell-irrigated areas; (2) the quality of services provided by health, educational, and other public service facilities; (3) employment opportunities; (4) output of commercial enterprises; (5) use of electrical appliances and participation in social and cultural activities; and, (6) the quality of electric services as evidenced by the frequency of load-shedding and black-outs and the degree of voltage regulation. The major assumption for goal achievement is that the GOP will continue to accord high priority to the energy and power sectors, in particular the distribution function within the power sector, as evidenced by adequate budgetary support.

The purpose of this project is to assist the GOP to expand reliable electric service to Pakistan's rural population for productive and social uses, to improve the rural poor's access to that service, and to assist the GOP to overcome a shortfall in electric generating capacity. End of project status indicators include the following: (1) Phase I of the Guddu Combined Cycle Power Generation Facility is operational; (2) a comprehensive National Rural Electrification Master Plan has been developed and is being implemented on schedule; (3) activities under the Rural System Expansion and the System Energy Loss Reduction Programs financed by this project have been completed and procedures have been institutionalized by WAPDA to continue these programs; (4) a Comprehensive Distribution Function Training Program has been developed and partially implemented and new training procedures have been institutionalized; (5) new procedures and systems for procurement, inventory control, statistics, customer service, warehousing, transportation, and communications have been institutionalized; (6) new warehouses, customer service centers, and a distribution function training facility have been constructed; (7) reduction in the time between date of application and date of actual connection for new customers; (8) reduction in the frequency of load-shedding and black-outs; and, (9) reduction of kerosene and diesel consumption in electrified areas. Major assumptions for achieving the purpose of this project are that: (1) financing for Guddu IV and both Phases I and II of the Guddu Combined Cycle Gas Turbine facility has been secured by the GOP; (2) WAPDA personnel at all organization levels are receptive and responsive to the policy and operational reforms required to improve the distribution function; (3) connections to be made and lines to be rehabilitated are selected on the basis of sound economic and technical criteria; and,

(4) WAPDA receives adequate policy and budgetary support from the GOP to implement the National Rural Electrification Master Plan.

C. Project Outputs

The project is expected to produce the following outputs which together should achieve the project purpose:

1. Approximately 185,000 residential, 17,000 commercial, 7,700 tubewells, 4,500 community, and 1,500 industrial or a total of 215,700 new customers connected.

2. 400 MW of new power generating capacity installed at the Guddu Combined Cycle Gas Turbine facility.

3. Approximately 14 persons have completed long-term training in the U.S., 314 have completed short-term training in the U.S., 160 have participated in U.S. Sister Utility Exchange Program internships, and 28,310 have completed short-term in-country training courses or a total of 28,798 personnel have been trained.

4. A training institute for distribution function personnel has been constructed and is operational.

5. 2 to 5 new model warehouses have been constructed and are operational.

6. 2 to 5 new model customer service centers have been constructed and are operational.

7. Energy losses have been reduced by 3 percent or the equivalent of a 122 MW unit operating continuously at a load factor of 60 percent.

8. A National Rural Electrification Master Plan has been developed and partially implemented.

9. A Comprehensive Distribution Function Training Program has been developed and partially implemented.

10. Work Order Management Systems have been established for System Energy Loss Reduction and Rural Electrification System Expansion Programs.

11. A new procurement and inventory management system has been developed and institutionalized.

12. Revised personnel administration policies and practices have been developed and institutionalized.

13. A new computerized management system has been installed and is operational.

14. New communication and transportation systems have been developed and institutionalized.

15. A new customer services accounting, education, and management system has been developed and institutionalized.

16. An analysis of recurrent costs and a review of property valuation and depreciation practices have been completed and WAPDA's cost-price policies have been rationalized.

Additional information on the relationship between the goal, purpose, inputs and outputs of this project is provided in the Log Frame in Annex H.

D. Project Components

1. Institutional Improvement

The objectives of this component are to assist WAPDA to : (a) prepare a comprehensive National Rural Electrification Master Plan; and, (b) strengthen its human and physical resources and management operations to implement the Plan and to operate the resultant rural distribution system in an efficient and financially sound manner. To achieve these objectives, funds will be provided for long and short-term technical assistance, training of WAPDA employees, commodities, and the design and construction of model warehouses and rural customer service centers.

a. Technical Assistance

Approximately 32 person-years of long-term and short-term expatriate and 66 person-years of long-term Pakistani technical assistance will be provided under this component. A proposed technical assistance plan is included in Section IV., Implementation Plan. One U.S. civil engineer for 2 years and local architectural and engineering (A&E) consultants will be financed to assist in the construction activities planned under this component. The remaining long-term advisors, consisting of 6 expatriates and 12 Pakistanis, will serve as the core Technical Assistance Team (TAT) for the entire project. In this capacity, they will work with senior and middle level managers of WAPDA to coordinate the implementation of all components of the project (except the Power Generation component), will study and recommend solutions to the full range of problems of the distribution function, and will recommend, schedule, and supervise all short-term assistance programmed under this component.

The TAT and short-term advisors will work with WAPDA personnel in the following areas :

i. Comprehensive distribution planning (financial, administrative, and technical), including the preparation of a comprehensive National Rural Electrification Master Plan;

ii. The development and implementation of a Sister-Utility Exchange Program;

iii. The design of a Comprehensive Distribution Function Training Program, the implementation of which will begin under this project;

iv. The design of a Comprehensive Energy Loss Reduction Program that will be implemented under this project;

v. The hierarchy, functions, responsibilities, authority, organization and staffing of the Office of the General Manager of Distribution and other administrative units in WAPDA that share responsibility for electric power distribution and rural electrification;

vi. The functions, responsibilities, authority, organization, staffing, and facilities of Area Electricity Boards (AEB's);

vii. The functions, responsibilities, authority, organization and staffing of the Rural Electrification Office (REO);

viii. Distribution function staffing and personnel administration policies and practices;

ix. Customer service facilities and procedures;

x. Customer accounts management;

xi. Cost of service, rates,recurrent costs, and property valuation and depreciation practices (See Annex T);

xii. The collection, analysis, dissemination, and utilization of statistics;

xiii. Procurement and inventory management and facilities;

xiv. Customer education and community relations;

xv. Single-phase distribution;

xvi. Aluminum conductor connection practices;

xvii. Poles (concrete and steel lattice) including the creation of an extra light-weight, concrete pole for village electrification;

xviii. Protection, coordination and sectionalizing practices;

xix. Distribution load management, including direct load control;

xx. Watt-hour meter specifications, testing, control and replacement;

xxi. Voltage regulation;

xxii. Service continuity and reliability;

xxiii. Transportation needs assessment and management;

xxiv. Communication needs assessment and management;

xxv. Computer needs assessment and management (See Annex K); and,

xxvi. Comprehensive management systems to identify, select, design, construct, inspect and reimburse the cost of work orders to be financed under the Energy Loss Reduction and Rural Distribution System Expansion components of this project.

b. Commodities

Almost all planning, budgeting, accounting, customer accounts management, inventory control and other administrative and data processing functions in WAPDA that relate to the distribution of electricity are performed manually. Even basic office furnishings such as file cabinets are either not used or are used only sparingly. Inasmuch as the implementation of many of the TAT's recommendations will require the procurement of a number of items such as addressograph machines, typewriters, word processors, file cabinets, computers, and electrical testing instruments and devices, $3 million in grant funds has been earmarked for this purpose. In addition, $97,000 has been budgeted for vehicles for the TAT. More details are provided in the Proposed Commodity Procurement Plan in Section IV.

c. Sister-Utility Exchange Program

This program, which will be developed and managed by the TAT, will support efforts to strengthen and modernize the distribution function in WAPDA. Under the program, one-on-one sister utility relationships will be established between the Office of the General Manager of Distribution (GMD) and each of its eight AEBs, and privately or publicly owned electric utilities in the United States. The objectives of the program are to reinforce the identity and sense of uniqueness of the GMD and each AEB, to promote self-improvement, and to provide access to how others perform similar tasks. These objectives will be achieved by the sharing of information and the exchange of correspondence, documents and professional and non-professional staff. Staff exchanges may vary from one month to one year, depending on the objective of each particular exchange.

It is expected that each member of a sister utility company relationship will continue to pay the salaries of

its employees involved in an exchange of staff and will provide office space and basic logistical support to guest staff. At least half of the short-term expatriate assistance programmed for this component will be provided under this program. This exchange program will also be an integral part of the training program that will be developed under the Distribution Function Training component of this project.

d. Training of WAPDA Implementation Staff:

The achievement of the objectives of this project will depend more on the attitude, interest and commitment of WAPDA officers who are assigned to implement its various components than on any other factor. For that reason, it is imperative that such officers understand the objectives of the project and the interrelationship of its components and that they have early exposure to the electric utility policies, procedures and technologies that the TAT will be drawing on as they study WAPDA's problems and recommend solutions. Only with such exposure and personal understanding of the appropriateness and feasibility of what is recommended can WAPDA's officers be expected to accept recommendations and successfully implement them.

Accordingly, training will be provided early on in the project to officers and employees who are assigned key implementation responsibilities for this component and the training component. Similar training will also be provided for the 12 Pakistani professionals contracted as members of the TAT.

e. Design and Pilot Construction of Facilities

WAPDA's accelerated rural electrification program is expected to cost an average of about $100 million each year during the next five years. Approximately 80 percent of that amount will be spent annually for materials and equipment that will have to be stored in and processed through distribution sector stores (warehouses). A large amount of materials and equipment will also have to be handled by these stores each year for urban expansion, rehabilitation, and routine operation and maintenance. As of June 30, 1981, the value of all stock in distribution function stores was Rs 736 million (about $70.6 million). With the acceleration of the rural electrification program, stocks will expand and the already serious stock management, handling and storage problems will intensify.

A general study of Power Wing Procurement and Inventory Management, being conducted by the firm of Peat, Marwick and Mitchell (PMM) under a World Bank-funded contract has

concluded that inventory management in the Area Electricity Boards is very weak, and that existing problems will increase unless radical steps are taken to reorganize the stores' function, staff it with trained and motivated people, and provide it with adequate and appropriate storage facilities and equipment. The TAT will review the problems identified and the solutions recommended by PMM and will assist WAPDA to implement those recommendations that are approved by WAPDA and A.I.D.

PMM's general recommendations included the construction of a still undetermined number of well-designed and strategically located large stores to replace a much larger and growing number of small stores. WAPDA's eight AEBs are operating a total of 269 stores, most of them in former residences and other buildings that were intended to be provisional facilities. Another 21 such stores are planned and will be established soon if the existing criteria for establishing stores are not changed. It is likely that the new stores plan, when developed, will call for a decrease in the number of store types from the current five to three. While it is too early to know precisely how many new stores are required and their types and locations, it is clear that the number will be large.

Given this clear and substantial but quantitatively uncertain need, one expatriate civil engineer and Pakistani A&E consultants will be provided to develop standardized designs for each type of store recommended by the TAT. WAPDA will provide sufficient funds to construct at least one demonstration model of each type.

In addition to the storage facilities problem, Mission consultants have recommended and WAPDA concurs that customer service facilities need to be improved. Consequently, customer service facilities have been included in the list of areas and activities for which the TAT will be responsible. Here again, the need is clear but impossible to quantify at this time. As in the case of the stores facilities, funds have been provided to permit the TAT to develop standardized designs of customer service facilities for rural areas. Again, WAPDA will provide sufficient funds to construct at least one demonstration model of each type of center required.

2. Distribution Function Training

The importance and distinctive requirements of the distribution function in WAPDA have only recently begun to be fully recognized and have yet to be accommodated. With almost 3,500,000 customers to be attended on a near constant basis and more than Rs 500 million to be collected each month from these and additional customers who are being connected each day,

the distribution function in WAPDA is already one of the largest business enterprises in Pakistan. At the same time, because of the large quantity of electric lines, transformers, switches, meters and other devices that it must install, operate and maintain, it is also one of the country's largest and fastest growing technical organizations in Pakistan.

This reality, plus many other considerations (a large, heterogenous and diversely educated work force, the need to introduce new technologies, the requirement for many prevailing work habits and attitudes to be changed) combine to make the immediate and long range training needs of distribution unique among the public and private sector entities of Pakistan. The objective of this component is to design and initiate the implementation of a comprehensive training program to satisfy those needs.

With over 67,000 distribution employees (many of them young, illiterate, and without the minimum aptitudes and preparation required for the positions they occupy), the distribution function training requirements are of such a magnitude and diversity and are growing so fast that all of them simply cannot be attended to even within the six year life of this project. Hence, one of the first activities to be undertaken by WAPDA and the TAT under this component will be to establish training goals and objectives which are consistent with the basic institutional goals and objectives of WAPDA and the policies of the GOP. Once those goals and objectives are approved by WAPDA management and A.I.D., a Comprehensive Training Program will be developed and its initial stages implemented.

a. <u>The Comprehensive Training Program</u>

WAPDA and the Mission have agreed that a Comprehensive Training Program should be developed for all distribution function officers and employees and that the program should include and/or provide for the following:

i. Short, medium and long range training plans;

ii. Literacy training;

iii. Aptitude testing;

iv. A strong pay-back agreement to recoup training costs from employees who depart WAPDA/GOP prematurely following training;

v. Training for all distribution function levels and positions;

vi. Selected on-the-job training in U.S. utilities through the Sister Utilities Exchange Program (See component 1);

vii. The establishment of a distribution training unit in WAPDA to plan, design, provide or provide for and manage all distribution function training needs;

viii. Establishment of a Distribution Training Institute with satellite training centers in each Area Electricity Board;

ix. A special incentive/career development program to recruit and retain key training staff;

x. A direct link between training, promotion, and general career development;

xi. A scholarship program for post graduate business, administrative, engineering, and economics training in local and foreign universities;

xii. Selected use of existing local public and private training entities and companies; and,

xiii. The special training needs that will be identified or result from other components of this project.

An Illustrative Training Program which is summarized in the Proposed Training Plan in Section IV and also in Annex S has been developed to guide the design of the Comprehensive Program.

Both dollars and U.S.-owned rupees will be made available to help cover the cost of the design and initial implementation of the program. These funds will be used to : contract expatriate and Pakistani technical assistance to work with the TAT and WAPDA personnel; procure selected training aids, publications and equipment; print training documents; cover out-of-country training costs; and, design and construct a central distribution training center.

This training component is essential to the success of other project components, especially the Institutional Improvement component. It also is supported by other project activities. For example, training without other organizational changes will be less effective. Similarly, organizational changes unaccompanied by training to enable employees to carry out such changes are likely to fail. The reinforcement of the project components is critical to the long-term sustainability of this project's impact.

b. Technical Assistance

Under this component, approximately 26 person-years of long and short-term expatriate and 30 person-years of long-term Pakistani national technical assistance will be provided to work with the TAT and WAPDA personnel. This training-specific assistance will include an expatriate advisor to the Director of the Distribution Training Office, two curriculum development specialists, a technical training specialist, 2 lineman training specialists, and specialized short-term lecturers. It is expected that about two-thirds of the specialized lecturers will be volunteers obtained through the Sister Utilities Exchange Program.

c. Distribution Training Institute

The design and initial implementation of the Comprehensive Distribution Training Program will include the design and construction of a Central Power Distribution Training Institute. WAPDA and the Mission have tentatively agreed that the Institute should be located in Islamabad because of its accessibility. The establishment of a separate facility for distribution oriented training is essential. Distribution training needs are myriad and complex and have long been neglected. Acquiring space at existing institutes which focus on training in generation and transmission risks the continued subservience of distribution related subjects to the more established generation and transmission courses. The number of distribution officers and employees needing training is too great to be accommodated at the existing training centers and non-residential facilities, such as those for commercial and financial functions.

An illustrative campus drawing (see Annex S) has been developed for planning and budgeting purposes. The new training center will include classrooms, an audio-visual room, computer room, library, and offices, a cafeteria, a hostel, and various types of categories of staff housing. An estimate of the cost of the facility is also included in Annex S.

d. Training of WAPDA Implementation Staff

WAPDA officers assigned responsibilities for the development and implementation of the Comprehensive Training Program will be provided training as discussed under component 1.

3. Distribution System Energy Loss Reduction

A critical problem in the energy and power sectors of Pakistan is excessive loss of energy (KWh) between the

power generators and the end users. WAPDA estimates that annual losses in its system in PFY 1980/81 were 31.3 percent of all electric energy generated by its plants or a total of 4.1 billion KWh. A breakdown of the losses by source is provided in Table 1. This amount of energy is enough to light 23.6 million 60-watt light bulbs for 8 hours a day, 365 days of the year. Based on an estimated average thermal generation cost of $0.05/KWh, these losses cost WAPDA and the national economy about $205 million in PFY 1980/81.

Table 1 also indicates that 2.6 percent of total energy generated is lost in the generated plants, 10.6 percent in transmission lines and substations and 18.1 percent in the distribution network. The losses attributable to generation are considered within industry limits and are acceptable. Transmission losses are high but are currently being reduced to acceptable levels by the construction of additional transmission lines and grid substations under the World Bank-financed Third WAPDA Project. Distribution system losses, however, are almost triple the industry average. Efforts to date to reduce them have concentrated mainly on reducing theft.

Electric energy losses are calculated by subtracting the total number of KWh metered (sold) during a given period from the total number received (or generated) during the same period. In the case of the distribution system, the losses are attributable to the heating of conductors, transformers, and the like, that transfer the electric energy from the grid substations to the meter of the customer, and to faulty connections, defective and improperly calibrated energy meters, pilferage, administrative error, administrative oversight, and theft.

The losses due to the heating of the lines, transformers, and the like are referred to as technical losses. They can never be entirely eliminated because electricity always generates some heat when it flows. The amount of heat generated increases exponentially as the current in a given conductor increases. Because they cannot be eliminated, the practice in the industry is to try to keep technical losses at a point where their cost is less than the capital cost of additional lines, larger size lines, and other measures that can be taken to reduce them. The other losses of energy (defective meters, pilferage, administrative error) are referred to as administrative losses, and administrative methods are required to control them. In theory, these losses can be reduced to zero, and, in many countries including developing countries, they are essentially equal to zero. WAPDA estimates that about two-thirds of its distribution system losses are due to technical reasons (faulty connections, overloaded lines, overloaded transformers) and one-third administrative.

TABLE 1

WAPDA'S ENERGY LOSSES DURING PFY 1980/81

	Item	Amount
1.	Gross generation	13,206 million KWh
2.	Losses by generation auxiliaries	344 million KWh
3.	Losses by generation auxiliaries as percentage of gross generation (line 1)	2.6 percent
4.	Net generation	12,862 million KWh
5.	Units supplied for distribution	11,455 million KWh
6.	Transmission and transformation losses	1,406 million KWh
7.	Transmission and transformation losses as a percentage of gross generation (line 1)	10.6 percent
8.	Transmission and transformation losses as a percentage of net generation (line 4)	10.9 percent
9.	Units sold	9,068 million KWh
10.	Distribution system losses	2,388 million KWh
11.	Distribution system losses as a percentage of gross generation (line 1)	18.1 percent
12.	Distribution system losses as a percentage of units supplied for distribution (line 5)	20.8 percent
13.	Total losses as a percentage of gross generation (line 1)	31.3 percent

SOURCE: Statistical Data, WAPDA General Manager of Distribution (GMD)

a. Energy Loss Reduction Program

The objective of this component is to develop and initiate the implementation of a comprehensive distribution system technical energy loss reduction program. The program will be a joint effort of WAPDA and the TAT. The program will include a management information system to collect and maintain reliable information about distribution circuit and circuit component capacities and loads, economic and financial costs of energy generated by WAPDA's different generating plants, peak demand load management, and economic criteria for selecting conductor and transformer sizes and for deciding when installed conductors and transformers should be changed.

Energy and demand losses will be reduced by expanding the use of compression connectors, reducing loads on existing primary and secondary lines, replacing economically undersized conductors with larger sizes, installing capacitors (electric energy storage devices), installing voltage regulators, replacing underloaded and overloaded transformers, and by applying modern load control techniques.

The administrative vehicle which will be used to implement the program will be an Energy Loss Reduction Work Order System. WAPDA already has and uses such a system, but it will have to be improved and expanded to include more rigorous financial and economic analyses. Table 2 provides an example of a model work order for one type of activity that will be carried out under this program and the manner in which the costs and benefits can be calculated. Annex M provides additional Model Work Orders for other types of activities. In practice, it is likely that a given Energy Reduction Work Order will include more limited work for each of several different activities. As is the practice in well managed electric utilities and as is already being done to some extent in WAPDA, a detailed list of materials, cost estimates and engineering drawings will be required for each activity included in a given Work Order. Each Work Order will be subjected to benefit/cost and economic analysis as discussed in the Economic Analysis Section of this paper. For management planning purposes and in line with typical electric utility practices, it is anticipated that the dollar value of Work Orders will range from $50,000 to $500,000 with an average cost of $250,000.

b. Technical Assistance

Approximately 5 person-years of long-term expatriate and 20 person-years of long-term Pakistani national technical assistance will be provided to assist WAPDA develop and implement the program, including the review and

TABLE 2

MODEL WORK ORDER FOR ENERGY LOSS REDUCTION PROGRAM

CHANGE OF TEN MILES OF PRIMARY(11,000 VOLTS)THREE PHASE LINE CONDUCTOR FROM #5 SWG COPPER TO RABBIT (EQUIVALENT TO 1/0 ACSR)

1. Estimated Cost of Materials

Quantity	Description	Unit Cost $	Total Cost $
40 each	Wooden Cross Arm (Replacement of broken pieces)	16.74	670
40 each	Cross Arm braces	1.30	52
60 each	11 KV Pin type insulator and pin	5.45	327
60 each	11 KV Disc type insulator and dead-end clamp	13.45	807
1 set	Miscellaneous (clamps,bolts, nuts,binding wires,jumper etc)	90.00	90
31 miles	New Conductor	928.00	28,768
		Total	30,714
Less Salvage value of 31 miles of replaced Conductor (#5 SWG Copper)		252.00	- 7,812

2.	Net cost of materials	22,902
3.	Warehouse charge (1% of line 2)	229
4.	Labor (10% of line 2)	2,290
5.	Tools & instruments (1% of line 2)	229
6.	Transportation (6% of line 2)	1,374
7.	Engineering & Supervision (10% of line 2)	2,290
8.	Sub-total (line 2 to 7)	29,314
9.	Contingency (10% of line 8)	2,931
10.	Estimated Total Cost FY - 82	32,245
11.	Estimated Total Cost of FY-83 a/ Work Orders	35,470
12.	" " " " FY-84 a/ " "	39,016
13.	" " " " FY-85 a/ " "	42,918
14.	" " " " FY-86 a/ " "	47,210
15.	" " " " FY-87 a/ " "	51,931

a/ Assumes inflation of 10 percent per annum

approval of Work Orders and the subsequent inspection and certification of completed works. Specialized short-term assistance and general back-up suport by the TAT will also be provided.

c. Commodities

About $26 million or 74 percent of the $35.1 million allocated to this component will be used to purchase tools, instruments, connectors, capacitors and other commodites required for energy loss reduction activities.

d. Training of WAPDA Implementation Staff

Training will be provided early on in the project to WAPDA officers and Pakistani TAT members assigned to implement this component. The training will focus on the study of recently developed analytical models and techniques that are being used in energy loss reduction programs in electric utilities in the United States and other countries. Some exposure to electric utility operations in the United States will also be provided.

e. Implementation

Implementation of the approved Energy Loss Reduction Program will be the responsibility of WAPDA's eight Area Electricity Boards (AEBs). Once a Work Order has been prepared and approved by the respective AEB, the WAPDA Component Manager, and the technical advisor, in accordance with an approved management system, it will be submitted to A.I.D. with a request that it be considered for financing under this component. A.I.D.'s technical and administrative approval of Work Orders for funding will be transmitted in the form of a Project Implementation Letter that will indicate the fixed amount that A.I.D. will reimburse the GOP if the Work Order is implemented as approved. The amount to be reimbursed will be expressed as a percentage of the total estimated cost of the Work Order or a percentage of the total cost of each sub-item of the Work Order. Because the replacement of most conductors, installation of capacitors, and the like require carefully planned interruptions of electric service, it is anticipated that most Work Orders will be executed by WAPDA's own work force.

WAPDA's Component Manager, the technical advisor and Mission contracted Pakistani Project Engineers will monitor the execution of approved Work Orders on a spot check basis. Once all work required by a Work Order has been completed, the technical advisor or a Mission Project Engineer will inspect it in accordance with the pre-approved management system. If all work has been performed satisfactorily, A.I.D. will

reimburse WAPDA the predetermined amount of the estimated cost of the preparation and execution of the Work Order.

f. Funding

A total of the equivalent of $35.1 million (U.S. and GOP funding included)has been budgeted for this component. While it is impossible with available information to make a reliable estimate of the total amount of losses and peak demand that will be reduced as a result of this project, illustrative calculations provided in Annex M indicate that the order of magnitude of the reductions will be substantial. The illustrative calculations are strongly supported by the report of a July 1982 World Bank Research Project entitled "Energy Efficiency : Optimization of Electric Power Distribution System Losses".

4. Power Generation

Without assisting WAPDA to deal with its demand-supply power gap, there would be little point in supporting the GOP's program of rural electrification expansion. Thus, the USG agreed to contribute to the financing of generating capacity (gas turbines) during the August 1981 USG/GOP negotiations, as part of the USG commitment to provide assistance to the GOP's rural electrification program. In designing this component, several factors were considered including: the impact of expanded rural electrification on the demand for power; the estimated demand-supply power gap and its timing (this figure has been revised upward from the estimate available last August); and, the extent and nature of financing from other donors (e.g., Japan and the ADB). These and other factors were analyzed in the context of two important design determinants : (a) as a matter of policy, the project was to be designed so that its results would, at the least, not exacerbate the demand-supply gap; and, (2) project inputs would be scheduled so that the supply side would be in a position to handle the demand increase created by the expansion of rural electricity connections.

The decision to at least balance the increase in demand which the expanded rural electrification program under this project would generate, with support to the power generation component, was strongly recommended by the project design team and wholly endorsed by the GOP and the Mission. This decision stemmed from the fact that an increase in rural electricity connections would bring no benefits if electricity would be disconnected for several hours every day, as is the current practice.

The generation capacity shortfall has resulted principally from errors in projections of load growth and energy loss reduction, disputes over the availability and price of natural gas to fuel electric power facilities, and delays in the awarding of power plant contracts. The shortfall, which was expected to be over for this season in May 1982, continues. It reached a seasonal peak of 750 MW in early 1982. It is projected by WAPDA to occur every year from the present through 1990 and to peak at 912 MW in PFY 1984/85. In PFY 1983/84, the shortfall is expected to exist all 12 months of the year. Additional details about the shortfall are provided in Table 3.

The indicated shortfalls are based on the best case scenario, that is, the timely completion of all the power generation facilities listed in WAPDA's current Power Generation Construction Program which is shown in Table 4. It is reasonable to assume that some of the program's generation facilities will not be completed on schedule and that actual generation capability shortfalls are likely to be greater than projected. Two projects in the Power Generation Construction Program that require immediate and urgent attention are the Guddu IV Steam Project (Item 12 in Table 4) and the two-phase Guddu Combined Cycle Gas Turbine Project (Items 6 and 13 in Table 4). Funding is already available for all other units scheduled for construction before December 1986.

WAPDA has informed the Mission that a contract for the Guddu IV Steam Project should be awarded by mid-August 1982 upon the completion of negotiations for supplier credits. In December 1981, WAPDA received tenders for the project from several countries and is currently completing the evaluation of tenders. Even if a contract is awarded in August 1982, however, it is unlikely that construction will be completed in time to have the facility in service by August 1985 as projected in WAPDA's Power Generation Construction Program.

The second of the two priority projects is the two-phase Guddu Combined Cycle Gas Turbine Project. The first phase includes the installation of a pipeline, four gas turbines, four power generators, and necessary transformers and other accessories required to connect the output of the generators to WAPDA's transmission system. The second phase includes the installation of boilers to recover the heat from the gas turbine exhaust, steam turbines, power generators and necessary transformers and other accessories required to connect the plant to WAPDA's transmission system. (See Figure 1).

Phase 1 of this project is especially urgent. It is the only type of facility that can be completed within a relatively short time (about two years) and, for that reason, was

TABLE 3
PROJECTED LOAD GROWTH AND GENERATION SHORTFALL OF WAPDA'S POWER SYSTEM

Pakistan Fiscal Year 19-	Peak Demand (Month of May) (MW)	Percent Increase (Decrease) Over May of Previous Year	Generation Capability in May with No Reserves (a) (MW)	Spinning & Maintenance Reserves MW (a)	Generation Capability in May after Discounting Reserves (MW)	Amount of Generation Shortfall MW	Number of Months with a Shortfall	Maximum Shortfall Amount	Maximum Shortfall Month
81/82 (b)	2,505	4.6 (c)	2,490	257	2,233	750	6	750	Feb.
82/83	2,996	19.6	2,718	257	2,461	535	12	535	May
83/84	3,326	11.0	2,736	314	2,422	904	9	904	May
84/85	3,691	11.0	3,093	314	2,779	912	10	912	May
85/86	4,811	(d)	4,576	314	4,262	549	6	549	May
86/87	5,313	10.4	5,750	514	5,236	77	6	387	Feb.
87/88	5,867	10.4	6,350	514	5,836	31	1	31	May
88/89	6,469	10.3	6,965	514	6,451	18	1	18	May
89/90	7,123	10.1	7,599	568	7,031	92	1	92	May
90/91	7,832	10.0	9,267	1,068	8,199	None	0	None	
91/92	8,596	9.8	9,756	1,068	8,688	"	0	"	
92/93	9,421	9.6	10,578	1,068	9,510	"	0	"	
93/94	10,308	9.4	11,330	1,068	10,262	46	5	272	Feb.
94/95	11,259	9.2	12,727	1,068	11,659	None	6	469	Mar.
95/96	12,280	9.0	14,089	1,068	13,021	"	0	None	
96/97	13,369	8.9	14,859	1,068	13,791	"	5	591	Jan.
97/98	14,531	8.7	16,093	1,068	15,025	"	4	131	Feb.
98/99	15,768	8.5	16,952	1,282	15,669	99	5	607	Mar.
99/00	17,081	8.3	18,691	1,282	17,409	None	3	861	Jan.

(a) The reliability of a power system is directly related to the amount of reserve generation capacity that is available to cover unavoidable shut-downs of operating units. The level of reserves indicated here is less than normal for the electric utility industry in many countries. In the United States, for example, the general practice is to provide reserve generation capacity equal to about 15% of the projected peak demand. In all the years above except PFY 89/90 and 90/91, the planned reserve capacity is less than 10% of the projected peak demand. In PFY 85/86 it drops to only 5.8%

(b) Actual (severely suppressed because of load shedding).

(c) The actual peak demand in May of the previous year (PFY 80/81) was 2,394 MW. (severely suppressed because of load shedding).

(d) Base change coincident with planned completion of the WAPDA-KESC 500 KV interconnection line computation not valid.

SOURCE: WAPDA/NESPAK's recently prepared "Project Data-450 MW COMBINED CYCLE PLANT AT GUDDU" and a letter from WAPDA dated July 3, 1982.

TABLE 4

ACTUAL AND PROJECTED POWER GENERATION
CONSTRUCTION PROGRAM OF WAPDA

Item No.	Name of Generation Unit	Type	Installed Capacity (MW)	Planned In-Service	Actual/Planned Source of Funding
1	Tarbela 5	Hydro	175	10/82	CIDA and ADB
2	Tarbela 6	Hydro	175	11/82	CIDA and ADB
3	Tarbela 7	Hydro	175	1/83	CIDA and ADB
4	Tarbela 8	Hydro	175	2/83	CIDA and ADB
5	Quetta 2	Gas Turbine	25	6/83	Japan
6	Guddu Combined Cycle Phase I	Gas Turbine	400	1/85	AID & ADB
7	Tarbela 9	Hydro	175	12/34	OPEC, CIDA & ADB
8	Tarbela 10	Hydro	175	6/85	OPEC, CIDA & ADB
9	Interconnection KESC	Hydro	840	6/85	World Bank
10	Interconnection KESC	Hydro	225	6/85	World Bank
11	Interconnection KESC	Hydro	137	6/85	World Bank
12	Guddu 4	Steam	210	8/85	To be financed by country of supplier
13	Guddu Combined Cycle Phase II	Steam	200	2/86	Islamic Development Bank and Kuwait Fund
14	Mangla 9 & 10	Hydro	200	12/86	Not known
15	KESC D-3	Steam	200	9/86	Not known
16	Jamshoro 1 & 2	Thermal	800	2/87	Not known
17	Mid Country	Thermal	400	12/87	Not known

Continued.....

TABLE 4 CONTINUED

ACTUAL AND PROJECTED POWER GENERATION
CONSTRUCTION PROGRAM OF WAPDA

Item No.	Name of Generation Unit	Type	Installed Capacity (MW)	Planned In-Service	Actual/Planned Source of Funding
18	KESC D-4	Steam	200	1/88	Not known
19	Tarbela 11	Hydro	406	5/88	Not knwon
20	Tarbela 12	Hydro	406	9/88	Not known
21	KESC D-5	Steam	200	12/88	Not known
22	Not yet determined	Gas Turbine	200	2/89	Not known
23	Tarbela 13	Hydro	406	5/89	Not known
24	Tarbela 14	Hydro	406	9/89	Not known
25	Lakhra 1	Steam (Coal)	600	2/90	Not known
26	Not yet determined	Gas Turbine	200	12/90	Not known
27	Chashma 1	Nuclear	900	2/91	Not known
28	Kohala 1-4	NA	600	4/91	Not known
29	Lakhra 3	Steam (Coal)	400	12/91	Not known
30	Tarbela 15	Hydro	406	4/92	Not known
31	Thatta 1	Steam	500	9/92	Not known
32	Tarbela 16	Hydro	406	10/92	Not known
33	Tarbela 17	Hydro	406	12/92	Not known
34	Duki 1	Steam (Coal)	100	2/93	Not known
35	Kalabagh 1	Hydro	800	9/93	Not known
36	Chashma 2	Nuclear	900	8/94	Not known
37	Abbasian 1-4	NA	600	4/95	Not known

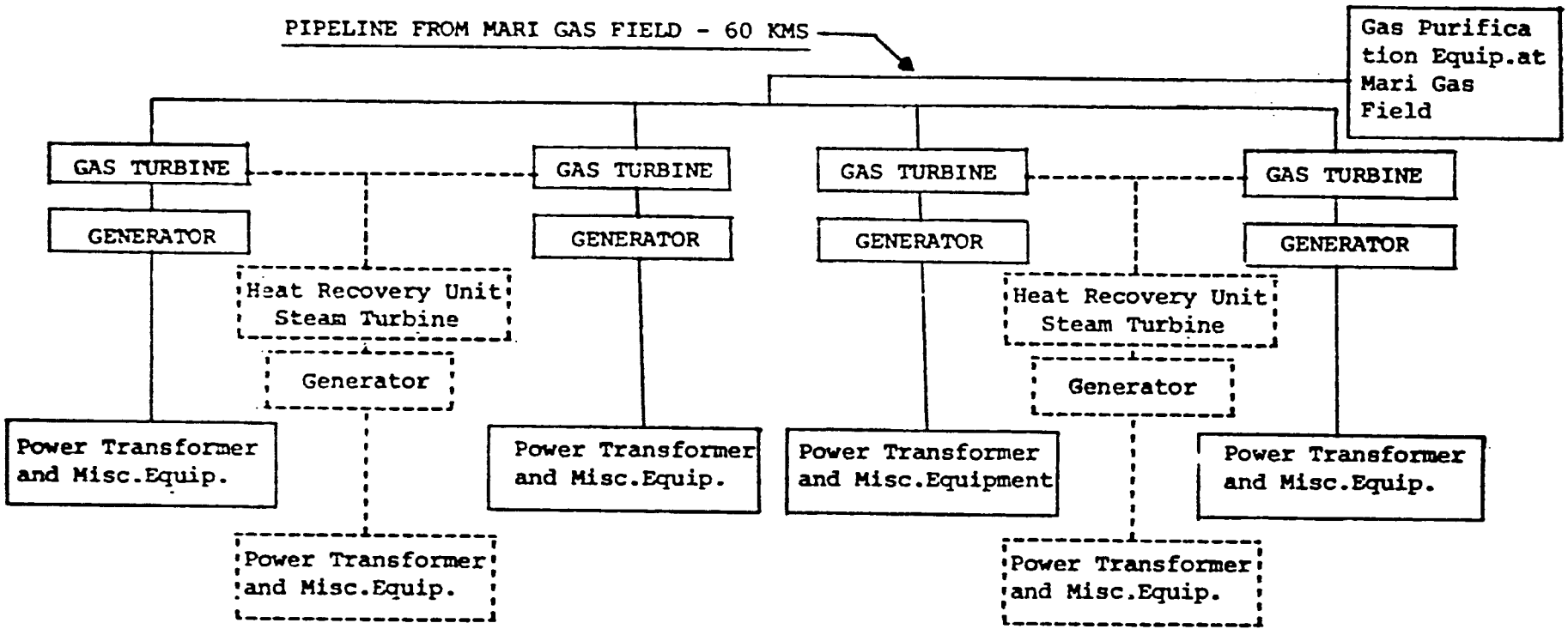
Continued.....

TABLE 4 CONTINUED

ACTUAL AND PROJECTED POWER GENERATION
CONSTRUCTION PROGRAM OF WAPDA

Item No.	Name of Generation Unit	Type	Installed Capacity (MW)	Planned In-Service	Actual/Planned Source of Funding
38	Kalabagh 2	Hydro	880	8/95	Not known
39	Thatta 1	Steam	500	10/95	Not known
40	South 1	Nuclear	900	8/96	Not known
41	Not yet determined	Hydro	1,600	7/97	Not known
42	Thatta 3	Steam	500	12/97	Not known
43	Not yet determined	Hydro	1,600	9/98	Not knwon
44	South 2	Nuclear	900	10/99	Not known
45	Not yet determined	Hydro	1,600	1/2000	Not known

LAYOUT OF WAPDA'S 450/600 MW GAS TURBINE COMBINED CYCLE PROJECT AT GUDDU



			(a) (b)
———	Phase I	- Basic Gas Turbine Portion --	300/400 MW
- - - - -	Phase II	- Heat Recover Portion - - - - - - -	150/200 MW
		TOTAL	450/600 MW*

(a) Hot Weather Capability

(b) Cool Weather Capability

selected by WAPDA as the best way to avoid or mitigate the very large generation capability shortfalls that now appear inevitable during the next three years. If Phase I of the project is further delayed to the extent that the currently scheduled completion date of January 1985 slips, the generation capability shortfall in the spring of 1985 is likely to be 1,212 MW instead of the 912 MW currently projected. Phase II of this Project is also critical not only because it too is needed to reduce the shortfall but also because all the energy required to operate Phase II will escape into the atmosphere between the time Phase I is completed and Phase II is completed and becomes operational.

Under this component, A.I.D. will assist the GOP and WAPDA to overcome a portion of Pakistan's severe power generation capability shortfall by providing $52 million toward the foreign exchange costs of Phase I of the Guddu Combined Cycle Gas Turbine Project. WAPDA anticipates that the balance of the currently estimated foreign exchange costs ($60.5 million) of Phase I will be provided by the ADB and that all of the foreign exchange costs of Phase II ($84.17 million) will be financed jointly by the Islamic Development Bank and the Kuwait Fund. A detailed cost estimate and proposed funding plan for both phases of the Guddu Project are provided in Table 5. Of the $52 million provided by A.I.D., $50 million will be used for procurement of U.S.goods and equipment and $2 million will finance technical assistance and training.

The proposed amount of A.I.D. funding is twice the amount originally believed necessary by the GOP during the economic assistance package negotiations in August 1981 and included by the Mission in the PID. At that time, WAPDA estimated the foreign exchange costs of the gas turbines, generators and auxiliary equipment (Phase I of the current Combined Cycle Project less the pipeline) at $66 million. At that time, the GOP anticipated that the ADB would provide $40 million for the gas turbines, generators, and the like. Consequently the indicated balance of $26 million was suggested for A.I.D.

There has been considerable discussion within the GOP about the level of its natural gas reserves, about the best uses of those reserves, and about the price that WAPDA should be charged for natural gas used to fire electric power generation facilities. At the same time, WAPDA and the GOP have had a number of discussions with the Mission and staff of other donor organizations about alternative ways to fund the project. During the almost one year that has transpired, inflation, more solid design and cost information, and the need to include the cost of a pipeline has led WAPDA to increase its cost estimate for the foreign exchange component of Phase I from

DETAILED 1983 COST ESTIMATES FOR THE 450/600 MW GUDDU COMBINED CYCLE GAS TURBINE POWER STATION PROJECT

(PHASE I - 4 x 100 MW Units)

Item Number	Description	Quantity	Foreign Exchange Component U.S. $	Local Cost Component Pak Rs.
			(In Millions)	
	PHASE - I			
1.	100 MW Gas Turbines a/	four	57.10	297.00
2.	Control Room Equipment	as required	2 20	10.20
3.	Auxiliary Equipment	"	5.20	24.96
4.	Erection/Supervision Services	"	3.60	20.00
5.	Training	"	0.20	0.25
6.	220 KV Switchyard Extension and Switchgear	"	4.00	-
7.	125 MVA Transformers	four	2.50	61.19
8.	Control, Protection, Communication, Despatching, Supervision, etc.	as required	3.10	-
9.	16" dia Gas Pipeline, including auxiliaries and purification plant including erection.	sixty miles	17.60	91.00
10.	Spare parts	as required	4.73	22.70
11.	Office building, furniture, vehicles, administrative expenses, clearing and forwarding charges, interest during construction, etc.etc.	"	-	452.10
12.	Engineering Services		2.50	12.12
13.	Contingencies		9.77	60.58
	Total		112.50	1,052.10

a/ Nominal rating of 100 MW is cool weather capability. Hot weather conditions may reduce unit capability to 75 MW.

TABLE 5 CONTINUED

Item No.	Description	Quantity	Foreign Exchange Component U.S. $	Local Cost Component Pak Rs.
			(In Millions)	
	PHASE - II			
14.	Hot Recovery Steam Generators (150 Tons/HR)	four	13.20	306.00
15.	100 MW Steam Turbine and Generator.	two	40.00	
16.	125 MVA Power Transformer	two	1.25	6.00
17.	Cooling water system and Condenser	as required	2.60	21.60
18.	Control and protection equipment	"	1.50	7.20
19.	Erection, supervision etc.	"	4.40	53.52
20.	Training	"	0.15	0.25
21.	Spares	"	2.30	11.04
22.	Office building, furniture, vehicles, administrative expenses, clearing and forwarding charges interest during construction	"	-	653.06
23.	Escalation Common facilities @ 8% per annum for 2 years (if not shown above)	"	9.74	-
24.	Pipeline (included in Phase - I)	"	-	-
25.	Purification, metering, filters, etc. (included in Phase - I)	"	-	-
26.	Engineering Services	"	1.60	10.47
27.	Contingency		7.43	30.98
	Total		84.17	1,100.12
	GRAND TOTAL (Phase I and II)		196.67	2,152.22

$66 million to $112.5 million. This estimate is based on recent information and should provide adequate funding for 1983 procurement in accordance with the proposed implementation plan.

The Mission has accepted the cost estimate and has an understanding with WAPDA that the consultants to be provided under this component will review the project design, equipment specifications and cost estimates. It is also understood that WAPDA, with the early assistance of the TAT, will reassess the economic benefits and costs of this component. It is fully expected that such a review would confirm the findings of an A.I.D.project design consultant that this station will be the most efficient of all thermal units in the WAPDA system. It is also expected that the economic reassessment and review will support the recommendations of the project design team (See Annex O). Mission review and approval of these assessments will be a condition precedent for use of A.I.D. funds for commodity procurement for this component.

WAPDA and the GOP are currently holding discussions with the ADB about the additional assistance required to finance Phase I and with the Islamic Development Bank and Kuwait Fund about the funding of Phase II and,as appropriate,will include Mission representatives in those discussions. For this reason, it is impossible at this time to provide definitive information about other donor funding. Given the urgent need for the project, it is reasonable to accept the GOP's request for assistance with the condition that funds for activities other than technical assistance not be disbursed until outstanding issues have been resolved in form and substance acceptable to the Mission. These issues include : (a) implementation of Guddu IV; (b) Guddu Gas Turbine Power Plant equipment specifications; (c) Guddu Gas Turbine project funding; (d) Guddu Gas Turbine project fuel supply contract (quantity, quality and price); and, (e) satisfactory project economic review. The GOP has initiated action on all these issues and has assured the Mission that once the TAT is on board, all questions will be quickly resolved.

5. Rural Distribution System Expansion

The GOP plans to provide electricity as quickly as possible to all Pakistan's villages, currently estimated at 45,000. WAPDA's response to the targets established by the federal and provincial governments has been impressive in terms of the numbers of villages that will soon have access to the national power transmission grid and the number to which electric distribution lines have already been extended. Over 220 large grid substations are being built under the

World Bank financed Third WAPDA Project. By the end of calendar year 1984, when all of the substations are scheduled to have been completed, almost all settled areas of the country will be less than thirty miles from a substation.

In the five years since 1977, 7,252 villages have been electrified. That number is 21 percent higher than the 6,003 villages that were electrified in the thirty-year period between 1947 and 1977. During PFY 1981/82, a total of 1,913 villages were electrified by WAPDA without outside assistance. During the next two PFYs, a total of 6,362 villages have been targeted by WAPDA for electrification with assistance from ADB, CIDA, the Kuwait Fund, and A.I.D.

Village electrification, however, has not meant that all the inhabitants in the electrified villages have been connected. An average of only about 15 percent of the total number of potential connections (households, community centers, commercial establishments, industries and irrigation tubewells) in the villages already electrified have been connected. There are three main problems associated with this, and WAPDA is keenly aware of them. The most acute and evident problem is the current and potential overloading of existing and planned generation facilities. While the overloading cannot be attributed solely to the relatively small number of rural connections being made, those connections are the most vulnerable to the resultant generation shortfall. Another problem is the underutilization of the very large investments already made and those being made in rural grid substations and rural transmission and distribution lines. In addition, all village electrification to date has been done without serious economic planning.

In recognition of these problems, WAPDA has contracted five local consultants to assist with the preparation of a National Rural Electrification Master Plan. Especially noteworthy is that, in the terms of reference of those contracts is a provision that the consultants are required "to conduct financial, economic, socio-economic and environmental analyses, similar to those conducted under feasibility studies under USAID." (See Annex P.) This provision will assure close coordination between these local consultants and the project's TAT, whose first and most urgent activity will be to assist WAPDA to develop the Master Plan.

a. Rural System Expansion and Connections Program

In support of the GOP and WAPDA's very strong commitment to rural electrification and to complement the other components of this project, a total of about $57 million will be made available under this component

for Rural Distribution System Expansion and Connections. An additional $15 million will be provided under the Agricultural Commodities and Equipment Program (391-0468) to import transformers, energy (watt-hour) meters and other items required to connect privately owned irrigation tubewells, etc. Because of the severe generation capability shortfall, activities under this component are scheduled to begin about April 1985 after the National Rural Electrification Master Plan has been developed and approved and the additional power generation capacity (component 4) is in place.

Following approval of the Rural Electrification Master Plan, a Rural System Expansion and Connection Program will be developed in conformance with the Master Plan and along the lines of the Illustrative Program that is summarized in Tables 6-9 and also in Annex M. As shown in Table 6, the illustrative program indicates that 215,381 connections (184,364 residential, 4,539 community, 17,158 commercial, 1,583 industrial, and 7,741 tubewell) could be made at an average cost of $470 per connection. It is likely that the National Rural Electrification Master Plan will assign priority to tubewell connections (approximately 100,000 are currently operating on diesel motors) and to additional connections in already electrified villages. If that happens, it should be possible to make even more connections under this component at a lower average cost per connection because distribution lines are already in place and the only additional cost to connect new customers would be the cost of meters and very short line and service drop extensions.

As in the case of the energy loss reduction activities, a Work Order System will be used to implement the approved Rural System Expansion and Connection Program. Again, WAPDA already has and uses such a system. With the assistance of the Project's TAT, the system will be improved and expanded to include more rigorous selection criteria based on financial and economic analyses. For management planning purposes, and in line with typical system growth practices of electric utilities, it is anticipated that the value in dollar equivalents of Work Orders will range from $100,000 to $1,000,000 with an average value of about $500,000.

b. Technical Assistance

Approximately 3.5 person-years of long-term expatriate and 28 person-years of long-term Pakistani technical assistance will be provided under this component. In addition, assistance will be provided by the TAT to improve distribution design and construction standards (See Technical Analysis), the Work Order System, and, as already stated above, to develop the Rural Expansion Program

TABLE 6

ILLUSTRATIVE SUMMARY OF RURAL ELECTRIFICATION WORK

	Item		Qty.	A.I.D.	GOP	TOTAL
					(In $ 000)	
1.	Primary (11,000 volts) Lines					
	a) Single Phase	miles	881.2			5,602
	b) Three Phase	"	1,867.8			22,138
	Sub-Total		2,749.0			27,740
2.	Secondary (230/400 volts) Lines					
	a) Single Phase	miles	336.1			3,962
	b) Three Phase	"	39.8			526
	Sub-Total		375.9			4,488
3.	Distribution Transformers					
	a) Single Phase	KVA	71,400			3,054
	b) Three Phase	"	16,500			1,153
	Sub-Total		87,900			4,207
4.	Customer's Connections					
	a) Residential Connections		184,364			21,623
	b) Community	"	4,539			517
	c) Commercial	"	17,158			2,156
	d) Industrial	"	1,583			1,064
	e) Tubewell	"	7,741			17,627
	Sub-Total		215,385			42,997
				61,731	17,701	79,432
5.	Regulators, Capacitors, etc.			617	-	617
6.	Tools & Instruments			623	-	623
	Sub-Total			62,971 a/	17,701	80,672
7.	Labor, Warehousing, Transport, Engineering & Supervision				11,294	11,294
	TOTAL			62,971 a/	28,995	91,966
	Contingency			6,297	2,900	9,197
	GRAND TOTAL			69,268	31,895	101,163

a/ Of this amount, $ 27.7 million has been earmarked to import commodities. This includes $ 15 million that is scheduled to be provided under the Agricultural Commodities and Equipment Project No: 391-0468 in FY 1984. The balance of $ 35.3 million has been earmarked to reimburse the GOP/WAPDA for the cost of locally procured commodities.

TABLE 7

ILLUSTRATIVE ANNUAL DISTRIBUTION OF WORK ORDERS OF THE RURAL DISTRIBUTION SYSTEM EXPANSION PROGRAM BY PROVINCE

U.S. Fiscal Year	Number of Work Orders	Unit Cost of Work Orders (In $)	Total Cost (In $)
	PUNJAB		
'86	26	676,685	17,593,810
'87	42	744,354	31,262,868
Sub-Total:	68	-	48,856,678
	SIND		
'86	8	614,024	4,912,192
'87	12	675,427	8,105,124
'88	15	742,969	11,144,535
Sub-Total:	35	-	24,161,851
	NORTHWEST FRONTIER PROVINCE		
'86	13	452,555	5,883,215
'87	16	497,810	7,964,960
'88	18	547,591	9,856,638
Sub-Total:	47	-	23,704,813
	BALUCHISTAN		
'86	1	428,933	428,933
'87	3	471,826	1,415,478
'88	5	519,009	2,595,045
Sub-Total:	9	-	4,439,456
	SUMMARY ALL PROVINCES		
'86	48	-	28,818,150
'87	73	-	48,748,430
'88	38	-	23,596,218
GRAND TOTAL:	159	-	101,162,798

ILLUSTRATIVE NUMBER OF CONNECTIONS PER MODEL WORK ORDER [a]

Type Connection	Present Potential Number per Area [b]	Target End-of-Project Saturation	Estimated Number Already Connected	Estimated Number of New Connections
		PUNJAB		
Residential	6,400	30%	576	1,344
Community	142	30%	13	30
Commercial	330	90%	99	198
Industrial	27	90%	8	16
Tubewell	120	95%	39	75
			Total	1,663
		SIND		
Residential	4,000	40%	360	1,240
Community	133	40%	12	41
Commercial	102	95%	31	66
Industrial	13	95%	4	8
Tubewell	78	95%	24	50
			Total	1,405
		NORTHWEST FRONTIER PROVINCE		
Residential	1,800	60%	162	918
Community	36	60%	3	19
Commercial	40	95%	12	26
Industrial	6	95%	2	4
Tubewell	27	95%	8	18
			Total	985
		BALUCHISTAN		
Residential	1,400	60%	126	714
Community	37	60%	3	19
Commercial	27	95%	8	18
Industrial	4	95%	1	3
Tubewell	7	95%	2	5
			Total	759

a/ Based on data from 1978 A.I.D. Financed Rural Electrification Feasibility Studies and GOP supplied information about number, types and geographical distribution of tubewells.

b/ Assumes that each Work Order will provide connections in ten or eleven villages, some already electrified and some that will be electrified under this project.

Estimated Cost of an Illustrative Rural System Expansion Work Order for Punjab Province

	Item, Quantity and Unit Cost		Extended Cost
1.	Primary (11,000 Volts) Lines		
	a. Single-Phase	4.4 miles @ $3,938/mile	$ 17,327
	b. Three-Phase	8.6 miles @ $7,346/mile	63,176
2.	Secondary (230/400 Volts) Lines		
	a. Single-Phase	3.1 miles @ $7,427/mile	23,024
	b. Three-Phase	0.4 miles @ $8,348/mile	3,339
3.	Distribution Transformers		
	a. Single-Phase Capacity	700 KVA @ $27/KVA	18,900
	b. Three-Phase Capacity	150 KVA @ $44/KVA	6,600
4.	Number of Connections		
	a. Residential	1344 @ $71/each	95,424
	b. Community	30 @ $71/each	2,130
	c. Commercial	198 @ $71/each	14,058
	d. Industrial	16 @ $425/each	6,800
	e. Tubewell	75 @ $1,438/each	107,850
	f. Total	1,663	
5.	Sub-Total (Items 1 to 4)		$358,628
6.	Regulators, Capacitors and Other Special Items (1% of Item 5)		3,586
7.	Total Direct Cost of distribution material and equipment (Items 5 and 6)		$362,214
8.	Warehouse charge (1% of Item 7)		3,622
9.	Labor (6% of Item 7)		$ 21,733
10.	Tools (1% of Item 7)		3,622
11.	Transportation (6% of Item 7)		21,733
12.	Engineering and Supervision (2% of Item 7)		7,244
13.	Sub-Total (Item 7 to 12)		$420,168
14.	Contingency (10% of Item 13)		42,017
15.	Total Cost Per FY-82 Work Order		$462,185
16.	Total Cost per FY-83 Work Order		$508,404 a/
17.	Total Cost per FY-84 Work Order		$559,244 a/

a/ Assumes 10% inflation compounded annually.

TABLE 9 Continued

Item, Quantity and Unit Cost	Extended Cost
18. Total Cost per FY-85 Work Order	$615,168 a/
19. Total Cost per FY-86 Work Order	$676,685 a/
20. Total Cost per FY-87 Work Order	$744,354 a/
21. Total Cost per FY-88 Work Order	$818,789 a/

a/ Assumes 10% inflation compounded annually.

that will guide implementation of this component. The technical assistance to be provided under this component is required to assist with the implementation of the approved Program including the review and approval of System Expansion Work Orders and the inspection and acceptance of completed work.

c. Commodities

Both U.S. and Pakistani commodities will be procured to support activities under this component. Items to be imported from the United States are likely to include energy (watt-hour) meters, capacitors, regulators, single phase transformers, tools, connectors and other items not readily available in Pakistan. The items likely to be procured locally include poles, conductors and selected energy meters and transformers.

d. Training of WAPDA Implementation Staff

Limited special training will be provided under this component for WAPDA staff assigned to implement the program.

e. Implementation

As in the case of the Energy Loss Reduction Program, the implementation of activities under this component will be the responsibility of WAPDA's eight Area Electricity Boards (AEBs), using the Work Order System. Once a Work Order has been prepared and approved by the respective AEB, the WAPDA Component Manager and the technical advisor, in accordance with an approved management system, it will be submitted to A.I.D. with a request that it be considered for financing under this component. A.I.D.'s technical and administrative acceptance of Work Orders for funding will be transmitted in the form of a Project Implementation Letter that will indicate the fixed amount that A.I.D. will reimburse the GOP if the Work Order is implemented as approved. The amount to be reimbursed will be expressed as a percentage of the total estimated cost of the Work Order or a percentage of the total cost of each sub-item of the Work Order. Except for actual meter connections which should be made by WAPDA's staff for administrative control purposes, most of the activities that might be included in a Rural System Expansion Work Order can be performed satisfactorily by qualified contractors, and WAPDA will be encouraged to use contractors as required to avoid further increases in the size of its own staff.

WAPDA's Component Manager, the technical advisor and Mission-contracted Pakistani engineers will monitor the execution of approved Work Orders on a spot check basis. Once all work required by a Work Order has been completed, the technical advisor or a Mission Project Engineer will inspect it in accordance with the pre-approved management system. If all work has been performed satisfactorily, A.I.D. will reimburse WAPDA the predetermined amount of the estimated cost for the preparation and execution of the Work Order.

IV. IMPLEMENTATION PLAN

A. Implementation Schedule

All project activities except those under the Power Generation and Rural System Expansion Components are scheduled to take place over a period of six years from the date of signing of the Project Agreement. Activities under the Power Generation Component will be started as soon as the Agreement is signed and are scheduled to be completed during the third project year. Activities under the Rural System Expansion Component will start the third project year and continue until the Project Assistance Completion Date (PACD), which is September 30, 1988. A proposed implementation schedule is presented in Table 10.

As soon as possible after the Project Agreement is signed, short-term technical assistance will be provided to assist WAPDA review and finalize the specifications, economic analysis and tender documents for the Guddu Combined Cycle Power Generation Facility. While the documents are being reviewed, WAPDA, in collaboration with the Mission, will finalize arrangements for financing of the balance of the foreign exchange costs of the Facility. Upon receipt of acceptable documents and confirmation. that the balance of funding has been secured, the Mission will authorize WAPDA to issue the tender documents for the items that will be financed with A.I.D. funds and a request for proposals for the provision of long-term technical assistance that will be required to approve as built drawings, inspect equipment, and monitor construction.

At the same time, the Mission will negotiate a direct A.I.D. contract for the Technical Assistance Team (TAT) required to implement Components 1-4 and will place orders for the vehicles required by the TAT. The priority focus of the TAT will be the development of the Rural Electrification Master Plan which should be finished by June 1983. The TAT will also focus on the development of the Comprehensive Training and Energy Loss Reduction Programs, the organization of the Sister Utilities Exchange Program, arrangements to train WAPDA implementation staff, and the contracting and training of Pakistani TAT staff. All these activities should be completed within six months after the arrival of the TAT. Activities under the Comprehensive Training, Sister Utility Exchange and Energy Loss Reduction Programs will be phased in as each program is approved. Temporary quarters will be used for in-country training under the Comprehensive Training Program until the permanent facility is completed at the end of the third year of the project. The first activity under the Energy Loss Reduction Program will be the award of contracts for commodities that will have to be imported from the United States. Simultaneously, the preparation of energy loss reduction Work Orders will begin and a number of Work Orders will be approved and ready to execute as

TABLE 10

PROPOSED IMPLEMENTATION SCHEDULE FOR RURAL ELECTRIFICATION PROJECT NO: 391-0473

	Activity a/	1982 Qtr. 3	1982 Qtr. 4	1983 Quarter 1	1983 Quarter 2	1983 Quarter 3	1983 Quarter 4	1984 Quarter 1	1984 Quarter 2	1984 Quarter 3	1984 Quarter 4	1985 Quarter 1	1985 Quarter 2	1985 Quarter 3	1985 Quarter 4	1986 Quarter 1	1986 Quarter 2	1986 Quarter 3	1986 Quarter 4	1987 Quarter 1	1987 Quarter 2	1987 Quarter 3	1987 Quarter 4	1988 Quarter 1	1988 Quarter 2	1988 Quarter 3	1988 Quarter 4
1.a	Project Agreement signed		X																								
b	Technical Assistance Short-Term IQC																										
c	Mission approval T/G Component 4 Documentation				X																						
d	NAPDA firms up $ 60.5 million ADB funds																										
e	Mission approves issuance of T/G IFB				X																						
f	Mission approves NAPDA issuance of RFP for A/E services for T/G				X																						
2.a	A.I.D. negotiates TAT Contract		X																								
b	Technical Assistance Team in Pakistan																										
c	Preparation National Rural Electrification Master Plan (For implementation see section 10.a. below)																										
d	Preparation of Comprehensive Training Program (For implementation see section 7-i below)																										
3.0	Technical Assistance Professional Inputs (See Table 12)																										
3.1	Component 1 - Institutional Improvement																										
	a.L/T Salaried Expatriates																										
	b.S/T Salaried Expatriates																										
	c.S/T Volunteer Expatriates																										
	d.L/T Pakistani Professionals																										
3.2	Component 2 - Distribution Function Training																										
	a.L/T Salaried Expatriates																										
	b.S/T Salaried Expatriates																										
	c.S/T Volunteer Expatriates																										
	d.L/T Pakistani Professionals																										

Review of component specifications, economic analysis, tender documents

Subsequent to satisfactory completion of 1-c and 1-d above

a/ For legend, see last page of the Proposed Implementation Schedule for Rural Electrification Project No: 391-0473

TABLE 10 CONTINUED

PROPOSED IMPLEMENTATION SCHEDULE FOR RURAL ELECTRIFICATION PROJECT NO: 391-0473

	Activity	1982		1983				1984				1985				1986				1987				1988			
		Qtr.		Quarter				Quarter				Quarter				Quarter				Quarter				Quarter			
		3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
3.3	Component - 3 Distribution System Energy Loss Reduction																										
	a. L/T Salaried Expatriates																										
	b. L/T Pakistani Professionals																										
3.4	Component 4 - Power Generation																										
	a. S/T and L/T Expatriates																										
3.5	Component 5 - Rural Distribution System Expansion																										
	a. L/T Salaried Expatriates																										
	b. L/T Pakistani Professionals																										
4.0	Training (See Table 13)																										
4.1	Training of WAPDA Implementation Staff																										
	a. Component 1																										
	b. Component 2																										
	c. Component 3																										
	d. Component 4																										
	e. Component 5			None																							
4.2	Pakistani Members of Technical Assistance Team																										
	a. Component 1																										
	b. Component 2																										
	c. Component 3																										
	d. Component 4																										
	e. Component 5			None																							

TABLE 10 CONTINUED

PROPOSED IMPLEMENTATION SCHEDULE FOR RURAL ELECTRIFICATION PROJECT NO: 391-0473

	Activity	1982		1983				1964				1985				1986				1967				1988			
		Qtr.		Quarter				Quarter				Quarter				Quarter				Quarter				Quarter			
		3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
4.3	Training of Gas Turbine Operators (Component 4)																										
	a. Operation																										
	b. Maintenance																										
4.4	Illustrative Comprehensive Program (Component 2)																										
	a. Short-Term U.S. Training																										
	i - Short Courses																										
	ii - Sister-Utility Exchange																										
	b. Long-Term U.S. Academic Training																										
	i- Vocational/Technical Education																										
	ii- Instructional																										
	iii- Finance/Accounting																										
	iv- Inventory Procurement Management																										
	v- Marketing																										
	vi- General Management																										
	vii- Computers Management Information System																										
	c. In-Country Training																										
	i- Electrical Utility Management																										
	ii- Commercial																										
	iii- Financial																										
	iv- Power Distribution Energy (Technical)																										
	v- Automatic Data Processing (ADP)																										
	vi- Procurement and Inventory Management																										
	vii- Supervisory Management																										
	viii- Technical Supervisor																										
	ix- Training of Trainers																										
	x- Construction Management																										
	xi- Vocational-Technical																										

TABLE 10 CONTINUED

PROPOSED IMPLEMENTATION SCHEDULE FOR RURAL ELECTRIFICATION PROJECT No: 391-0473

	Activity	1982 Qtr. 3	1982 Qtr. 4	1983 Quarter 1	1983 Quarter 2	1983 Quarter 3	1983 Quarter 4	1984 Quarter 1	1984 Quarter 2	1984 Quarter 3	1984 Quarter 4	1985 Quarter 1	1985 Quarter 2	1985 Quarter 3	1985 Quarter 4	1986 Quarter 1	1986 Quarter 2	1986 Quarter 3	1986 Quarter 4	1987 Quarter 1	1987 Quarter 2	1987 Quarter 3	1987 Quarter 4	1988 Quarter 1	1988 Quarter 2	1988 Quarter 3	1988 Quarter 4
5.0	**Commodity Procurement**																										
5.1	Vehicles	IFB																									
5.2	ADP hardware and software				R																						
5.3	Office equipment, test instruments & tools (Components 1, 3 and 5)																										
5.4	Office equipment and training aids (Component 2)																										
5.5	Imported electrical equipment (Component 3)			IFB	B	C	R																				
5.6	Local electrical and line construction materials (Component 3)																										
5.7	Gas Turbines, generators, controls and substation equipment			IFB	B	C			R				R														
5.8	Imported equipment and materials (Component 5)											IFB	C		R	IFB	C		R								
5.9	Local electrical and line construction materials (Component 5)																										
6.0	**Component 1 Activities**																										
6.1	Develop National Rural Electrification Master Plan (See Section 2.c, above)																										
6.2	Design a comprehensive energy loss reduction program for use in implementation of Component 3. (See Section 8.0)																										
6.3	Design the Distribution System Expansion Program for use in implementation of Component 5 (See Section 10)																										
6.4	Develop a comprehensive management system to select, design, construct, inspect, and authorize reimbursement of cost for Work Orders satisfactorily carried out under Components 3 and 5.																										

TABLE 10 CONTINUED

PROPOSED IMPLEMENTATION SCHEDULE FOR RURAL ELECTRIFICATION PROJECT NO. 391-0473

	Activity	1982		1983				1984				1985				1986				1987				1988			
		Qtr.		Quarter				Quarter				Quarter				Quarter				Quarter				Quarter			
		3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
6.5	Prepare Study and Recommendations to strengthen and make more efficient the organization responsible to General Manager Distribution																										
6.6	Prepare Study and Recommendations to strengthen and make more efficient the organization responsible to Chairmen of Area Electricity Boards.																										
6.7	Prepare Study and Recommendations to strengthen and make more efficient the organization responsible to Chief Engineer of Rural Electrification Office.																										
6.8	Develop a "Sister-Utility" Program and assist NAPOA in selecting key Managers for Training in the Program.																										
6.9	Develop a customer relations manual and demonstrate benefits of maintaining confidence and good relations with individual customers and communities.																										
6.10	Using data developed by IBRD consultants Peat, Marwick and Mitchell, develop a logistic system which will be modern and cost effective (to be coordinated with NAPOA computer facilities).																										
6.11	Assess Computer (ADP) Needs as recommended by SER/DM (See Annex K)																										
6.12	Implement Recommendations that result from Computer needs assessment																										
6.13	Review and up-date Distribution Planning, Design, construction, operations and maintenance criteria, standards and practices																										

TABLE 10 CONTINUED

PROPOSED IMPLEMENTATION SCHEDULE FOR RURAL ELECTRIFICATION PROJECT NO: 391-0473

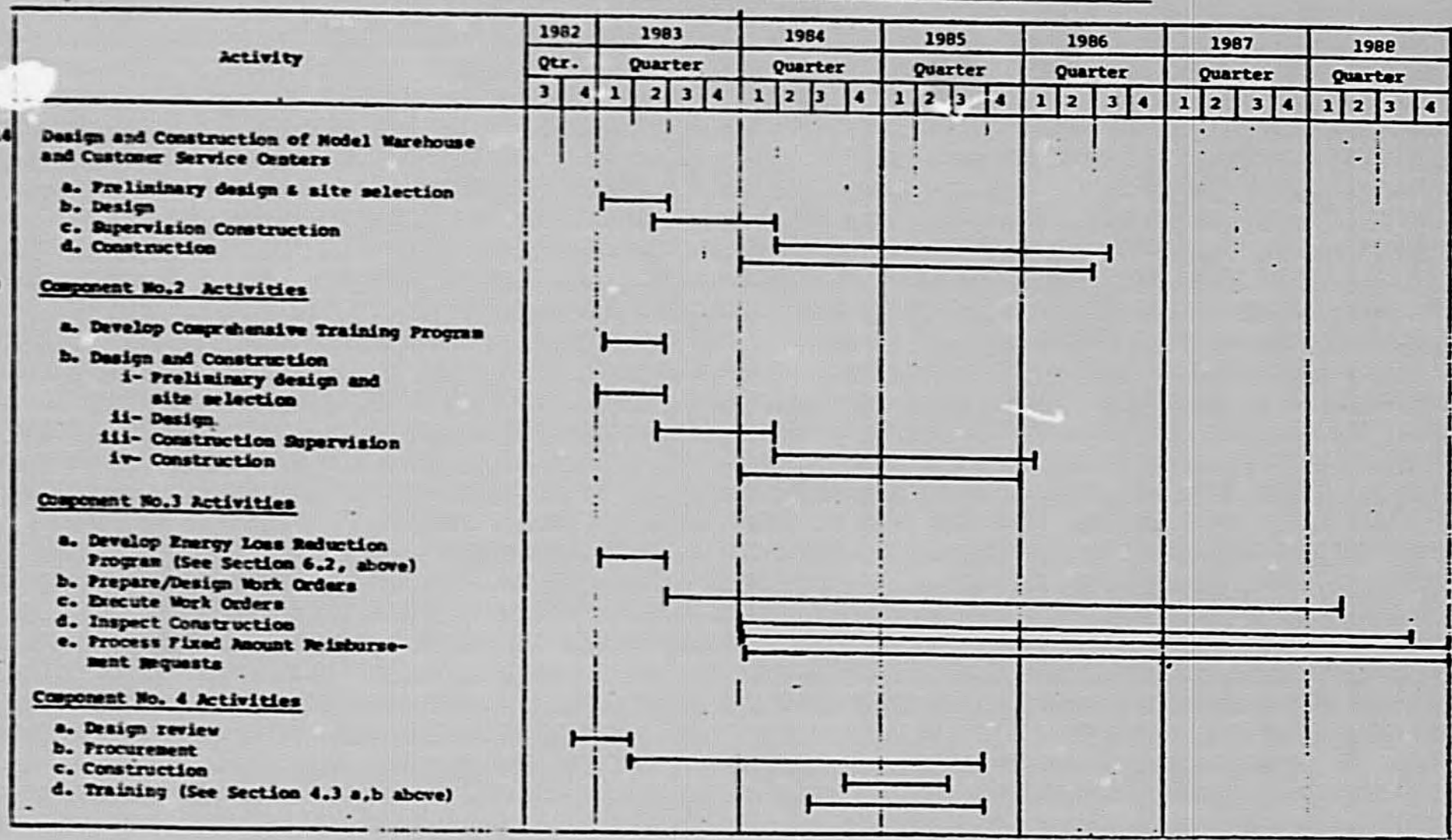


TABLE 10 CONTINUED

PROPOSED IMPLEMENTATION SCHEDULE FOR RURAL ELECTRIFICATION PROJECT NO: 391-0473

Activity	1982		1983				1984				1985				1986				1987				1988			
	Qtr.		Quarter				Quarter				Quarter				Quarter				Quarter				Quarter			
	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
10.0 Component No.5 Activities																										
a. Develop Distribution System Expansion Program																										
b. Prepare/Design Work Orders																										
c. Execute Work Orders																										
d. Inspect construction																										
e. Process Fixed Amount Reimbursement Requests																										

Legend:

ADB	Asian Development Bank
ADP	Automated Data Processing
A/E	Architectural & Engineering
IBRD	International Bank for Reconstruction and Development (World Bank)
IFB	Invitation for Bids
RFP	Request for Proposals
IQC	Indefinite Quantity Contract
L/T	Long-Term
S/T	Short-Term
TAT	Technical Assistance Team
T/G	Turbine Generator
B	Receive Bids
C	Award Contract
R	Receive Equipment

soon as the first materials arrive at the end of the first quarter of the second project year. Rural System Expansion activities will follow this same sequence with a lag of several months depending on the status of power generation construction and the National Rural Electrification Master Plan.

B. Administrative and Monitoring Arrangements

1. A.I.D. Responsibilities

The USAID/Pakistan Office of Energy and Engineering (E&E) will have overall responsibility for managing the project. E&E is currently staffed with one USDH and nine Pakistani professionals. The USDH is an electrical engineer with extensive experience in electric utilities. Six of the Pakistani professionals also are engineers. The staff of E&E is being expanded. Two additional USDH positions and one Pakistani professional position (an electrical engineer) have recently been approved. In addition to this in-house capability, the project is designed in such a manner that many functions that otherwise would have to be performed by Mission staff will be performed by the project-financed Technical Assistance Team (TAT).

E&E will be assisted in all contracting and procurement actions by the Mission's Office of Project Development and Monitoring, all disbursement matters by its Office of Financial Management, all evaluation and training matters by its Program Office and all logistic matters by its Office of Management. These Mission staff resources together with complementary support of AID/Washington backstopping staff and the Regional Legal (located in Islamabad), Environmental, Contracts and Commodity Management Advisors are considered adequate to handle USAID/Pakistan's responsibilities under the project.

2. GOP Responsibilities

The Office of the General Manager for Distribution of WAPDA will be the GOP implementing agency for the project. The head of that Office, the General Manager for Distribution (GMD), will be the Project Director and additional Borrower's Authorized Representative (BAR). As such, he will have overall GOP responsibility for managing and coordinating the implementation of the entire project. Direct GOP responsibility for each of the five components of the project will be as follows:

Project Component	Component Manager
Institutional Improvement	General Manager of Distribution
Distribution Function Training	Chief, Distribution Training (New Position)

Distribution System Energy Loss Reduction	Chief Engineer, Design (Distribution)
Power Generation	Chief Engineer, Thermal Generation
Rural Distribution System Expansion	Chief Engineer, Rural Electrification

Each of the Component Managers in WAPDA will be responsible for: (a) all aspects of the implementation of the component assigned; (b) the timely coordination of the activities of their component with the Managers of the other four components and other officers and administrative units of WAPDA and the GOP; (c) providing adequate counterparts to work with consultants; (d) liaising on a day-to-day basis with A.I.D. representatives and members of the Technical Assistance Team; and, (e) assisting with the scheduling of and participating in project evaluations. As discussed in the Detailed Project Description Section and indicated in Table 13, training will be provided early on in the project for all WAPDA staff assigned important project implementation responsibilities.

The budget and staff levels of the Office of the GMD (approximately 67,000 employees) and each of the Component Managers are judged by the Mission to be adequate to handle the GOP's administrative and monitoring responsibilities under the project. For details about the organization and staffing of the GMD, see the Administrative Analysis Section and Annex N.

C. Procurement Plan

1. Commodities

The proposed Commodity Procurement Plan shown in Table 11 lists nine groups of commodities that will be procured under this project and shows for each the estimated cost, the probable source, and the method of procurement. Five of the nine groups will be procured by WAPDA, two by the Mission and two by the technical assistance contractor for Components 1,2,3 and 5. The estimated total value of the groups to be procured by WAPDA, the Mission and the technical assistance contractor are respectively, $128 million (96 percent), $1.5 million (1 percent) and $3.6 million (3 percent). With the exception of vehicles and perhaps the ADP hardware, all commodities procured under this project will have their source and origin in the United States or Pakistan.

a. Vehicles

Twenty-nine right-hand-drive vehicles will be procured by the Mission as soon as possible after the Project

TABLE 11

PROPOSED COMMODITY PROCUREMENT PLAN

Project Component	Description of Commodity	Estimated Total Amount [a]	Source	Method of Procurement
a. Institutional Improvement, Training, Energy Loss Reduction and Rural System Expansion	Vehicles [b] - 29 (25 sedans, 2 utility vehicles and 2 station wagons)	$ 295,000	Probably Japan	Competitive by USAID/Pakistan
b. Institutional Improvement	ADP System (Computer) [c] hardware & software	$ 1,250,000	Local IBM or Wang Computer Dealer in Pakistan	Non-competitive by USAID/Pakistan after study to determine model and brand
c. Institutional Improvement, Energy Loss Reduction and Rural System Expansion	Office equipment, test instruments and tools	$ 2,300,000 Rs 1,300,000	U.S. and Pakistan	Competitive Procurement by U.S. T.A. contractor
d. Distribution Function Training	Office equipment and training aids	$ 1,250,000	"	"
e. Energy Loss Reduction	Imported electrical equipment and materials such as capacitors, energy (Watt-hour) meters. compression connectors, transformers and voltage regulators	$ 9,500,000	U.S.	Host Country Competitive Procedures
f. Energy Loss Reduction	Locally manufactured electrical and line construction equipment and materials such as conductor, poles, nuts and bolts, energy (Watt-hour) meters and transformers	$ 14,700,000	Pakistan	Host Country Competitive Procedures

TABLE 11 Continued

PROPOSED COMMODITY PROCUREMENT PLAN

Project Component	Description of Commodity	Estimated Total Amount	Source	Method of Procurement
g. Power Generation	Gas turbines, generators, controls and sub-station equipment	$ 50,000,000	U.S.	Host Country Competitive Procedures
h. Rural System Expansion	Imported equipment and materials such as compression connectors, transformers, energy (Watt-hour) meters, capacitors and voltage regulators	$ 17,793,000 d/	U.S.	Host Country Competitive Procedures
i. Rural System Expansion	Locally manufactured electrical and line construction equipment and materials such as conductor, poles, nuts and bolts, energy (Watt-hour) meters and transformers	$ 36,476,000	Pakistan	Host Country Competitive Procedures
	Total:	$ 133,564,000 Rs 1,300,000		

a/ Includes 10% Contingency.

b/ See Annex I.

c/ See Annex K.

d/ Does not include $15 million in commodities for transformers and other items to connect tubewells that are scheduled to be provided under the Agricultural Commodities and Equipment Project (391-0468).

Agreement is signed. A source/origin waiver request for the vehicles is included in Annex I.

b. ADP (Computers) Hardware and Software

The ADP requirements of WAPDA will be reviewed during project implementation as recommended by SER/DM.(See Annex K). It is anticipated that the required computer hardware and software will be procured by the Mission on a non-competitive basis from the local IBM or Wang dealer. A final decision will be made in consultation with SER/DM following completion of the ADP needs assessment that SER/DM has recommended.

c. Office Equipment, Test Instruments and Tools

Specific items to be procured such as addressograph machines, typewriters, file cabinets, and meter testing instruments will be procured locally and from the United States throughout the life of the project. Only items that have been recommended by the TAT and approved by WAPDA and the Mission will be procured. To save time, especially in the case of items that have to be imported from the United States, and to facilitate the placement of many relative small purchase orders, the technical assistance contractor will serve as the purchasing agent for these items.

d. Office Equipment and Training Aids

(Same as c. above)

e. Imported Electrical Equipment and Materials

Items such as capacitors, watt-hour meters, compression connectors, transformers and voltage regulators will be procured through a single tender document that will be issued during the latter half of the first project year following the approval of the Energy Loss Reduction Program for which these items will be required. While local manufacturers will be eligible to supply these items, most are not manufactured locally or will not satisfy technical specifications. WAPDA has extensive experience with this type of procurement and will be responsible for procuring these items in accordance with A.I.D. Handbook 11.

f. Locally Manfactured Electrical and Line Construction Equipment and Materials

Standard locally manufactured stock items such as conductors, poles, nuts, bolts, watt-hour meters and transformers will be provided by WAPDA out of its warehouses (stores) on an as-needed-basis to execute Mission approved Energy Loss

Reduction Work Orders under component 3. After each approved Work Order is executed, A.I.D. will reimburse WAPDA for part of its total estimated cost in accordance with A.I.D. guidelines for Fixed Amount Reimbursement. WAPDA will continually replenish its stocks in its stores in accordance with GOP approved competitive procurement procedures. A.I.D. will monitor such procurement indirectly through the Procurement and Inventory Management Advisor who will be provided as part of the TAT.

g. Gas Turbines, Generators, Controls and Substation Equipment

Specific items to be financed by A.I.D. will be determined very early in the first year of the project in consultation with the Asian Development Bank, the expected co-financer of the foreign exchange costs of this equipment. The decision will also take into account the availability of A.I.D. funds. A total of $50 million in ESF loan funds has been allocated for the procurement of these commodities. As indicated in Table 16, the first $25 million is scheduled to become available in FY 1983 and a second equal amount in FY 1984. It is expected that all the items financed by A.I.D. will be procured by WAPDA from the United States in accordance with A.I.D. Handbook 11.

h. Imported Electrical and Line Construction Equipment and Materials

Items such as compression connectors, transformers, energy meters, capacitors and voltage regulators will be procured through two tenders that will each cover the full range of items required. The first tender will be issued in early 1985 as soon as FY 1985 funds become available and the second in early 1986. A similar tender will be issued in early 1984 under the Agricultural Commodities and Equipment Project. While local manufacturers will be eligible to supply these items, most are not manufactured locally or will not satisfy technical specifications. WAPDA has extensive experience with this type of procurement and will be responsible for procuring these items in accordance with A.I.D. Handbook 11.

i. Locally Manufactured Electrical and Line Construction Equipment and Materials

As in the case of component 3, standard locally manufactured stock items such as conductors, poles, nuts and bolts, watt-hour meters and transformers will be provided by WAPDA out of its warehouses (stores) on an as-needed-basis to execute A.I.D. approved Rural System Expansion Work Orders under Component 5. After each approved Work Order is executed, A.I.D. will reimburse WAPDA for part of its total estimated cost in accordance with A.I.D. guidelines for Fixed Amount Reimbursement. WAPDA will continually replenish

its stock in its stores in accordance with GOP approved competitive procurement procedures. A.I.D. will monitor such procurement indirectly through the Procurement and Inventory Management advisor who will be provided as part of the TAT.

2. Technical Assistance

Table 12 summarizes the broad range of technical assistance required to implement this project. All the assistance is interrelated except that required for the Power Generation Component. Consequently, with the exception of the civil engineering and local architectural and engineering assistance, all assistance required under components 1,2,3 and 5 will be provided and managed by a single contractor. This includes a number of Pakistani professionals who will work under the direct supervision of the expatriate advisors and volunteer expatriate specialists that will be provided under the Sister Utility Exchange Program.

The prime technical assistance contractor will provide appromixately 88 person-years of assistance (30 expatriate, 58 national) under component 1, 50 person-years (26 expatriate, 24 national) under component 2, 25 person-years (5 expatriate, 20 national) under component 3, and 31.5 person-years (3.5 expatriate, 28 national) under component 5. The amount provided under component 1 is the largest because of the broad range of activities that will be implemented under that component and because these advisors also will support and share responsibility for all the other components except component 4.

Next in order of magnitude is the technical assistance to be provided under component 2 which includes a number of lecturers and training specialists who will organize and conduct training courses. A total of 56.5 person-years of assistance will be provided under Components 3 and 5. Of that amount, 48 person-years (85 percent) will be by Pakistani professionals who will receive special training under the project. The balance (8.5 person-years) will be provided by two expatriate advisors.

While Generation and Transmission Offices of WAPDA have extensive experience contracting and managing consultancy contracts for the preparation of development project feasibility studies and the design and construction of large generation and transmission facilities, the Office of the General Manager of Distribution has limited experience with the contracting and management of expatriate consultancy contracts. This situation plus the fact that the TAT will be responsible for monitoring and making final inspection of fixed amount reimbursement activities under components 3 and 5 has led the Mission and WAPDA to conclude that all technical assistance required under components 1,2,3 and 5 will be contracted directly by A.I.D.

TABLE 12

PROPOSED TECHNICAL ASSISTANCE PLAN

Nature of T.A.	Type	Person Year(s)	Type of Contract and Source
Component 1 - Institutional Improvement			
(a) Team Leader and Advisor to the Chairman of WAPDA, Members and the General Manager of the Distribution Organization (1)	Long Term	5	Direct A.I.D. Contract with a U.S. Firm or Association
(b) Financial Management Advisor (1)	Long Term	4	Direct A.I.D. Contract with a U.S. Firm or Association
(c) Commercial Management Advisor (1)	Long Term	4	Direct A.I.D. Contract with a U.S.Firm or Association
(d) General Advisor(1)	Long Term	2	Direct A.I.D. Contract with a U.S. Firm or Association
(e) Procurement and Inventory Advisor (1)	Long Term	3	Direct A.I.D. Contract with a U.S. Firm or Association
(f) Computer Systems Management Specialist(1)	Long Term	2	Direct A.I.D. Contract with a U.S. Firm or Association
(g) Other Expatriate Specialists (Management, Planning, Administration, Financial, Commercial, Data Processing, Technical Functions) (20)	Short Term	5	Direct A.I.D. Contract with a U.S. Firm or Association

TABLE 12 Continued

Nature of T.A.	Type	Person Year(s)	Type of Contract and Source
(h) Volunteer Expatriate Specialists (Management, Administration, Financial, Commercial, Technical Functions Planning) (60)	Short Term	5	Volunteer Sister-Utility Exchange Program with U.S. Electric Utilities
(i) Pakistani Professionals (Management, Planning, Administration, Financial, Commercial, Data Processing and Technical) (12)	Long Term	58	Local Hire or Sub-Contractor Furnished Employees of A.I.D. Contracted U.S. Firm or Association
(j) Civil Engineer (1)	Long Term	2	Direct A.I.D. Contract(PSC)
(k) Local A/E Consultants to design and supervise Construction of Model Stores (Warehouses) and Customer Service Centers	Long Term	8	Direct A.I.D. Contract with a Local A/E Firm

Component 2 - Distribution Organization Training

(a) Advisor to Director Distribution Training Office(1)	Long Term	5	Direct A.I.D. Contract with same U.S. entity as Component 1 above
(b) Curriculum Specialists (2)	Long Term	6	Direct A.I.D. Contract with same U.S. entity as Component 1 above
(c) Technical Training Specialist (1)	Long Term	5	Direct A.I.D. Contract with same U.S. entity as Component 1 above

TABLE 12 Continued

Nature of T.A.	Type	Person Year(s)	Type of Contract and Source
(d) Lineman Training Specialists(2)	Long Term	4	Direct A.I.D. Contract with same U.S. entity as Component 1 above
(e) General Training Specialist and Lecturers (8)	Short Term	2	Direct A.I.D. Contract with same U.S. entity as Component 1 above
(f) Volunteer Lecturers and Training Specialists (48)	Short Term	4	Volunteer Sister-Utility Exchange Program with U.S. Electric Utilities
(g) Pakistani Professionals (Specialists and Trainers) (6)	Long Term	24	Local Hire or Sub-Contractor Furnished Employees of A.I.D. Contracted U.S. entity
(h) A/E Consultants to Design and Supervise the Construction of a Distribution Training Institute	Long Term	6	Direct A.I.D. Contract with Local A/E Firm

Component 3 - Distribution System Energy Loss Reduction

(a) Technical Energy Loss Reduction Advisor (1)	Long Term	5	Direct A.I.D. Contract with same U.S. entity as Component 1 above
(b) Pakistani Engineers to Monitor and Inspect Rehabilitation Design and Construction Activities for Fixed Amount Reimbursement (5)	Long Term	20	Local Hire or Sub-Contractor Furnished Employees of the A.I.D. Contracted U.S. entity

TABLE 12 Continued

Nature of T.A.	Type	Person Year(s)	Type of Contract and Source
Component 4 - Power Generation			
(a) Combined Cycle Power Generation Specialists (4)	Short Term	1	IQC-Direct A.I.D. Contract
(b) Engineering Services (2)	Long Term	4	U.S. Firm, Host Country Contract
Component 5 - Rural Distribution System Expansion			
(a) Rural Electrification Engineering Advisor (1)	Long Term	3.5	Direct A.I.D. Contract with same U.S. entity as Component I above
(b) Pakistani Engineering and Administrative Professionals to Monitor, Inspect and Approve Sub-Project Selection, Design and Construction for Fixed Amount Reimbursement (7)	Long Term	28	Local Hire or Sub-Contractor Furnished Employees of the A.I.D. Contracted U.S. entity

Five person-years of assistance is scheduled to be provided under component 4 to assist WAPDA first to finalize specifications, economic analyses and tender documents and subsequently to monitor the fabrication of the equipment, monitor construction, and arrange for the training of operators and maintenance personnel. The construction schedule dictates that the first type of assistance be provided as soon as possible. Consequently, the Mission will arrange for short-term assistance through an A.I.D. Indefinite Quantity Contract (IQC) immediately following the signing of the Project Agreement. The balance of the assistance is required by the Office of WAPDA's General Manager for Generation, which has extensive experience contracting such assistance. Consequently, this assistance will be contracted by WAPDA from the United States in accordance with A.I.D. Handbook 11.

A novel aspect of this project and its technical assistance and training proposals is the Sister Utilities Exchange Program. Under it, technical assistance will be provided on a volunteer, no-charge basis by American public and private electric utilities, including cooperatives. One of the primary responsibilities of the prime technical assistance contractor will be to develop and manage this Program. This Program is discussed in greater detail in the description of component 1 and the Administrative Analysis Section.

It should be noted that 62 percent of the total person-years of assistance programmed for the TAT will be provided by Pakistani professionals. This approach was adopted because of the need for local experience and know-how. Another reason is to be able through them, to cost effectively extend the services of the TAT to all of the more than 700 administrative units of the Office of the General Manager of Distribution that are scattered throughout the country. A third and equally important reason is that such an arrangement will provide on-the-job training and strengthen local private sector consultancy capability. WAPDA's Area Electricity Boards already draw heavily on the private sector, and it is important that its capability be strengthened simultaneously as the GMD and area Electricity Boards are strengthened.

D. Training Plan

Three categories of training will be provided under this project. The largest and most important category falls under the Distribution Function Training component. Under this component, a comprehensive training program will be developed for all distribution function officers and employees of WAPDA, and a training institute will be designed, constructed and equipped to provide training to senior and middle level managers assigned to distribution functions. The definitive program which will be developed as soon as possible following the signing of the Project Agreement will provide

limited long and short-term training and internships in the United States and a broad range of in-country courses. An illustrative program is found as Item D in Table 13.

The second category of training is the specialized short-term type that will be provided under components 1,2 and 3 to prepare WAPDA Project Implementation Staff and Pakistani TAT members to be effective members of the project implementation team. Under this category, a total of 114 persons will be provided from 2 to 3 months of short-term training in the United States. Two-thirds of this amount will be for WAPDA Project Implementation Staff and one-third for Pakistani members of the TAT. Details of this category of training are also provided in Table 13.

The third and last category of training is the smallest in terms of scope and the number of persons to be trained. WAPDA technicians will be sent to the U.S. to work in electric utilities or to attend supplier organized classes to learn how to operate the gas turbines and other equipment that will be provided under the Power Generation component.

E. Evaluation Plan

Three evaluations will be conducted during the life of the project. They will be complemented by regular joint USAID - WAPDA progress review meetings following the release of quarterly project reports. The first evaluation will be conducted in March 1984, approximately twelve months after the arrival of the core technical assistance personnel who will work on components 1,2 and 3; the second, approximately twenty-four months later in March 1986; and the third, or terminal evaluation in March 1988 when all major project activities have been completed or are near completion.

The first evaluation will be designed to assess progress achieved in implementing activities in accordance with the proposed implementation schedule. In particular, progress in preparing the Master Plan, the Comprehensive Training Program, and the System Energy Loss Reduction Program, in implementing the Power Generation component, in establishing the Sister Utilities Exchange Program, and in ordering commodities will be examined. The adequacy of technical assistance and institutional arrangements to undertake these activities will also be assessed. On the basis of this evaluation, necessary adjustments will be made in the amount and scheduling of inputs, the project budget, and implementation mechanisms.

During the second evaluation, progress achieved and problems encountered in implementing all project components especially the Rural System Expansion component will be examined. Data on the power demand-supply gap will be reassessed, and the

TABLE 13

PROPOSED TRAINING PLAN

Project Component	Type of Training	Length of Training	Place of Training	No. of Participants	Proposed Schedule
A. Training of WAPDA Implementation Staff					
1. Institutional Development	Internship or Specialized Course	2-3 months	U.S.	36	FY 83
2. Distribution Function Training	" "	" "	"	16	" "
3. Distribution System Energy Loss Reduction	" "	3 months	"	8	" "
4. Power Generation	-	-	-	-	-
5. Rural Distribution System Expansion	Internship or Specialized Course	3 months	U.S.	16	FY 83/FY 84
B. Pakistani Members of Technical Assistance Team					
1. Institutional Development	Internship or Specialized Course	2-3 months	U.S.	18	FY 83
2. Distribution Function Training	" "	" "	"	8	" "
3. Distribution System Energy Loss Reduction	" "	3 months	"	4	" "
4. Power Generation	-	-	-	-	-
5. Rural Distribution System Expansion	Internship or Specialized Course	3 months	U.S.	8	FY 83/FY 84

TABLE 13 Continued

Project Component	Type of Training	Length of Training	Place of Training	No. of Participants	Proposed Schedule
C. Training of Gas Turbine Operators					
Power Generation	Internship or Specialized Courses	To be determined	U.S.	To be determined	To be determined

D. Illustrative Comprehensive Program For Distribution Function Training (See Annex S for Details)

1. Summary of Short-Term U.S. Training

a. Short Courses

Course	Duration	Average Annual Participants	Frequency	Total Project Participants
Organization and Operation of Rural Electrification System	6 weeks	10	Annually	50
Electric Utility Management and System Planning	4 weeks	30	Three times a year	150
Total:		40		200

b. On-The-Job Training Sister Utilities Program

Average Length of Exchange	Average Number of Exchanges Per Year	Number of Years	Total Number of Exchanges
4 months	40	4	160

TABLE 13 Continued

2. Long-Term U.S. Academic Training

Subject	Degree	Total Project Participants
Vocational/Technical Education	Masters	2
Instructional	Masters	2
Finance/Accounting	MBA	2
Inventory Procurement Management	MBA	2
Marketing	MBA	2
General Management	MBA	2
Computer Management Information Systems	MBA	2

3. Summary of In-Country Training

Course Category	Number of Courses	Average Annual Participants	Number of Years	Total Project Participants
Electric Utility Management	15	900	4	3,600
Commercial	8	400	4	1,600
Financial	12	480	4	1,920
Power Distribution Energy(Technical)	15	380	4	1,520
Automated Data Processing(ADP)	2	80	4	320
Procurement & Inventory Management	5	380	4	1,520
Supervisory Management	5	600	4	2,400
Technical Supervisor	8	640	4	2,560
Training of Trainers	7	150	5	750
Construction Management	6	180	4	720
Vocational-Technical	8	2,850	4	11,400
Total:	91	7,040		28,310

operational efficiency of Phase I of the Guddu Combined Cycle Gas Turbine Project will be determined. The adequacy of the Work Order System and FAR mechanism for implementing components 3 and 5 will also be studied. Progress in constructing the training facility, customer service centers, and the warehouses will be looked at as well as the effectiveness of the technical assistance and training programs. As a result of this evaluation, necessary modifications will be made in the design of the project, the budget and/or the implementation plan.

The third and final evaluation will measure the overall impact of the program including an analysis of the project beneficiaries, an assessment of the actual economic impact of the project, and an assessment of the extent to which institutional improvement and technology transfer have occurred as a result of the comprehensive technical assistance and training programs. Actual outputs will be measured against projected outputs, and an attempt will be made to quantify the extent to which the goal and purpose of the project were achieved. Another important objective of the terminal evaluation will be to record the Mission's experience with the Rural Electrification Project for future use by the Mission, the Agency, the GOP, WAPDA and other donors.

It is anticipated that participants in the first two evaluations will include: two or more senior WAPDA officials, a representative of the GOP's Ministry of Water and Power, USAID Mission staff, two AID/Washington staff and at least one senior member of the home office of the principal technical assistance contractor for components 1,2,3 and 5. Depending on the need at the time, it may also be desirable to draw on the home office staffs of the component 4 contractors to participate in the evaluation. The evaluation team for the terminal evaluation will consist of GOP/WAPDA representatives, USAID staff, AID/Washington personnel, and up to two outside experts from reputable U.S. organizations involved in rural electrification. Each evaluation will require 4-6 weeks and will involve site visits, interviews with appropriate personnel, and review of secondary source data.

V. PROJECT ANALYSES

A. Technical Analysis

The project as a whole as well as its individual components are technically feasible and sound. The technical assistance and training to be provided will build on the education and experience base existing in WAPDA. Various combinations of training for management, professional and technical staff and the skilled construction, operation and maintenance personnel will assure implementation and assimilation of practices and technologies currently in use in well run and efficient utilities around the world.

1. National Rural Electrification Master Plan

The size, cost and complexity plus the expected economic and social impact of Pakistan's National Rural Electrification Program dictate that a Master Plan be developed to guide its implementation. WAPDA already has contracted local consultants who are currently gathering and integrating basic physical and economic data which will be used to support the development of a National Rural Electrification Master Plan (See Annex P). The A.I.D.-funded Technical Assistance Team will participate in the analysis of that data, provide selected expertise, economic and technical models, and advise on the final drafting of the Master Plan.

2. Distribution System Planning and Design

WAPDA's standards for distribution system planning design are set forth in its Engineering Memorandum No.4, a formal internal publication that was prepared in 1966 by a recognized American engineering consulting firm. While the document treats all important aspects of distribution system operation (reliability, energy losses and so forth), it is outdated. Current WAPDA design standards do not take fully into account the major changes in energy economics since the drastic changes in oil prices starting in 1973. The Technical Assistance Team will work with WAPDA to review and update WAPDA design and construction standards, instructions, specifications and drawings to produce the most economic operating system conditions.

Mission studies have determined that a very serious problem for WAPDA is the energy lost in the power system due to technical (poor design standards) and administrative or non-technical losses (malfunctioning meters, improperly read or recorded meter readings, pilferage, and the like).

This loss in PFY 1980/81 accounted for 31.33 percent of all energy generated (See Table 1). This represents a serious waste of natural resources, reduced economic benefits and dissipated financial resources for WAPDA, the GOP and the nation. The Detailed Project Description, under the Distribution System Energy Loss Reduction component describes how this project will address this major problem. A valuable guide in this work will be the soon-to-be released World Bank Research Project Report R-633, "Energy Efficiency : Optimization of Electric Power Distribution System Losses". The World Bank is very much interested in assisting developing countries to reduce power system energy losses. On learning of the Mission's concern in this area, the Bank made available a draft of its recent study. This study confirms that the calculations used by the Mission as shown in Annex M-2 through M-7 ("Energy Loss Reduction Calculations for Illustrative Work Orders") are realistic and even conservative in projecting the amount of energy savings. The methodology to be employed in reducing losses is technically sound. Significant savings will be achieved immediately upon upgrading of the distribution system components.

Additional energy savings by reduction of losses are achieved by reducing the amount of peak load demand. To the extent that load management can shift energy use from peak demand periods, the current in the supply lines is reduced. Energy losses are a function of the square of the power line current. Accordingly, a small reduction of the electrical current provides meaningful energy savings. The magnitude of the peaking problem is seen from the daily load curve (of September 1, 1981) (See Annex M-8). In Annex M-9, the load has been rearranged and an approximately 260 MW reduction in peak load demand has been achieved. This type of load rearrangement, in addition to providing energy savings due to reduction of line losses, also would mean that load shedding would be reduced by 260 MW. Many feeders would be saved from disconnection during the peak load hours, resulting in better power service to thousands of consumers.

3. Rural Distribution System Expansion

The Rural Distribution System Expansion component will be implemented in accordance with the National Rural Electrification Master Plan and individualized Work Orders. Each Work Order will be reviewed and approved by the Technical Assistance Team to assure technical and economic soundness. A general feature of the designs now shown to be most economic (by minimizing powerline energy losses) will place larger conductors in the distribution system and heavier conductors in transformer and regulator windings.

These changes will automatically build in larger electrical and mechanical safety factors and will improve the surge current capacity of lines built with the new designs. All system expansion work carried out will provide improved service on technically sound circuits. The technical soundness of the rural distribution system is being improved by the strengthening of the WAPDA transmission system and the installation of many new grid substations. This work has had major support from the World Bank under its First, Second and Third Power Loans. The extent of this work can be seen from Annex M-10 which summarizes the numbers of grid substations and new transmission lines being installed. Annex M-11 depicts the area of Pakistan now within economic service range of 30 miles or less from a grid substation (each substation represented by a dot). The shaded area is very sparsely populated and where electric service is required, 11 KV circuits with lengths in excess of 30 miles will be used until this size of load in an area (covered by a radius of 30 miles) justifies the major investment of a new grid substation.

The objectives of providing additional rural connections without worsening the demand-supply power gap and, in fact, to reduce that gap will be achieved by this project. If the target of 215,700 connections is reached (including tubewells, agro-industries and others who would shift from diesel engines to electrically powered engines), the demand increase would come to no more than 300 MW. The project, by financing additional generation capacity will add between 300 and 400 MW on the supply side (depending upon the time of year); the energy loss component will in effect add at least another 100 MW. Thus, the project is soundly designed, in technical terms, to achieve its purposes and objectives.

4. Construction Estimates

All construction cost estimates involving imported commodities are based on actual 1982 costs and are projected to the year when construction is scheduled to take place with an allowance for cost escalation of 10 percent per annum. In the case of construction using local materials, 1982 costs were projected on the basis of 20 percent inflation per year.

Construction cost estimates for the Distribution System Energy Loss Reduction component Work Orders have been developed by: (a) taking actual costs for carrying out sub-component installations as shown in Annexes M-12 through M-16; and, (b) preparing illustrative Work Order estimates as shown in Annexes M-17 through M-21. These estimates are purely illustrative, and due to the nature of the work, testing and analysis will be necessary after arrival of the Technical Assistance Team to locate areas and specific circuits for upgrading. The Work Orders will likely average $250,000 each for purposes of administrative control. Each Work Order will be reviewed to determine its technical as well as economic soundness.

The cost estimate of the Power Generation component was developed with the assistance of A.I.D. consultants. Their work confirmed estimates developed by WAPDA and the consulting firm retained by WAPDA to prepare an extensive feasibility study.

Rural Distribution System Expansion component costs were developed by :

a. taking actual costs for carrying out sub-component installations as shown in Annexes M-12 through M-16;

b. combining the subsections developed in (a)above, into illustrative Work Orders, (See Annexes M-22 through M-25) to show typical Work Order costs for years 1982 through 1988; and,

c. combining Work Order costs with the targeted number of new connections desired for each province(Annex M-26 and the total number of Work Orders per province as shown in Annex M-27. In this way, costs for each province for each year during the project were obtained. The total of these equaled $101,162,798. Of this amount, the estimated cost of imported materials was $33,083,821 (as shown in Annex M-28).

5. Automated Data Processing

A comprehensive assessment of WAPDA's Automated Data Processing (ADP) needs will be undertaken by the Technical Assistance Team as recommended by SER/DM (See Annex K). The purchase of ADP hardware and software will be based on the findings and recommendations of that assessment.

6. Power Generation

The combined cycle power generation facilities that will be partially financed under component 4 will use heavy duty gas turbine engines to drive electric power generators. In a combined cycle operation, the heat from the gas turbine exhaust is captured in a heat recovery boiler and used to generate steam. The steam drives conventional steam turbines which in turn drive electric power generators. The combined use of the two technologies, gas turbines and steam turbines, raises the thermal efficiency of the overall plant to make it one of the most efficient designs in the power industry. For WAPDA, the Guddu Combined Cycle Gas Turbine Plant will be the most efficient of all its thermal power generation stations.

Normally both cycles of a combined cycle facility are constructed and placed in service at the same time. Because of WAPDA's serious power generation shortfall problem, WAPDA will install this facility in two phases as shown in Figure 1. Phase I is the gas turbine portion of the facility and Phase II is the heat recovery steam power generator portion. From a strictly technical operating point of view, it matters little whether or not the two phases are constructed at the same time as long as the design of the first phase contemplates the addition of the second phase. However, until the second phase is installed and placed into operation, all of the energy required to operate the second phase will be lost, wasted into the atmosphere with the exhaust gas from Phase I. WAPDA has assured the Mission that steps are being taken to arrange financing for Phase II to minimize the time between placing Phase I and Phase II into operation. Project implementation procedures will require A.I.D. approval of the final design of both Phases I and II of the Guddu Combined Cycle facility. The overall project feasibility will be reviewed and a determination will be made that it is both technically and economically sound prior to release of project funds for this component.

7. Training Methodology

Training will consist of three broad categories: (a) Classroom instruction will be limited to from one to four weeks depending on subject matter and combined with three to six months work-related experience after which the student will return to the classroom for review, examination and certification before proceeding to the next higher learning level in his selected career path; (b) Vocational apprentice programs will be established for trades and crafts to combine on-the-job training supplemented by classroom work and/or home study as appropriate; and (c) a Sister Utility Program will be established as described in component 1.

a. Training Modules

The technique of combining theoretical and practical training is not new. Numerous engineering universities and other institutions of higher learning in the U.S. as well as elsewhere in the world have curricula which require a series of classroom studies for 12 weeks followed by 12 weeks of work-related effort until a Bachelor's degree is earned. Public utilities and other industries are anxious to participate in these programs and graduates usually have good positions awaiting them, as they are generally adjudged to be superior to the graduate who has received only theoretical training. This approach is particularly suited to an accelerated training

program because : (i) it permits planners to assign course priorities according to agreed-upon needs, thereby enhancing productivity at a more rapid rate than is otherwise possible; (ii) it is consistent with tried and proven adult learning principles in that it permits quick application of knowledge and skills learned in the classroom; and, (iii) it is responsive to the supervisors' reluctance to permit staff and employees to be away from their job responsibilities for long periods of time.

b. Classroom Training

Formal classroom training is needed for employees being inducted into WAPDA so that they can learn WAPDA procedures and strengthen specific professional and technical skills(e.g. accounting, commercial procedures, use of electrical equipment) that are inadequate at the time of initial employment. Equally important are formal classes to upgrade the skills of existing employees to improve performance in current jobs and to prepare them for higher level positions.

Though much of this training requires initial acquisition of knowledge before it can be applied on the job, it is important that formal coursework be designed to include considerable time for practice in applying the material covered in lecture/formal presentations. Continued reinforcement of material covered in the classroom through techniques such as the use of case studies, performing specific tasks involved in the job, visits to field offices, and laboratory demonstrations and practice are essential ingredients to the success of formal training courses. Developing an appropriate mix and sequence of learning activities is a major component of curriculum development, and existing courses offered at various training centers will require considerable improvement to ensure that the material is appropriate, well presented, and comprehensible to students. Such classroom training must also be designed in such a way that the differences in prior education, training, and work experience reflected within groups of students are considered. Thus in some courses, supplemental modules might be prepared to augment material for individuals having problems in particular areas.

The development of training aids, supporting material to lecture presentations, and other learning devices (many of which will have to be translated into Urdu) will be required to ensure that the formal classroom experience is productive. In the early phases of curriculum development and initial delivery of courses, particular attention will be given to the evaluation of courses to determine what improvements are

necessary. For certain kinds of courses, it may be desirable to establish minimum achievement/performance levels for each module which must be passed before students proceed to the next module within a course. A varient of this approach would be to spread a formal course over a 3 - 9 month period during which students would spend 1 - 2 weeks in formal training every 2 - 3 months covering a particular course module, and at the conclusion of all modules would have satisfied the course requirement. Those who had trouble with a particular module could return to the training site 1 - 2 days before the second module to review material and strengthen their understanding/competency in the material covered in the previous module.

These and related approaches to formal training, all of which build on adult learning principles, will be incorporated into the formal courses which will be developed so that the knowledge and skills imparted are, in fact, used back on the job.

c. Apprentice Programs

Vocational apprentice programs date back to the beginning of the Industrial Revolution in Europe where an apprentice entered a vocation as a helper performing menial tasks and "learning by doing" under the watchful eyes of skilled craftsmen until he acquired the knowledge and skill to become a craftsman himself. Over the years, it has been determined that the inclusion of classroom/home study can reduce the apprenticeship period from 10 to 12 years down to a maximum of four years and develop equally as good or better craftsmen. This type of training is the best way to develop qualified linemen, metermen, relay technicians and the other electrical technicians that are necessary for the successful operation and maintenance of a distribution network. It will, however, require the reorientation of managers and supervisory personnel to plan and organize their work, to delegate appropriate responsibility, to direct the overall activity and to monitor achievements at key check points as the work progresses.

d. Sister-Utility Exchange Programs

Sister-Utility Exchange Programs encourage staff to share experiences and exchange ideas through exchange of documents, policies, procedures and professional and non-professional staff. Staff exchanges between utilities have varied in length from one month to one year, depending on the objective of each exchange, and have involved personnel from Line Foreman to Chief Executive Officers. The program has been instrumental in promoting self-improvement and has created a positive quest for excellence heretofore not achieved.

The sister-utility program has proved itself in many countries and is technically sound.

8. Summary

All five project components are based on technically sound analyses, proven methodologies, and on analytical safeguards which assure prudent use of project funds.

9. Background Information

Annex M contains the following detailed information in support of the technical analysis of this project :

M-1	Historical Load Growth of WAPDA's Power System
M-2	Energy Loss Reduction Calculations for Illustrative Work Order No.1
M-3	Energy Loss Reduction Calculations for Illustrative Work Order No.2
M-4	Energy Loss Reduction Calculations for Illustrative Work Order No.3
M-5	Energy Loss Reduction Calculations for Illustrative Work Order No.4
M-6	General Expression for Calculating Energy Loss Reduction Achievable by Changing Conductors
M-7	General Expression for Calculating Energy Loss Reduction Through Application of Feeder Capacitor Banks
M-8	Breakdown of Actual WAPDA Daily Load (Demand) Curve
M-9	The Potential Benefit of Load Management
M-10	World Bank Funded Third WAPDA Project Grid Stations and Transmission Lines
M-11	Location of and Access to National Grid Substations on Completion of Third WAPDA Project
M-12	Estimated Cost of Material for Domestic, Residential, Community, and Commercial Connections

M-13	Estimated Cost of Material for a 50 KVA Pole-Mounted Distribution Transformer, Three-Phase 11,000-400/230 V, 50 Hz
M-14	Estimated Cost of Material for One Mile of Primary (11,000 volt) Three-Phase Line Assuming One Cut-Off per Mile and a Span of 450 ft. (Rabbit Conductor equivalent to 1/0 ACSR)
M-15	Estimated Cost of Material for one Mile of Secondary (230/400 Volt) Three-Phase Line Assuming 170 ft. Span of ANT Conductor (equivalent to # 1/0 AAC)
M-16	Estimated Cost of Material for a 25 KVA Pole-Mounted Distribution Transformer, Three-Phase 11,000-400/230 V, 50 Hz
M-17	Estimated Cost of Illustrative Work Order No.1
M-18	Estimated Cost of Illustrative Work Order No.2
M-19	Estimated Cost of Illustrative Work Order No.3
M-20	Estimated Cost of Illustrative Work Order No.4
M-21	Estimated Cost of Illustrative Work Order No.5
M-22	Estimated Cost of an Illustrative Rural System Expansion Work Order for Punjab Province
M-23	Estimated Cost of an Illustrative Rural System Expansion Work Order for Sind Province
M-24	Estimated Cost of an Illustrative Rural System Expansion Work Order for Northwest Frontier Province
M-25	Estimated Cost of an Illustrative Rural System Expansion Work Order for Baluchistan Province
M-26	Illustrative Number of Connections Per Model Work Order

M-27 Illustrative Annual Distribution of Work Orders of the Rural Distribution System Expansion Component by Province

M-28 Illustrative Distribution and Estimate of Cost of Imported Commodities for Rural Distribution System Expansion Component

M-29 Number of Villages Electrified

M-30 Breakdown of WAPDA Power Generation by Type of Generation Plant

M-31 Frequency Distribution of Number of Villages by Total Population in Each Province

M-32 Number of Villages by Population and Province

M-33 Kilometers of Primary (11,000 Volt) and Secondary (230/400 Volt) Power Distribution Lines Installed by WAPDA

M-34 Number of Tubewells by Ownership and Province in Pakistan (As of 6/30/75)

M-35 Number of Tubewells (Shallow and Drilled) by Type of Power (As of 6/30/75)

M-36 Growth Trend of Tubewells in Pakistan by Type of Power, 1971-1979

M-37 Growth Trend of Tubewells in Punjab Province by Type of Power, 1971-1979

M-38 Growth Trend of Tubewells in Sind Province by Type of Power, 1971-1979

M-39 Growth Trend of Tubewells in Northwest Frontier Province by Type of Power, 1971-1979

M-40 Growth Trend of Tubewells in Baluchistan Province by Type of Power, 1971-1979

B. Administracive Analysis

1. Institutional Improvement

Electric utilities everywhere are capital intensive enterprises with three basic functions: power generation, transmission and distribution. The generation function is concerned with the planning, design, construction, operation and maintenance of a relatively small number of large, highly technical facilities, called upon to generate the amount of electric energy needed at the time required, at minimum costs. The concern of the transmission function is the planning, design, construction, operation and maintenance of a relatively small number of high voltage transmission lines and sub-stations required to transmit bulk electric energy from generation plants to consumption centers.

Distribution, the third basic function, is different from generation and transmission to such an extent that it is often the responsibility of separate companies, cooperatives or government entities. The main concerns of the distribution function are commercial: sales; collection of revenue; new customers; customer complaints; tariffs; public relations; and, other aspects of the delivery of electricity to end users. The distribution function is also concerned with supply-demand projections and the planning, design, construction and maintenance of lines, transformers and other technical matters -- all attuned to the needs and problems of existing and potential customers.

The distribution function is generally divided into three basic line sub-functions: technical (engineering); commercial (customer service); and, financial. Administration also is important but generally it is a staff rather than a line function. The technical function is staffed mainly with engineers, draftsmen, linemen, meter testers, and meter installers while the commercial and financial functions are staffed predominantly with business administrators, accountants, meter readers, bookkeepers, clerks, cashiers and warehousemen.

In Pakistan, there are two electric utilities. One is KESC which serves Karachi. The other, which serves the balance of the country, is the Power Wing of WAPDA. WAPDA itself, as its name indicates, was organized as a development authority and still has responsibility for a broad range of activities in addition to electric power. Since it was created in 1958, its focus has been and continues to be on the planning and execution of very large infrastructure projects. That focus is still reflected in its organization, its management style, its staffing and other

administrative policies and practices and by the low status and priority that until recently it has assigned to its power distribution function.

WAPDA's Chairman, Member Power and other senior officers are keenly aware of the need to focus more attention on the distribution function and have already started to take steps in that direction. The most significant action to date was the creation in 1981 of eight Area Electricity Boards. Another measure being considered because of the size and complexity of the Power Wing is the consolidation of all power distribution functions into one administrative unit and the elevation of that unit to the status of a Wing. The balance of the present Power Wing would then become the Power Generation and Transmission Wing. Figures 2 and 3 show how WAPDA is currently organized while Figure 4 shows how it might be organized if a Distribution Wing were created.

As indicated earlier, in many countries, power distribution is the responsibility of one or more completely independent commercial and service oriented entities that buy the energy they distribute from a large power generation and transmission entity. The advantage of the proposal currently being considered by WAPDA is that it allows the distribution function to develop and be managed as an independent operation under the auspices of an authority (WAPDA) responsible for the overall coordination of power generation, transmission and distribution. The proposal is administratively feasible. The technical assistance and training to be provided under this project will assist in the development and implementation of a sound plan.

2. Organization and Staffing of Distribution Field Offices

At present, WAPDA has over 700 distribution field offices (Area Electricity Boards, Circles, Divisions and Sub-Divisions) scattered throughout the country. Basic information about each of the eight Area Electricity Boards is provided in Table 14. Additional information and organization charts for each type of office are found in Annex N.

All distribution field offices have evolved in accordance with a horizontal expansion policy that was established in 1961 and has not been changed since. The policy fixes the number of employees and size of each field office in relation to the number of customers served and provides that each office split into two when the number of customers served or the number of subordinate offices reaches certain levels.

FIGURE 2

EXISTING ORGANIZATION OF WAPDA POWER WING

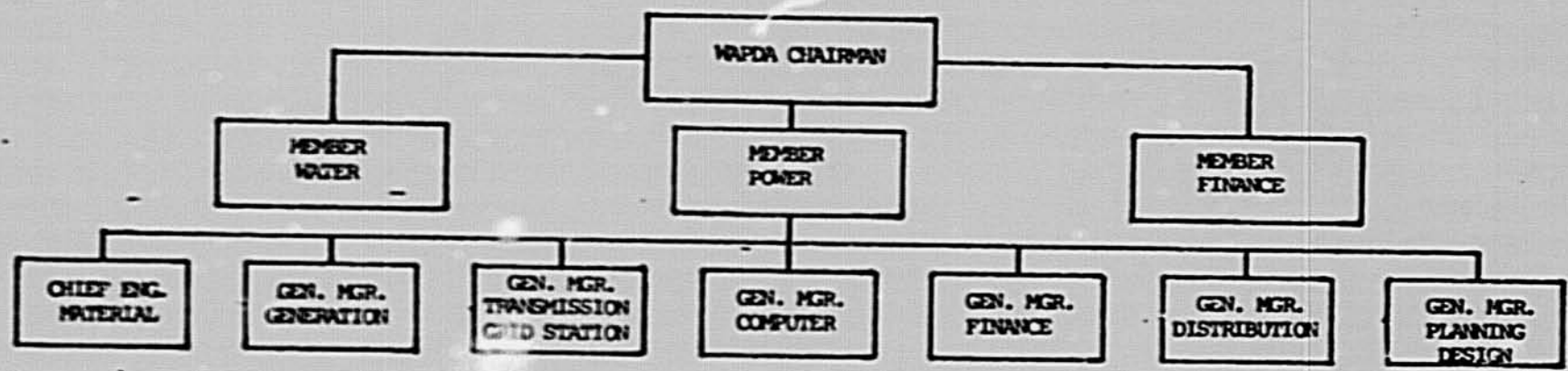
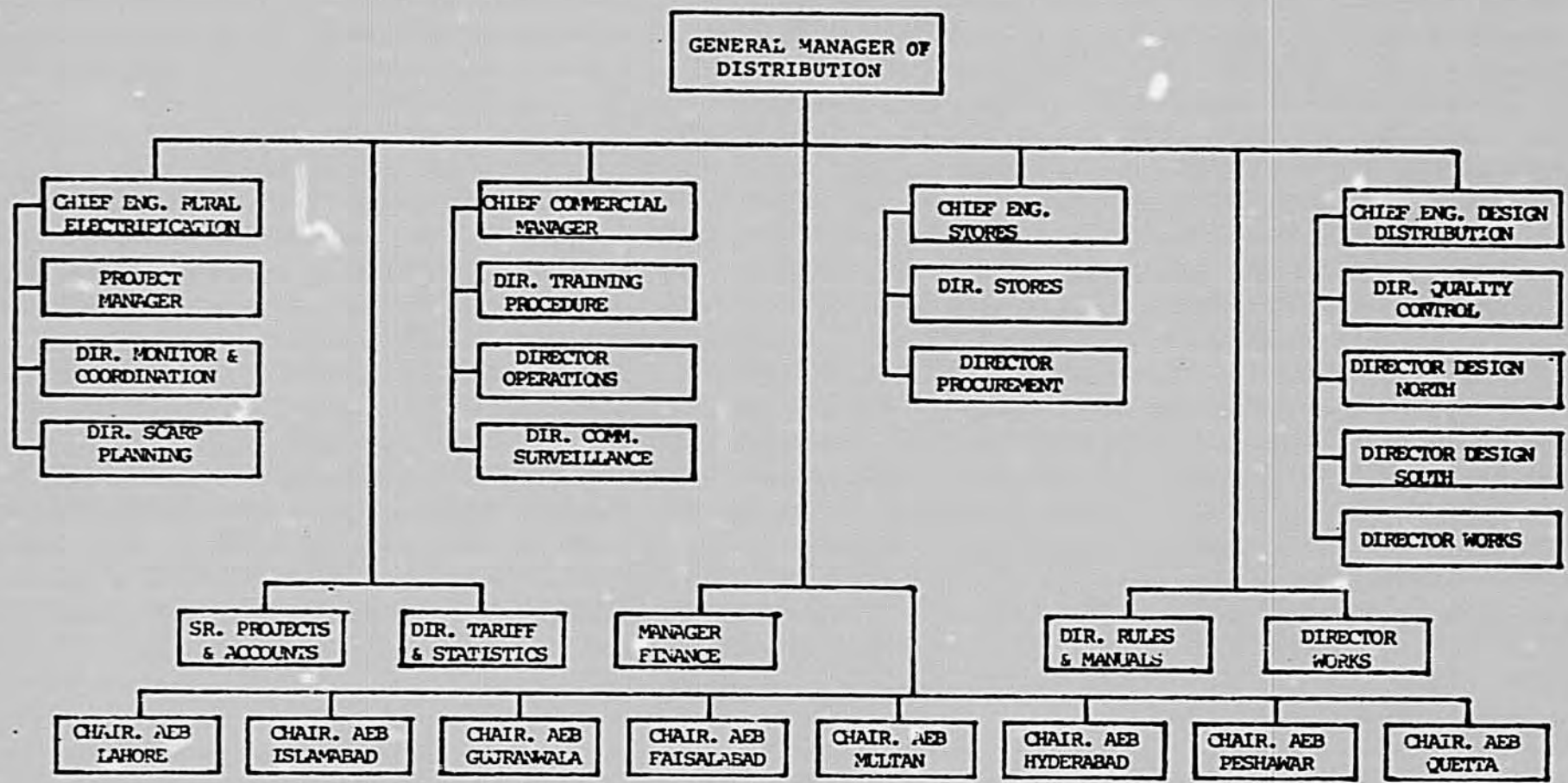


FIGURE 3

EXISTING ORGANIZATION OF THE OFFICE OF WAPDA'S GENERAL MANAGER OF DISTRIBUTION



NOTE: Organization Charts for AEBs, Circles, Operating Divisions, Construction Divisions and Operating Sub-Divisions are provided in Annex N.

FIGURE 4

ILLUSTRATIVE NEW ORGANIZATION OF WAPDA WITH A POWER DISTRIBUTION WING

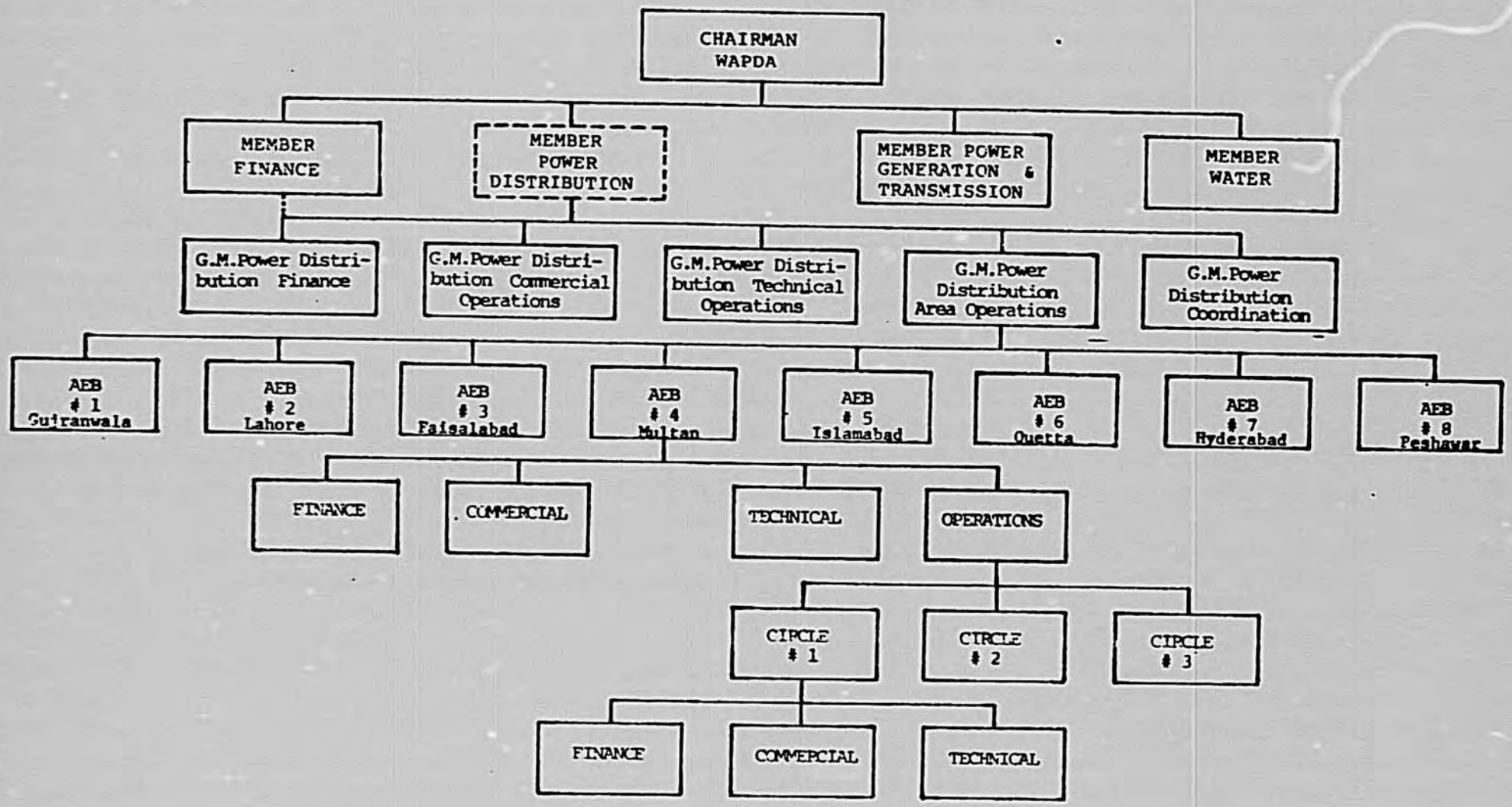


TABLE 14

BASIC INFORMATION ABOUT
WAPDA'S AREA ELECTRICITY BOARDS

No.	Description/Indicator	Name of Board: Gujranwala	Lahore	Faisalabad	Multan	Islamabad	Quetta	Hyderabad	Peshawar	TOTAL
1.	Area (Sq.Miles)	6,663	1,799	16,897	34,734	11,648	134,050	53,045	30,079	288,915
2.	Population (in 000s)	7,208	4,859	9,050	13,095	5,916	2,140	10,549	15,706	68,523
3.	Non Coincidental Maximum Demand	380	633	346	547	327	124	467	369	3,193
4.	No. of 11 KV Feeder	255	256	290	287	211	60	256	276	1,891
5.	Unit Received (GWHr) 7/81-6/82	1,008	2,496	1,947	2,086	1,552	472	1,534	1,741	12,836
6.	Unit Sold -do-	852	1,897	1,724	1,604	1,448	311	1,181	1,240	10,257
7.	Percent of Loss	16	24	12	23	7	34	23	29	21
8.	Net fixed Assets (as of 6/82) Rs.(M)	454	1,166	1,464	787	1,042	377	1,044	860	7,194
9.	Total value of billing for past 12 months (7/81 - 6/82)	795	1,392	932	966	782	127	757	27	5,778
10.	Total value of operational expenses for past 12 months (7/81 - 6/82)	32	92	88	24	105	58	167	87	652
11.	Consumers : Domestic	359	367	360	370	379	55	286	477	2,653
12.	(In 000s) Commercial	58	110	80	95	71	17	91	83	605
13.	Community	-	2	-	-	1	-	-	1	4
14.	Tubewells	24	14	15	20	8	4	12	15	112
15.	Small Industries	19	21	21	17	8	1	12	15	114
16.	Large Industries	-	1	-	-	1	-	-	1	3
17.	Grand Total	460	515	476	502	468	77	401	592	3,491
18.	Total Number of Villages	5,249	-	4,302	10,184	4,586	5,652	6,091	7,288	43,352
19.	Number of Villages electrified (as of June, 1982)	1,717	-	1,031	1,909	1,515	291	2,153	3,534	12,510
20.	Number of Circles	3	4	3	4	3	2	3	5	27
21.	No. of Operation Divisions	12	16	15	13	13	5	14	16	104
22.	No. of Operation Sub-Divisions	57	84	65	65	54	20	67	73	485
23.	No. of Construction Divisions	2	2	2	3	3	1	3	3	19
24.	No. of Const. Sub-Divisions	7	12	6	6	7	3	11	3	60
25.	Total No.of Personnel	7,330	10,369	8,385	6,050	7,878	2,305	6,026	9,480	57,821
26.	Total No.of Heavy Vehicles	30	27	15	30	28	19	54	43	246
27.	Total No.of Light Vehicles	81	265	92	81	99	54	230	138	1,040

SOURCE: Gathered by USAID/WAPDA Team at each A.E.B.

Note: Detailed information about each of the Area Boards is provided in Annexes N-1 through N-8.

In summary, Sub-Divisions grow until they have 9000 urban customers or 6000 rural customers; then they split in two. Operating Divisions are limited in size to six Sub-Divisions; after that number is exceeded, they also split in two. The recent creation of the Area Electricity Boards has prompted WAPDA to recognize the need to examine its distribution field office organization and staffing policy which have resulted in a very low (52 to 1) customer to employee ratio (See Table 15). A ratio of 300-500 customers for each utility employee is generally found in most electric utilities including many in developing countries.

The inherent low customer density of rural distribution systems and the resultant high capital and operating cost per customer make it imperative that WAPDA rationalize its distribution staffing policy as it accelerates rural electrification. The technical assistance and training that will be provided under this project will make it administratively feasible for WAPDA to conduct the studies, draw on the experience of others and make rational changes in its staffing and other related policies such as the use of vehicles, location of offices and the use of radios and computers.

3. Work Order Systems

Distinct Work Order Systems will be designed and used under this project to implement Energy Loss Reduction and Rural System Expansion activities. All modern electric utilities use such Work Orders to manage both capital investment and major maintenance activities. WAPDA already uses them for a number of its distribution activities including village electrification and distribution line rehabilitation. Technical assistance will be provided under component 1 of this project to improve existing systems, and training will be provided under component 2 to introduce the changes.

It is estimated that 130 Work Orders with an average value of $250,000 each will be required to implement all energy loss reduction activities of this project. Assuming that the energy loss reduction activities will be distributed equally among WAPDA's eight AEBs, each AEB will be required to design and implement an average of 16 energy loss reduction Work Orders over a period of about five years. Taking into account the size of the staff of each AEB, the fact that a Work Order can be approved and executed as soon as it is completed, and the amount of technical assistance and training which will be provided under this project, the design, approval, execution and general management of that small a number of Work Orders is clearly feasible.

TABLE 15

GROWTH OF WAPDA POWER WING EMPLOYEES AND CUSTOMERS

Effective As Of	Number of All Types of Employees in the POWER WING of WAPDA										Customer Data	
	Generation		Transmission and Grid Substations		Distribution		Other		Total	Number of Customers	Customer to Employee Ratio	
	Number	% of Total	Number	% of Total	Number	% of Total	Number	% of Total			Power Wing	Distribution
11/30/81	7,685	8.9	9,242	10.7	66,833	77.6	2,382	2.8	86,142	3,450,000	40.0	52.0
6/30/81	6,582	8.5	8,551	11.0	60,951	78.3	1,730	2.2	77,814	3,270,000	42.0	53.7
6/30/80	6,623	9.5	7,827	11.3	53,802	77.4	1,228	1.8	69,480	2,723,000	39.2	50.6
6/30/79	6,363	9.6	7,556	11.4	52,527	79.1	-	0	66,446	2,528,000	38.1	-48.1
6/30/78	6,106	11.0	6,781	12.2	42,509	76.7	-	0	55,396	2,280,000	41.2	53.6
6/30/77	5,701	11.1	6,292	12.2	39,392	76.7	-	0	51,355	2,050,000	39.9	52.0
6/30/76	6,556	14.0	6,178	13.2	36,955	79.2	-	0	46,689	1,856,000	39.8	50.2

Note: Annexes N-9 and N-10 show the Distribution Employees by age, position category and national pay scale.

The same is also true in the case of Rural Distribution System Expansion Work Orders which, though larger in number and value (159 work orders with an average value of $635,000 each) and with a shorter implementation period (3 3/4 years), are far easier and quicker to design and to execute.

4. Comprehensive Training Program

In-country training under this program is scheduled to start during the third quarter of the second year of the project to allow sufficient time to develop the new program, phase out current training efforts, arrange for additional training facilities, procure training aids, select participants, and train teaching staff. That much lead time plus the amount of training specific technical assistance that will be provided under this project assures the administrative feasibility of planned in-country training.

5. Summary

The organization and staffing improvements contemplated under this project will parallel accepted utility practices and, in fact, will advance initiatives WAPDA is already considering. Most important is the fact that WAPDA's management has identified many of the problems this project will address and is determined to rationalize and improve its operation. Project design is therefore administratively relevant, feasible and sound.

C. Social Soundness Analysis

1. General

An A.I.D.-financed survey of the impact of previous electrification efforts in twenty-five villages located in five regions of the Punjab, Sind, and the Northwest Frontier Province was undertaken by the Department of Anthropology of the Quaid-i-Azam University of Islamabad during the last six months of 1977 under the sponorship of WAPDA. The study indicated clearly that electricity is a familiar and desired service in the rural areas. Electricity is compatible with existing village social patterns. With the development of better access to service, increased energy use and exposure to mass media will result, increasing villagers' participation in the economic, political, and social life of the nation. At the same time, the survey revealed that existing electrical service is perceived by the rural populace as technically inefficient, unreliable, and hampered by logistical problems and an excess of bureaucratic red tape. The Rural Electrification Project will help to overcome these technical and institutional difficulties and will increase the delivery of dependable electrical service to rural areas.

2. Target Group Profiles

Four out of five of Pakistan's estimated 84 million people live in its 45,000 villages; a majority of the population depend on agriculture for subsistence. Eighty percent are illiterate. Nearly half are under age fifteen. One village in four is electrified; even in these villages, only one house of every four has electrical connections and receives power only two to four hours per day.

The basic unit of rural Pakistani society is the joint family household built around a father and his sons, or a group of brothers living and working together with their wives and children. Men's and women's spheres of work and life are sharply demarcated. Within most social groups, hierarchy is strongly expressed. Households are linked by kinship ties into lineages, which are key political and economic units.

Rural communities vary according to agroclimatic conditions and regional cultural patterns. Within the villages, households and kin-groups are ranked in socio-economic prestige hierarchies, and community cohesion is low. Joint activities center around village mosques.

Within most rural villages, energy needs are supplied by kerosene, firewood, and dried dung-cakes prepared by the women and children of each household. Many tubewells for agriculture are powered by diesel engines, as are sawmills and other small industries.

3. Socio-Cultural Compatability

Respondents to the impact surveys were nearly unanimous in their desire for village electrification. Most existing electric connections in the studied villages were domestic. In addition to lighting, seven out of eight user households possessed electric fans. Sixteen percent owned T.V. sets, and an additional forty percent planned to buy them soon. Eleven percent of user respondents owned tubewells, sawmills, cotton gins or other machinery. Communal uses of electricity included lighting for schools, offices, and mosques. Loudspeakers in mosques are used to summon the faithful to prayers and for public announcements as well. No negative impacts of electrification were observed in the survey.

4. Spread Effects from Rural Electrification

The benefits of electrification at the household and community levels are evident. Electricity users in all income groups reported greater satisfaction with their lives than non-users. Relatively few reported income increases directly attributable to electrification. This may be explained by the high percentage of domestic connections and the relatively poor quality of delivery of electrical service under the existing system of rural electrification.

Users of electricity have increased access to mass media, especially to radio and television. In the electrified villages, thirty-one percent of non-users reported watching (in shops or in other homes) one hour or more per day. In a society where literacy is low, broadcast media can serve as highly important vehicles for change. Rural electrification builds consciousness, increased awareness, and stimulates participation in national and local issues.

With continued and effective expansion of delivery of electrical service to rural areas, demand for electric consumables such as fans, televisions, radios, irons, and even refrigerators is likely to increase substantially.

Conversion of tubewells from diesel to electric should lower costs while continuing to expand productivity in agriculture, and more farmers should be able to purchase and operate cheaper electric tubewells in the project areas. Expansion of small-scale industries will be facilitated by village electrification, thereby raising rural productivity and providing additional employment.

5. Equity of Distribution of Project Benefits

Equity of access to rural electrification is most at issue between the relatively well-to-do and the less well-off among village households. Larger farmers and wealthier families have more contacts and influence with officials and can obtain services more easily. The cumbersome bureaucratic requirements associated with applications for electric service are an important factor inhibiting lower-income households from getting electrical connections. Costs (including under-the-counter costs) were reported to be the main reason why eighty-five percent of those non-users who had not applied for service had not made the effort. The Rural Electrification project will deal with this problem through the creation of consumer service departments in each sub-project area.

6. The Role of Women in the Project

As electricity is delivered more efficiently and more conveniently to homes and community facilities, enhancement of the quality of life for rural women and children will be an important consequence. Pakistani women will benefit directly from the provision of electricity for lighting and appliances and indirectly from the expansion of electrified agricultural and industrial equipment.

7. Summary

In view of the above analysis of the socio-cultural acceptability and impact of rural electrification in Pakistan, this project is deemed socially feasible and sound.

D. Economic Analysis

1. Introduction

The project design team prepared a draft project paper based on extensive and intensive data gathering and analysis. A major contribution of that team was a comprehensive economic analysis, which is basically reproduced in Annex O. The economic analysis presented in this text draws very heavily on that analysis.

For those components subjected to typical economic analysis (Energy Loss Reduction, Power Generation, and Rural System Expansion), the design team found that highly favorable rates of return were indicated, even when subjected to sensitivity analysis. The rates of return were substantially above those which were considered acceptable in recent IBRD and ADB energy projects. Projected economic returns also were higher than the opportunity cost of capital in Pakistan and compare most favorably with A.I.D. projects in general.

Following the departure of the design team, additional data were examined, some modifications in project design were made (although the basic design and strategy are unchanged), and the analysis was re-examined. The work undertaken since the team's departure has validated its findings. In fact, because of some of the design adjustments, an even more favorable overall rate of return can be projected.

2. Methodology

a. Institutional Improvement and Distribution Function Training Components

The activities of these two components are better evaluated by use of qualitiative economic analysis rather than the traditional quantitative analysis. To avoid unnecessary subjective assumptions with regard to amounts and timing of benefits, the qualitative approach has been used, and the examples included herein show very positive results.

b. Distribution System Energy Loss Reduction Component

This component, the objective of which is to reduce technical (heat) losses in WAPDA's expansive power distribution system, will be implemented in two steps. The first will be the development of a technical Energy Loss Reduction Program along the lines of World Bank Research Project Report No. R633 entitled "Optimization of Electric Power Distribution System Losses". Once the overall Energy Loss Reduction Program has been developed by WAPDA and the project is approved by the GOP and the Mission, the implementation of the component will begin.

Implementation will involve the actual location of elements throughout WAPDA's distribution system (overloaded lines, transformers, and so forth) that are causing high technical (heat) energy losses, the preparation of estimates on a prescribed Work Order format of how much it will cost to replace the elements and the savings to be realized, and finally the execution of approved Work Orders. The economical feasibility of the component as a whole is assured by the Work Order preparation procedures and approval system that will require each Work Order to have undergone a benefit-cost analysis as a precondition for its approval by A.I.D. Illustrative calculations are found in Annex M. These calculations demonstrate the range and magnitude of savings that will be possible depending on the physical characteristics of system elements that are causing the losses. The illustrative calculations and the model Work Orders used to estimate costs are generally simplified. In practice, each Work Order is likely to include a number of different energy loss reduction activities. However, the benefits and costs for the composite group of activities will be of the same magnitude as shown in the illustrative calculations given in Annex M. The Work Order analysis will be made on a comparatively "real time" basis, and costs of activities and energy loss reductions will be calculated on the basis of actual information available at that time. Earlier studies by the project design team provided internal economic rates of return of 70 percent for investments in energy loss reduction (see Annex O). Recent studies of the Mission and the World Bank indicate that benefit to cost ratios for energy loss reduction investments in distribution line upgrading for systems similar to WAPDA's will range from 5:1 to 15:1.

With the proposed program, it is expected that the working level involvement of WAPDA's technical staff and their awareness of progress and results will keep the program moving during the life of the project and that the training and experience will result in these procedures becoming a permanent part of the distribution organization working standards.

c. Power Generation Component

The Power Generation component is WAPDA's most urgent requirement. Recently, records from the WAPDA Load Despatching Office have been made available which document the extent of daily load shedding from region to region. The generation capability shortfall for the current fiscal year has lasted over six months and has reached a peak of 750 MW. Load shedding has been experienced for years and has, to some extent, curtailed new industrial investments, and load development in general (very obvious when electrical service applications are not acted on for a year or longer), and the overall economic growth of the nation has been impeded due to lack of adequate power service. WAPDA and Mission consultants in independent

studies have found the proposed Guddu Combined Cycle Gas Turbine Plant to be the most economical power generation facility. Also of great importance is the fact that gas turbine installations can be placed into service in the least amount of time.

The project design team analysis demonstrated that the component was economically justified. Subsequent analysis suggests that the benefits were probably understated. There appears to be no question, therefore, that this component represents a cost-effective assistance intervention. At this point, however, certain variables, essential to definitive economic analysis, are not entirely in place -- e.g. quantity and cost of fuel. For this and other reasons, WAPDA has agreed to the following:

i. WAPDA will proceed as quickly as possible to firm up additional required funding for Phase I (4 units of 100 MW and ancilliary equipment) and Phase II (heat recovery boilers, turbine generators, and the like);

ii. WAPDA will provide source, cost, quantity and quality information on the natural gas fuel contract; and,

iii. WAPDA, with technical assistance provided as soon as possible under this project, will submit an updated economic study of the overall Gas Turbine Generator Plant for A.I.D. review and approval. The Mission will review and, if justified, will approve the economic analysis and funding arrangements for this component prior to authorization of expenditure of project funds for commodity procurement and construction of the facility.

d. Rural Distribution System Expansion Component

The Rural Distribution System Expansion component, which is part of the USG assistance package negotiated in August 1981, will support the GOP's on-going rural electrification program and plans for expansion. However, given the very serious energy losses, the institutional weaknesses that have been identified, the need for training of distribution function employees, and the lack of an acceptable rural electrification plan, WAPDA, the GOP and the Mission have agreed to defer initiation of rural system expansion activities under this project until April 1985 or until the Guddu Gas Turbine units are operational. In the interim, the focus of the project will be on the development of the Rural Electrification Master Plan, institutional improvement, training, the energy loss reduction program and implementation of the Guddu Combined Cycle Power Generation Project.

It is anticipated that initiation of distribution system expansion can be undertaken in mid-1985 without further exacerbating the generation capacity shortfall. At that time, the AEB's will prepare Rural System Expansion and Connection Work Orders based on revised design and construction standards and economic and social guidance provided by the National Rural Electrification Master Plan that will have been completed by then. As indicated in the Detailed Project Description Section of this paper, this component will be implemented on a sub-project basis using a Rural System Expansion Work Order system. The benefit-cost analysis that will be required for each Work Order to be eligible for A.I.D. financing will assure the economic feasibility of the component as a whole.

Work Orders will be prepared and processed in a manner similar to that described in the Energy System Loss Reduction component. They will be reviewed and approved by the Mission when an acceptable benefit-cost ratio has been demonstrated. Examples of what might be included in Work Orders from different provinces and a summary sheet, which indicates how the overall expenditures for this component may develop, are included in Annex M.

Guidelines in the Master Plan are expected to encourage priority attention to the electrification of privately owned irrigation tubewells, agro-industries, and other industrial/commercial operations which make a meaningful contribution to the economy. Selection of connections to be made will also take into account the economic savings resulting from reduced imports of petroleum products (kerosene, diesel, lube oil and lubricants) which are displaced by use of electrical lighting and equipment. Specific economic analyses for displacement of petroleum products were made for sub-projects considered by the project design team in March 1982 and are provided in Annex O.

The delay in undertaking the Rural Distribution System Expansion component and the focusing of new services to provide greater saturation in "previously electrified villages", to industries and tubewells, are expected to make the benefit-cost ratio for the individual work orders and the overall project even more attractive than those developed in the analysis found in Annex O.

3. Project Benefits

a. Institutional Improvement and Training

The benefits that will accrue to WAPDA and to the economy of Pakistan as a result of the Institutional Improvement and Training components are likely to be substantial even if difficult to quantify. The benefits will be demonstrated by increases in the operating efficiency, increases in employee productivity, and improvement in the quality of employee output.

However, traditional analysis is not appropriate because these benefits are not marketed, do not have a price tag, accrue gradually over time, and are difficult to schedule. Nevertheless, it is possible to illustrate the nature and magnitude of these benefits by examining two illustrative examples.

The first example deals with reducing the large number of employees in the distribution area. (See Table 15 in the Technical Analysis Section.) The distribution work force has been growing at an average of almost 7,000 persons per year over the past several years. Streamlining the present work force, upgrading the skills of employees now on the payroll, and tightening hiring practices so that the rate of increase of new distribution function employees is reduced by half to about 3,500 per year would result in substantial savings in the form of reduced budgets for salaries and benefits. This savings would be in excess of Rs 200 million per year by the end of the 6-year project period (over $16 million at the $ 1.00 = Rs 12.16 rate of exchange on July 19, 1982). Streamlining the workforce further so that the ratio of number of customers served to number of Power Wing employees is increased from 42 to 80 percent per consumer (which would still be about one fourth comparable ratios in other LDCs) would save approximately Rs 512 million ($42 million equivalent) per year. Reductions of this magnitude may not be achieved during the life of this project. However, this project should produce considerable savings in this area, thereby yielding impressive benefits.

The second example deals with improvement in administrative practices. At present, the distribution energy losses are due, in part, to loose administrative controls. These losses are estimated to be a minimum of 6 percent of all energy sold, giving a current loss in energy sales revenues in excess of Rs 360 million (almost $30 million equivalent). Potential savings then at the present level of energy sales is almost $ 5 million for each 1 percent reduction in administrative losses. With the volume in power sales growing over 10 percent per year, savings resulting from improved administrative controls will grow proportionately.

There are numerous other scenarios and combinations of possible improvements that demonstrate that these two components offer substantial potential for savings and that if only a small portion of their total potential is realized, the benefits would outweigh by far the cost. The implementation of the Institutional Improvement and Training components will assist in bringing about basic changes of attitude of WAPDA's management and employees over the long-term with regard to organizational efficiency. A change of attitude and a policy which would require that new employees be literate and qualified are crucial if the Power Wing is to be an efficient and responsive electric utility organization.

Perhaps the best conceptual measure of the benefits that will result from these two components is suggested by the consequences of not undertaking them: energy losses will grow instead of diminish; ceteris paribus, the cost per unit of energy sold will increase; each year, the nation's economy will lose the equivalent of millions of dollars in revenues and wasted resources.

b. Distribution System Energy Loss Reduction

The benefits of this component derive from the value of the energy saved by decreasing the magnitude of energy loss between the grid substation and the end user. This project component will address only technical energy loss in the distribution part of the power system. This is absolutely wasted energy that escapes into the atmosphere as heat.

Should WAPDA obtain a loss reduction of 1 percent per year, the value of energy saved over the 5-year implementation period of component 3 would exceed $ 95 million. The annual energy savings at the end of the project would exceed 640 KWh or the equivalent of a 122 MW power plant in continuous operation at a load factor of 60 percent. The return on investment for this component is very high. In many instances, the return on investment in this type of activity during the first year would exceed 100 percent, and these savings would occur annually without further investment until system growth made upgrading a matter of economic necessity. Annex M contains several "Energy Loss Reduction Calculations for Illustrative Work Orders". The tables show for various distribution line improvement programs the KWH savings per year per dollar invested in the power distribution system improvement. For any situation providing savings of 20 KWH per year per dollar invested, the entire investment is returned in the first year. The benefit would be repeated for each succeeding year with essentially no additional investment.

Additional benefits of this component will result from changes of attitude by WAPDA's staff toward distribution system maintenance and rehabilitation. Once the staff recognize the great value of an energy loss reduction program, it is expected that not only will they maintain the rehabilitated system in order to continue realizing these savings, but that they will spread the practice to further reduce system losses and recover more of the energy now wasted. This component is a good example of what appropriate technology transfer and institutional development can bring in the form of large savings.

c. Power Generation

The analysis of this component will not be possible considering A.I.D. inputs alone. An integrated analysis will be made considering the plant as a whole. Inputs to be provided by

WAPDA, Japan, the Asian Development Bank, the Islamic Development Bank and others will be introduced into the cost side of the analysis in the years they are scheduled to occur without respect to source. WAPDA, with assistance from its engineering consultants and the Project Technical Assistance Team (TAT) will prepare for Mission review and approval a firm financial plan, updated costs and an economic analysis for the Guddu Combined Cycle Gas Turbine Plant. Approval and authority to proceed with utilization of project funds for commodity procurement for this component will be provided to WAPDA by a Project Implementation Letter. The combined cycle plant, using indigenous natural gas as fuel, will help meet the generation shortfall in the most expeditious way possible. Thus, it will help mitigate the need for load shedding and blackouts during peak load hours. There is little question that the value of electric power is very high for those consumers who reside or who have businesses in areas frequently subjected to blackouts. Given a choice, these consumers are willing to pay a much higher price for power during peak load hours to avoid blackouts. The price these consumers would be willing to pay exceeds that which they have to pay for substitute power if it were available. The cost of substitute power (either kerosene for lighting or diesel fuel for electricity and/or motive power) is three to five times the price of WAPDA electric power. Therefore, the benefit that will result from this component is even higher than estimated by the project design team.

d. Rural Distribution System Expansion

As mentioned earlier, Rural Distribution System Expansion will be carried out during the latter years of this project -- beginning about April 1985, if planned generation additions are made on schedule -- and the expansion work will be developed and implemented in accordance with the National Rural Electrification Master Plan. This Plan will be a joint effort of WAPDA, its Pakistani consultants and the Project Technical Assistance Team (TAT) and is based to a large extent on the approach developed by the project design team (see the Economic Analysis Annex O, Attachment B). The project design team found the internal economic rate of return (IERR) to be 23 percent for the base case situation and that the component was economically justified in all sensitivity analysis case studies. Those results were based on an implementation schedule which began investments in project year one. Due to more recent data from WAPDA, which demonstrate that present load shedding has reached 750 MW (with projections for PFY 1983/84 now reaching generation shortfalls of 912 MW), implementation of this component will be delayed until April 1985 by which time additional power generation capacity will be added to the system. This delay of adding new services until there is a better chance that power will be available during the critical evening hours plus utilization of the National Rural Electrification Master Plan which will require any proposed system expansion to pass economic feasibility

screening similar to that employed by A.I.D. will result in an even higher IERR for this component than was estimated by the project design team.

This component will yield substantial benefits to rural inhabitants in project areas. These benefits include an improved standard of living, increased irrigation and agricultural productivity, additional commercial activities, and an expansion of agro-based industries. The most immediate benefit is improved lighting. Based on the work of the project design team and subsequent design revisions, it is estimated that almost 190,000 rural families and community centers (mosques, schools, and the like) and about 17,000 commercial establishments will switch from kerosene lanterns to electric power for lighting as a result of the project. The rural residential or commercial consumer making the change to electricity will realize sizeable savings in fuel costs. The cost of the equivalent of one kilowatt-hour of lighting by kerosene lantern is estimated at Rs 4.45 as compared with Rs 0.80 for one kilowatt-hour of lighting with electricity. For the average rural electric consumer (one household connection), this represents a savings of about Rs 560 per year. For the average commercial establishment, this savings will be about Rs 1000 per year. The switch to electricity will result in an improved quality of life due to a more versatile form of lighting and a much safer environment with a marked reduction in fires.

Another benefit from changing to electricity will be increased productivity from motive power installations. At present, the most prevalent source of energy for motive power in project areas, aside from draft animals, is diesel-powered engines. Diesel engines are used in all types of commercial and industrial activities and for irrigation tubewells where electricity is not available. Diesel engines require a relatively high initial investment and are costly to maintain and expensive to operate due to the high cost of diesel fuel. On the other hand, electric motors cost about 20 percent of the price of diesel engines of the same capacity, are relatively maintenance-free, and cost much less to operate. It is estimated that consumers switching from diesel-driven equipment to electric motors will cut their plant investment and their operation and maintenance costs by two-thirds. It is projected that by the end of the project, approximately 1,500 industrial concerns and 7,700 irrigation tubewell owners will install electric motors. Such installations, whether being conversions from diesel engine driven pumps or new electric power pumps, will each contribute to the improvement of Pakistan's economy.

Rural electrification will bring about large savings in fuel, equipment and operation/maintenance costs for residential, commercial, industrial and irrigation energy users. These savings account for about 70 percent of the direct benefits realized from

this component. The benefits to the economy of Pakistan are reflected in the amounts of money thus saved by the rural population, by the country's reduced expenditures of foreign exchange on imported oil for kerosene, diesel and lube oil and by utilization of power produced from indigenous forms of energy such as hydropower, natural gas and coal. The change to indigenous fuels brings a large indirect benefit through creation of many industries and employment opportunities. World Bank literature correctly suggests that due to the large but unquantifiable social benefits of rural electrification, projects with yields somewhat below the opportunity cost of capital may still be worth undertaking. This, however, is not the case here since the direct economic benefits provide yields equal to or greater than the opportunity cost of capital.

Rural power consumers will be provided access to new products and conveniences.The most important of these will be access to electric fans which are locally manufactured and widely used to ease the summer heat where electricity is available. Refrigeration, television and other conveniences will also be accessible forthe first time to many rural inhabitants once the electric service is installed.

For the commercial, industrial and irrigation consumers, availability of reliable electric power will provide an impetus for change from traditional methods and techniques in areas where the high cost of diesel has heretofore inhibited investments in tubewells, commerce and industries. With the introduction of electricity, it is expected that many new commercial activities will spring up and exisiting ones will improve and expand.

4. Conclusions

Based on the above analysis, the project is economically feasible and should be undertaken. In fact, additional benefits, not reflected in this analysis, will accrue to Pakistan's economy.

The analysis demonstrates that the Institutional Improvement and Training components, which were not subjected to benefit-cost nor cost-effectiveness analyses, will yield relatively high levels of tangible economic benefits. Accordingly, these two components should be undertaken. They are sound and timely interventions, and they are essential and complementary to the other A.I.D. assisted components. As noted by the project design team, when the remaining three components were subjected to benefit-cost and sensitivity analyses, they were found to yield "relatively high economic rates of return". The results of each analysis, including changes in economic returns when subjected to sensitivity analysis, are summarized in the following table:

Internal Economic Rate of Return

Component Condition	Energy Loss Reduction	Power Generation	Rural Distribution System Expansion
Base Analysis	70%	16%	23%
Costs Increase 20%	58%	11%	19%
Benefits Decrease 20%	55%	10%	17%
Costs Increase and Benefits Decrease 10%	57%	11%	18%

WPADA management is responsive to the proposed activities which would lead to improved planning, feasibility studies and the general improvement of the level of power services. It can be expected, therefore, that the new procedures and analytical approaches introduced through this project will eventually spread throughout WAPDA. The resulting wider and longer run benefits, although not measureable, underscore the positive impact of project activities.

Technical staff of the ADB and IBRD fully concur with the approach the project proposes with regard to work order planning and implementation. A study recently commissioned by the IBRD, "Energy Efficiency: Optimization of Electric Power Distribution System Losses" - (Research Project No. R 633), verifies the results of the Mission's calculations with regard to the very large returns on investments which will result from upgrading distribution conductors, transformers, and capacitors. The Bank is stressing in each of its upcoming power projects the need to reduce distribution losses and is very interested in seeing that improvements are made in Pakistan's losses which were 31.3 percent of all generation during PFY 1980/81.

In summary, the economic analysis indicates that this project is sound, economically advantageous, and justified.

E. Financial Analysis

1. General

This project will provide assistance to support activities of the GOP/WAPDA's Rural Electrification Program. The entire program over the six-year period is estimated to cost $381,043,000. The GOP is expected to contribute the equivalent of $136,609,000 for the program to finance locally procured commodities; in-country training costs and the travel costs for U.S. long-term training; land and construction costs; and salaries, rents, utilities, and other operating expenses. The Asian Development Bank is expected to provide $60,500,000 toward the foreign exchange costs of Phase I of the Guddu Combined Cycle Gas Turbine Power Generation Project. A.I.D. will contribute a total of $184,474,000 consisting of $169,474,000 under this project and an additional $15,000,000 which has been earmarked for this project in FY 1984 under the Agricultural Commodities and Equipment Program (391-0468) to import transformers, meters, capacitors, and other equipment to connect irrigation tubewell pumps and other rural customers.

The project has been designed to support Pakistan's Rural Electrification Program by assisting WAPDA's distribution function in the areas of : institutional development; human resources development; distribution system energy loss reduction; and new rural electrification connections along with distribution system expansion once connections can be reliably served by WAPDA. By assisting in the first three areas, A.I.D. will be supporting GOP needs and efforts which are essentially unsupported by other donors. As mentioned previously, other donors are, however, providing funds to WAPDA for its rural electrification expansion program, but no other donor is also providing institutional support to strengthen the expansion program. In addition, A.I.D. will provide about $52,000,000 toward the financing of Phase I of the Guddu Combined Cycle Power Generation Facility which, as mentioned above, will be co-financed by the ADB.

Four summary tables are provided on the following pages : Table 16 summarizes project costs by fiscal year and source of funding; Table 17 describes project costs by expense category and source of funding; Table 18 depicts project costs by project component, expense category, and source of funding; and Table 19 provides A.I.D. funding by foreign exchange and local costs. Additional data are provided in the Financial Analysis Annex (Annex Q).

TABLE 16

SUMMARY OF PROJECT COSTS[a/]

BY FISCAL YEAR AND SOURCE OF FUNDING
(In $ 000)

Source of Funding	Fiscal Year					
	1982	1983	1984	1985	1986	Total
1. A.I.D.[b/]						
a. Loan	-	27,000[c/]	25,000[d/]	23,000	37,000	112,000
b. Grant	8,000	23,000	-	4,000	8,000	43,000
2. U.S. Owned Rupees[e/]	-	8,488	2,131	1,855	2,000	14,474
3. GOP [e/] [f/]	1,913	86,338	33,267	6,031	8,520	136,069
4. ADB[g/]	-	60,500	-	-	-	60,500
Total	9,913	205,326	60,398	34,886	55,520	366,043

a/ Project costs are defined as anticipated sub-obligations or commitments of funding through e,g., PIOs, contracts, or purchase orders.

b/ Does not include $15 million earmarked under the Agricultural Commodities and Equipment Project(391-0468)in FY 1984 to import transformers, capacitors, meters and other equipment to connect irrigation tubewell pumps and other rural customers under this project.

c/ Includes $25 million for Phase I of the Guddu Combined Cycle Gas Turbine Power Generation Project.

d/ Represents funds to be used for Phase I of the Guddu Combined Cycle Gas Turbine Power Generation Project.

e/ Expressed as dollar equivalents at the exchange rate of US $1.00=Rs 12.16 as of 7/19/82.

f/ Includes the equivalent of $86.5 million for Phase I of the Guddu Combined Cycle Gas Turbine Power Generation Project.

g/ Represents the balance of the foreign exchange costs of Phase I of the Guddu Combined Cycle Gas Turbine Power Generation Project.

TABLE 17

SUMMARY OF PROJECT COSTS a/

BY EXPENSE CATEGORY AND SOURCE OF FUNDING

(In $ 000)

Expense Category b/	Life of Project Funding					
	A.I.D. Dollars c/			U.S. d/ Rupees	COP d/	Other e/ Donors
	Loan	Grant	Total			
1. Technical Assistance						
a. Short-Term	-	2,544	2,544	952	-	-
b. Long-Term	-	12,225	12,225	7,381	-	-
2. Training						
a. U.S.						
i. Short-Term	-	3,899	3,899	1,518	-	-
ii. Long-Term	-	821	821	58	35	-
b. In-Country	-	-	-	-	5,840	-
3. Commodities						
a. Vehicles	-	268	268	-	-	-
b. Other	55,325	19,334	74,659	97	20,792	60,500
4. Other Costs						
a. Construction	-	-	-	3,172	77,769	-
b. Operating Costs	-	-	-	-	19,263	-
c. FAR f/	46,493	-	46,493	-	-	-
Sub-Total	101,818	39,091	140,909	13,178	123,699	60,500
Contingency (10%)	10,181	3,909	14,091	1,295	12,370	-
TOTAL	112,000	43,000	155,000	14,474	136,069	60,500

a/ Project costs are defined as anticipated sub-obligations or commitments of funding through PIOs, contracts or purchase orders.

b/ Inflation factors of 10% and 20%, compounded annually, have been applied to dollar and rupee costs, respectively.

c/ Does not include $15 million earmarked under the Agricultural Commodities and Equipment Project (391-0466) to import transformers, capacitors, meters and other equipment to connect irrigation tubewell pumps and other rural customers under this project.

d/ Expressed as dollar equivalents at the exchange rate of U.S. $1.00 = Rs 12.16 as of 7/19/82.

e/ The ADB is expected to provide $60.5 million to cover the balance of the foreign exchange costs of Phase I of the Guddu Combined Cycle Gas Turbine Power Generation Project.

f/ Payments under Fixed Amount Reimbursement System for Energy Loss Reduction and Rural System Expansion components.

TABLE 18

SUMMARY OF PROJECT COSTS a/

BY PROJECT COMPONENT, EXPENSE CATEGORY, AND SOURCE OF FUNDING

(In $000)

Project Component	Life of Project Funding					
	A.I.D. DOLLARS c/			U.S. d/	d/	Other e/
	Loan	Grant	Total	Rupees	G.O.P.	Donors
1. Institutional Improvement						
a. Technical Assistance	-	5,847	5,847	3,448	-	-
b. Training	-	449	449	139	-	-
c. Commodities	-	2,815	2,815	22	-	-
d. Other Costs	-	-	-	197	3,871	-
Sub-Total	-	9,111	9,111	3,806	3,871	-
2. Training						
a. Technical Assistance	-	5,075	5,075	3,114	-	-
b. Training	-	3,540	3,540	1,321	5,875	-
c. Commodities	-	1,172	1,172	22	389	-
d. Other Costs	-	-	-	2,974	2,896	-
Sub-Total	-	9,787	9,787	7,431	9,160	-
3. Energy Loss Reduction						
a. Technical Assistance	-	1,240	1,240	850	-	-
b. Training	-	122	122	27	-	-
c. Commodities	1,289	7,923	9,212	22	1,287	-
d. Other Costs	13,333	-	13,333	-	5,848	-
Sub-Total	14,622	9,285	23,907	899	7,135	-
4. Power Generation						
a. Technical Assistance	-	1,590	1,590	-	-	-
b. Training	-	228	228	-	3,933	-
c. Commodities	45,455	-	45,455	-	74,727	60,500
Sub-Total	45,455	1,818	47,273	-	78,660	60,500
5. Rural System Expansion						
a. Technical Assistance	-	1,017	1,017	922	-	-
b. Training	-	381	381	89	-	-
c. Commodities	8,581	7,693	16,274	32	15,183	-
d. Other Costs	33,160	-	33,160	-	9,687	-
Sub-Total	41,741	9,091	50,832	1,043	24,870	-
Total	101,818	39,092	140,910	13,179	123,699	60,500
Contingency(10%)	10,182	3,908	14,090	1,295	12,370	-
GRAND TOTAL	112,000	43,000	155,000	14,474	136,069	60,500

a/ Project costs are defined as anticipated sub-obligations or commitments of funding through PIOs, contracts or purchase orders.

b/ Inflation factors of 10% and 20%, compounded annually, have been applied to collar and rupee costs, respectively.

c/ Does not include $15 million earmarked under the Agricultural Commodities and Equipment Project (391-0468) to import transformers, capacitors, meters and other equipment to connect irrigation tubewell pumps and other rural customers under this project.

d/ Expressed as dollar equivalents at the exchange rate of U.S. $1.00 = Rs 12.16 as of 7/19/82.

e/ The ADB is expected to provide $60.5 million to cover the balance of the foreign exchange costs of Phase 1 of the Guddu Combined Cycle Gas Turbine Power Generation Project.

TABLE 19

SUMMARY OF A.I.D. FUNDING

BY FOREIGN EXCHANGE (FX) AND LOCAL COSTS (LC)

(In $000)

Expense Category a/	Life of Project Funding					
	A.I.D. DOLLARS b/				U.S. c/ Rupees (LC)	TOTAL
	Loan		Grant			
	FX	LC	FX	LC		
1. Technical Assistance						
a. Short-Term	-	-	2,544	-	952	3,496
b. Long-Term	-	-	12,225	-	7,381	19,606
2. U.S. Training						
a. Short-Term	-	-	3,899	-	1,518	5,417
b. Long-Term	-	-	821	-	58	879
3. Commodities						
a. Vehicles	-	-	268	-	-	268
b. Other	55,325	-	19,334	-	97	121,249
4. Other Costs						
a. Construction	-	-	-	-	3,172	3,172
b. FAR d/	-	46,493	-	-	-	-
Sub-Total	55,325	46,493	39,091	-	13,178	154,087
Contingency (10%)	5,533	4,649	3,909	-	1,295	15,409
TOTAL	60,858	51,142	43,000	-	14,474	169,496

a/ Inflation factors of 10% and 20%, compounded annually, have been applied to dollar and rupee costs, respectively.

b/ Does not include $15 million earmarked under the Agricultural Commodities and Equipment Project (391-0468) to import transformers, capacitors, meters and other equipment to connect irrigation tubewell pumps and other rural customers under this project.

c/ Expressed as dollar equivalents at the exchange rate of U.S. $1.00 = Rs 12.16 as of 7/19/82.

d/ Payments under Fixed Amount Reimbursement System for Energy Loss Reduction and Rural System Expansion components.

Project costs are defined as anticipated sub-obligations or commitments of funding through, e.g., PIOs, contracts, or purchase orders. Inflation was calculated on the basis of 10 percent per year for foreign exchange costs and 20 percent per year for local costs, all compounded annually. A contingency factor of 10 percent was applied to all costs. Rupees, where shown, are expressed as dollar equivalents at the exchange rate of U.S. $1.00=Rs 12.16 as of July 18, 1982.

2. Summary Cost Estimates and Financial Plan

a. A.I.D. Contribution

The A.I.D. contribution will be provided from three different sources of funding : (1) $155,000,000 in ESF grant and loan funds which will be obligated under this project; (2) $15,000,000 in ESF loan funds which has been earmarked under the Agricultural Commodities and Equipment Program(391-0468) in FY 1984 for this project; and (3) Rs 176,000,000 (or the equivalent of $14,474,000) in U.S. owned rupees which will be obligated under this project. The proposed obligation schedule for ESF dollar funds under this project is as follows : FY 1982 = $8,000,000 grant; FY 1983 = $50,000,000 consisting of $27,000,000 loan and $23,000,000 grant; FY 1984 = $25,000,000 loan; FY 1985 = $27,000,000 consisting of $23,000,000 loan and $4,000,000 grant; and FY 1986 = $45,000,000 consisting of $37,000,000 loan and $8,000,000 grant. The total A.I.D. dollar contribution, including funds to be provided under this project ($155,000,000) and under the Agricultural Commodities and Equipment Program ($15,000,000) represents 44.6 percent of the total costs of the program.

The allocation of U.S. owned rupees, which constitute 3.8 percent of total program costs, is shown by fiscal year in Table 16. No rupees will be obligated in FY 1982. Future yearly obligations will depend on the availability of funds for this purpose, which may be derived from Mondale rupees, U.S. appropriated rupees, counterpart funds, or some combination of these or other sources. It may be that in the out-years, additional dollars from the Project Reserve will be used to finance some of those local costs now programmed to be funded from rupee sources. The total A.I.D. dollar and rupee contribution to the proposed program represents about 48.4 percent of the total cost.

The A.I.D. dollar grant will finance exclusively foreign exchange costs under the project. Of the $43,000,000 grant, 50.1 percent will be spent on vehicles and other commodities, 37.8 percent on expatriate short and long-term technical assistance, and 12.1 percent for U.S. short-term and long-term

training. The A.I.D. dollar loan of $112,000,000 will be used to finance both foreign exchange and local costs under the project; $60,858,000 or 54.3 percent will be used to purchase commodities in the U.S. (as will all of the $15,000,000 to be provided under the Agricultural Commodities and Equipment Program) while the remaining $51,142,000 or 45.7 percent will be used to reimburse the GOP under the Fixed Amount Reimbursement (FAR) System for work orders carried out under the Energy Loss Reduction component ($14,666,000) and the Rural System Expansion Program ($36,476,000). Loan funds used to finance local costs will be disbursed in U.S. dollars in order to maximize the balance of payments impact of this program in accordance with the overall objectives of the renewed USG-GOP economic and development assistance program. A FAA Section 612(b) certification has been signed by the USAID/Pakistan Mission Director and is included in Annex C.

Allocations for the rupee component of the project are as follows : 63.3 percent for the local costs associated with expatriate consultants and the salaries of local consultants; 24.0 percent for the construction of the distribution function training facility, which includes the cost of local A&E services; 12.0 percent for travel and local costs associated with both short-term and long-term training in the U.S.; and 0.7 percent for locally-procured commodities. A.I.D. will finance the international travel costs for all participants attending training programs of one year or less in duration. A participant training travel waiver, which exempts the GOP from having to cover these costs, has been signed by the USAID/Pakistan Mission Director and is included in Annex J.

Allocation of the total A.I.D. dollar and rupee contribution (including the $15,000,000 to be provided under the Agricultural Commodities and Equipment Program) by expense category is as follows : 52.9 percent for commodities; 29.6 percent for construction and FAR payments; 13.8 percent for technical assistance; and 3.7 percent for training.

Allocation of the total A.I.D. dollar and rupee contribution (including the $15,000,000 to be provided under the Agricultural Commodities and Equipment Program) by project component is as follows : 39.1 percent for Rural System Expansion; 28.2 percent for Power Generation; 14.8 percent for Energy Loss Reduction; 10.2 percent for Distribution Training; and 7.7 percent for Institutional Improvement. For the total program, including the A.I.D., GOP, and ADB contributions, the allocations by component are as follows 52.2 percent for Power Generation; 26.1 percent for Rural System Expansion; 9.3 percent for Energy Loss Reduction; 7.6 percent for Distribution Training; and 4.8 percent for Institutional Improvement.

b. GOP Contribution

The GOP will provide the equivalent of $136,069,000 or 35.7 percent of the total program costs over a period of six years. The GOP allocation by expense category is as follows : 78.4 percent for salaries, rent, utilities and other operating costs, land, and the construction of model warehouses and model customer service centers; 16.8 percent for the purchase of local commodities; and 4.8 percent for in-country training and the travel costs associated with long-term U.S. training.

c. ADB Contribution

The ADB is expected to provide $60,500,000 in FY 1983 toward the foreign exchange costs of Phase I of the Guddu Combined Cycle Gas Turbine facility. This amount represents 53.8 percent of the total foreign exchange costs of Phase I, 30.4 percent of the total costs of Phase I, and 15.9 percent of the total costs of the entire six-year program.

F. Environmental Assessment

1. Overview

The 1978 Rural Electrification Project Paper contained an in-depth Environmental Assessment (EA) which remains applicable to the proposed activities under this project. However, a revision of the EA is required at this time due to the inclusion of a gas turbine component in the new project.

The following EA of this Rural Electrification project is based on the following guidelines: A.I.D.'s "Environmental Procedures (Regulation 216.1-8); A.I.D.'s Environmental Guidelines Manual; the Environmental Assessment of USAID/Pakistan's Rural Electrification Project Paper (1978); and, the Environmental Profile of the Islamic Republic of Pakistan (prepared by the University of Arizona). The latter document is still in draft form, but nevertheless contains excellent reference material and information which has been useful in preparing this revised EA.

2. Environmental Assessment of 1978

The 1978 Environmental Assessment is included in Annex L. A brief description follows.

a. Description of the Project Area

The proposed Rural Electrification Project will be implemented in all four provinces of Pakistan: Punjab, Sind, Baluchistan, and Northwest Frontier Province (NWFP). These provinces roughly correspond to three distinct geographic regions. The Indus Plains (Sind and Pubjab Provinces)consist of sand, silt and clay alluviums hundreds to thousands of feet thick, overlying old sedimentary rocks. The upper Indus plain corresponds to the Punjab province, and the lower Indus plain is roughly congruent with Sind. Within Pakistan, the former region is extremely fertile and cultivated. It supports a dense population.

The lower Indus plain, by contrast, consists of a single, narrow flood plain, surrounded by, for the most part, sandy soil. To the west, the river valley is bounded by the central mountain ranges; to the east, the vast Thar Desert approaches to within a few kilometers of the old flood plain. The land is low-lying and often flooded or swampy.

b. General Characteristics

The 1978 EA provided a thorough description of the climatic, demographic and agricultural features of Pakistan. No further discussion of these features is required.(See Annex L.)

c. Discussion of Environmental Impacts

i. Direct Impacts: The 1978 EA focused primarily on environmental impacts caused by the installation of transmission lines, erection of poles, and construction of foundations for poles requiring about 20 feet right of way.

ii. Indirect Impacts: Electrification of a rural area has the potential to increase development significantly through increased agricultural and industrial activity. Increased production implies increased employment, requiring additional housing, services, and infrastructure facilities. The 1978 EA provided several development alternatives, including a "low development" and a "high development" profile.

d. Conclusion of the 1978 EA

The environmental impacts identified in the EA were found to be acceptable. It was concluded that the risk of an unacceptable level of adverse environmental impact was minimal because the areas to be electrified were capable of sustaining increased development based on their suitability criteria.

The EA recommended that the suitability criteria used to select areas to be electrified under the project should emphasize agricultural and agro-industrial potential, availability of power from grid stations, population density, and the availability of rural infrastructure such as roads. Areas that met these criteria were considered to be man-modified environments on which rural electrification would have little negative impact. In areas and zones of pronounced seismic activity, particularly Baluchistan and NWFP, the system designers were to take into account the effect of seismic factors.

3. Gas Turbines

The proposed project envisages the installation of a gas turbine power station with power-generation capacity of 400 MW. The power plant will be composed of a fuel-forwarding system, gas pipeline, gas turbines and auxiliary control systems. The fuel-forwarding system is composed of local gas handling, gas pumping and fire protection equipment. A lube oil control system and fire protection equipment would also be required.

For an output of 323.6 MW, the turbines will require an inflow of 5.6 million cft/hour, or 134 million cft/day. The gas supply will come from the Mari gas fields, which can produce about 200 million cft/day. Almost 75 percent of gas available from the Mari fields will be consumed by the 400 MW gas turbines.

The turbines will eject almost one hundred percent of the injected gas at a temperature of 970°F. By providing heat

recovery steam generators, the exhaust temperature can be reduced to about 300°F, thereby reducing the levels of thermal pollution in the nearby atmosphere.

4. Summary of Environmental Impacts

The project will essentially service rural agricultural areas which may be viewed as ecosystems significantly modified by man. The following discussion describes the environmental impacts likely to occur from the propsed RE project:

a. Direct Impacts

Transmission lines will require a twenty foot right of way. However, the right of way does not preclude continued use of this land for agriculture. Efforts will be taken to minimize soil erosion during construction of towers on the right of way.

Sensitive natural areas such as river beds, marshes, mountainous areas, and the like, which would require extensive and costly support structures and additional machinery for installation, will be excluded from rural electrification development under this project.

Installation of poles will necessarily require a small disturbance of soil with a localized and temporary impact. Some removal of trees along the narrow right-of-way may be necessary. Small amounts of grasses or bushes may be removed during pole installation. Disturbance of wildlife habitats except for small amounts of tree pruning and removal is expected to be temporary and minimal. Construction, operations, and maintenance of the rural electrification project will have direct effects on the economy of the area served as well as on the country as a whole.

As stated above, the gas turbines will consume 134 million cft/day of gas from the Mari fields, which can produce about 200 million cft/day. The Government of Pakistan is concerned about the large amount of gas being used for power generation. It is taking steps to revise prices toward international prices and is undertaking studies to determine the most economic use of Pakistan's natural gas resources.

The turbine will consume 5.6 million cft/hr. of gas. Almost 100 percent of this will be exhausted at about 970°F. This extremely high temperature will be reduced to approximately 300°F by heat recovery steam generators. It will be necessary to reduce thermal pollution of the condenser cooling water required for the heat recovery section of the plant. Use of cooling towers will prevent thermal pollution of surface or ground water supplies. The exhaust gases will be in the form

of hydro-carbons, steam, nitrogen oxides, and carbon dioxide. The emissions are expected to cause some pollution in the air around the power station site. Therefore, emission sources should be controlled to provide the ambient air quality necessary for maintaining the health and well-being of the people located near the installation.

The turbines will produce powerful sound waves which, if not controlled, will have an adverse impact on humans as well as on flora and fauna in the adjacent area. The internationally accepted noise level at a distance of 120 m varies from 60 db to 90 db. The tender specifications will provide that these limits are not to be exceeded.

b. Indirect Impacts

Electrification of a rural area has the potential to increase development significantly through increased agricultural and industrial activity. Agriculture will most likely be affected positively by the installation of electrically-operated tubewells. This increase in tubewells may modify the environment somewhat in currently irrigated areas. In those areas with significant amounts of canal irrigation and a small number of tubewells, increased installation of tubewells will assist in the control of water-logging and in the reduction of salinity problems. Industrial pollution will be expected to decrease as a result of diminished use of diesel fuel due to the availability of electric power.

The project could have some impact on fertility trends in the project area. Although not certain, the effect, if any, would probably be to reduce fertility. Mortality, particularly infant mortality, may decrease to the extent that increased connections would contribute to improved health care conditions and facilities. Public health and education facilities will be favorably affected under the project. Health centers will be able to provide patient care in the evenings and may purchase special equipment e.g., refrigerators and heating devices.

Negative impacts of electrification on wildlife resources and forested areas may be caused by increased development activities. This negative impact, however, is a localized and short-term phenomenon. In the long-term, rural electrification may be expected to promote the conservation of forests and wildlife in remote areas by encouraging population concentration in existing settled areas.

In general, the economic and development impact is expected to be beneficial, while environmental impacts should be minimal and acceptable.

5. Irreversible and Irretrievable Commitments of Resources

The structures of the rural electrification program are expected to require significant resource commitments. Steel, aluminum, and copper required for poles and cables will be consumed on a large scale. In addition, almost 75 percent of the gas available from the Mari fields will be consumed by the gas turbine station. Resource conservation strategies will be pursued in the development of the GOP power production program.

6. Alternatives to the Proposed Project

a. No Project

This alternative is considered unacceptable as this implies continued consumption of other fuel sources and little potential for improving social and economic levels of living in Pakistan's rural areas. Without rural electrification, desirable levels of growth in these rural areas could not be achieved. Living standards may actually begin to decline as local economies suffer from continuing underdevelopment and neglect.

b. Increased Use of Other Resources

Electrical power is more cost-effective for lighting, heating and motive power than the existing alternatives of gas, kerosene lanterns, candles, fuelwood, petroleum products, and animal power. Increased or even continued current use levels of these energy sources would bring about environmental impacts less acceptable than the impacts identified with rural electrification. Deforestation will increase to a level more severe than at present if fuelwood consumption is not brought into balance with supply. This project will assist in preserving forest growth.

c. Exploration of Renewable Energy Resources

The GOP is making efforts to exploit renewable energy resources, but progress appears slow. Even if major advances are made in the renewable resources field, the nation's dependence on power will necessitate expansion of non-renewable and conventional energy production. Moreover, exploration activities in development of renewable energy resources, while eminently desirable, would make little or no contribution to the short-term power demand-supply gap, to which part of this project is addressed.

7. Conclusion

The environmental impacts of the proposed rural electrification project are considered acceptable

G. Narcotics Impact Statement

With the exception of the Rural Distribution System Expansion component, none of the proposed project activities can be meaningfully connected to the U.S. Government's continued efforts, in conjunction with the GOP, to curtail opium poppy cultivation and the processing of opium into heroin in Pakistan. In the case of rural distribution system expansion activities, however, it is possible that areas where poppies are cultivated will be considered for electrification. This project component therefore lends itself to specific actions and policies relative to narcotics suppression.

Two specific actions will be taken in this regard. A provision will be included in the site selection criteria for electrification under the Rural Expansion and Connection Program, prohibiting the provision of electric lines and services financed under this project to areas where there is illict cultivation of poppies or the manufacture of opium-derived drugs. In addition, the following poppy clause will be included in the Project Agreement as a Special Condition:

" The Government of Pakistan (GOP) agrees to undertake appropriate measures to prohibit cultivation of opium poppy and/or processing of opium into heroin or morphine base within any area benefiting from this Project. In the event that a determination is made that the cultivation of opium poppy and/or processing of opium into heroin is occurring in an area programmed to benefit or benefiting from this Project, no assistance under this Project directly benefiting that area shall commence, and, if commenced, such assistance shall be suspended until the prohibited activity is eliminated. This suspension of assistance may, at the option of the United States Government, and in accordance with applicable law, include disconnecting electric service in the area until the prohibited activity is fully eliminated. If the prohibited activity found to exist is not fully eliminated within a specified period of time to be agreed upon by the United States Government and the GOP, all assistance under this Project directly benefiting that area may be terminated.

If, prior to the Project Assistance Completion Date (PACD) established by A.I.D. for this Project as it may be from time to time amended, it is determined that the prohibited activity is occurring in an area which has benefited from this Project and the prohibited activity is not eliminated within a period of time to be agreed upon by the United States Government and the GOP, the GOP shall reimburse A.I.D. for all assistance that the GOP has received from A.I.D. under this Project, which has resulted in direct benefits to that area in which the prohibited activity is occurring. Such reimbursement shall be treated as a refund under the relevant provisions of the Project Agreement. "

Guddu Combined Cycle Gas Turbine Facility establishing the Facility's technical and economic feasibility has been prepared.

c. Except as A.I.D. may otherwise agree in writing, prior to the disbursement under this project or to the issuance by A.I.D. of documentation pursuant to which disbursement will be made for commodities or construction under Power Generation component of this project, the Borrower/Grantee, acting through WAPDA, shall furnish to A.I.D. in form and substance satisfactory to A.I.D., evidence that: (1) adequate and appropriately scheduled financing for Phase I of the Guddu Combined Cycle Gas Turbine Facility has been secured; and, (2) formal procedures are in progress to arrange adequate and appropriately scheduled financing for Phase II of the Guddu Combined Cycle Gas Turbine Facility.

3. Conditions Precedent to Disbursement for Fixed Amount Reimbursement of System Expansion Work Orders under the Rural Distribution System Expansion Component

Except as A.I.D. may otherwise agree in writing, prior to the disbursement under this project or to the issuance by A.I.D. of documentation pursuant to which disbursement will be made for fixed amount reimbursement (FAR) of System Expansion Work Orders under the Rural Distribution System Expansion component of this project, the Borrower/Grantee acting through WAPDA, shall furnish to A.I.D. in form and substance satisfactory to A.I.D., evidence that: (a) a comprehensive National Rural Electrification Master Plan has been developed and is being implemented according to schedule; (b) execution of plans for additional power generation capacity is proceeding satisfactorily; and, (c) an economically feasible and administratively sound System Expansion Work Order Design and Management System consistent with the Master Plan has been developed based on accurate data.

4. Conditions Precedent to Disbursement for Fixed Amount Reimbursement for Work under Energy Loss Reduction Component

Except as A.I.D. may otherwise agree in writing, prior to the disbursement under this project or to the issuance by A.I.D. of documentation pursuant to which disbursement will be made for fixed amount reimbursement (FAR) for work under the Energy Loss Reduction component of this project, the Borrower/Grantee, acting through WAPDA, shall furnish to A.I.D. in form and substance satisfactory to A.I.D., evidence that an economically feasible and administratively sound Rehabilitation Work Order Design and Management System has been developed based on accurate data.

5. Conditions Precedent to Disbursement for the New Comprehensive Training Program for Distribution Function Personnel of WAPDA under Distribution Function Training Component

Except as A.I.D. may otherwise agree in writing, prior to the disbursement under this project or to the issuance by A.I.D. of documentation pursuant to which disbursement will be made for the New Comprehensive Training Program under the Distribution Function Training component of this project, the Borrower/Grantee, acting through WAPDA, shall furnish to A.I.D., in form and substance satisfactory to A.I.D., evidence that a feasible and effective New Comprehensive Training Program for distribution function personnel of WAPDA has been developed.

6. Conditions Precedent to Design and/or Construction of a Central Distribution Function Training Institute under the Distribution Function Training Component

a. Except as A.I.D. may otherwise agree in writing, prior to the disbursement of funds by A.I.D. or to the issuance by A.I.D. of documentation pursuant to which disbursement will be made for architectural and engineering services to review the site of the construction of a Central Distribution Function Training Institute under the Distribution Function Training component of this project, the Borrower/Grantee acting through WAPDA, shall identify a proposed site for the Training Institute acceptable to A.I.D.; and,

b. Except as A.I.D. may otherwise agree in writing, prior to the disbursement of funds by A.I.D. or to the issuance by A.I.D. of documentation pursuant to which disbursement will be made for architectural and engineering services with respect to such Training Institute, other than site investigations, the Borrower/Grantee acting through WAPDA, shall establish its right, in form and substance satisfactory to A.I.D., to ownership or adequate and sufficient use of occupancy of the proposed land site for the Training Institute.

B. Covenants

1. The Borrower/Grantee, acting through WAPDA, shall make every reasonable effort to require that each person trained under this Project works in electric utility, electricity distribution, and/or rural electrification activities in Pakistan for not less than three times the length of time of his or her training program provided, however, that in no event shall the individual be allowed to work for less than one year nor be required to work for more than five years from the date of the individual's completion of training.

2. The Borrower/Grantee shall furnish to A.I.D. quarterly activity reports, the requirements of which shall be set forth by A.I.D. in periodic Project Implementation Letters. The requirements may include, but are not limited to providing information concerning: (a) comprehensive distribution planning (financial, administrative, and technical), including development of a comprehensive National Rural Electrification Master Plan; (b) the hierarchy, functions, responsibilities, authority, organization, and staffing of the Office of the General Manager of Distribution and other WAPDA administrative units sharing responsibility for electric power distribution and rural electrification; (c) the functions, responsibility, autonomy, organization, staffing, and facilities of Area Electricity Boards; (d) the duties, responsibility, and authority of the Rural Electrification Office (REO); (e) distribution function staffing and personnel administration, policies, and practices; (f) improvements in customer service facilities and procedures; (g) improvements in customer accounts management; (h) rationalization of cost of service, rates, recurrent costs, and property valuation and depreciation practices; (i) improvement in collection, dissemination, and utilization of statistics; and, (j) improvements in procurement and inventory management procedures.

C. Negotiating Status

The above Conditions Precedent and Covenants have been discussed with and agreed to by the Government of Pakistan. During Project Agreement negotiations, USAID/Pakistan will incorporate into the Agreement appropriate language to cover these terms and conditions.

VII. A N N E X E S

VI. CONDITIONS, COVENANTS, AND NEGOTIATING STATUS

A. Conditions Precedent to Disbursement

1. Conditions Precedent to First Disbursement

Except as A.I.D. may otherwise agree in writing, prior to any disbursement under this Project or to the issuance by A.I.D. of documentation pursuant to which disbursement will be made, the Borrower/Grantee shall, except as the parties may otherwise agree in writing, furnish or have furnished to A.I.D. in form and substance satisfactory to A.I.D. within sixty (60) days after the signing of the Project Agreement:

a. An opinion of Counsel acceptable to A.I.D that the Project Agreement has been duly authorized and/or ratified by, and executed on behalf of the Borrower/Grantee and it constitutes a valid and legally binding obligation of the Borrower/Grantee in accordance with all of its terms; and,

b. A statement setting forth the names and titles of persons holding or acting in the Office of the Borrower/Grantee and representing that the named person or persons have the authority to act as the representative or representatives of the Borrower/Grantee, together with a specimen signature of each person certified as to its authenticity.

2. Conditions Precedent to Disbursement for Commodities and Construction Related to the Power Generation Component

a. Except as A.I.D. may otherwise agree in writing, prior to the disbursement under this project or to the issuance by A.I.D. of documentation pursuant to which disbursement will be made for commodities and construction under the Power Generation component of this project, the Borrower/Grantee, acting through WAPDA, shall furnish to A.I.D., in form and substance satisfactory to A.I.D. evidence that (i) adequate and appropriately scheduled financing has been secured; and, (ii) a contract has been executed for the construction of a completely operational Guddu IV Steam Generating Facility.

b. Except as A.I.D. may otherwise agree in writing, prior to the disbursement under this project or to the issuance by A.I.D. of documentation pursuant to which disbursement will be made for commodities or construction under the Power Generation component of this project, the Borrower/Grantee, acting through WAPDA, shall furnish to A.I.D., in form and substance satisfactory to A.I.D. evidence that an updated feasibility study for Phases I and II of the

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E.O. 12065: N/A

TAGS9
SUBJ: APAC REVIEW - RURAL ELECTRIFICATION PID (391-0473)

THE APAC REVIEWED AND APPROVED THE SUBJECT PID ON OCTOBER 15, 1981. THE FOLLOWING GUIDANCE IS PROVIDED MISSION FOR PREPARING PROJECT PAPER (PP).

1. INSTITUTIONAL CONCERNS: THE GOP'S WATER AND POWER DEVELOPMENT AUTHORITY (WAPDA) WILL IMPLEMENT THIS PROJECT. WAPDA HAS A HISTORY OF GIVING RURAL ELECTRIFICATION A LOWER PRIORITY AS EVIDENCED BY THE RELATIVELY LOWER BUDGETS LEVELS, WEAK STAFFING AND LACK OF OTHER RESOURCES IT DEVOTES TO THIS EFFORT. THE PP SHOULD EXAMINE THE INSTITUTIONAL ARRANGEMENTS FOR RURAL ELECTRIFICATION WITHIN WAPDA AND OUTLINE IN DETAIL WHAT CHANGES ARE NEEDED IN THE CURRENT INSTITUTIONAL FRAMEWORK TO ENSURE THAT RURAL ELECTRIFICATION IS GIVEN THE PRIORITY IT SHOULD HAVE SO THAT THE AID-ASSISTED PROJECT IS EFFICIENTLY IMPLEMENTED.

2. ELECTRIC RATE SUBSIDIES: THE PP SHOULD DETAIL CURRENT STATUS OF ELECTRIC RATE SUBSIDIES NOW BEING ALLOWED CERTAIN CONSUMERS, PARTICULARLY TUBEWELLS, AND

DISCUSS HOW THE LEVEL OF THESE SUBSIDIES IMPACTS ON WAPDA'S FINANCIAL VIABILITY, PARTICULARLY THE RECURRING COSTS OF THE RURAL ELECTRIFICATION SYSTEM. THE-PP SHOULD ALSO OUTLINE ANY GOP PLANS FOR PHASING OUT THESE SUBSIDIES AND PROJECT HOW THE TIMING OF THE PHASEOUTMAY INFLUENCE THIS FINANCIAL ANALYSIS.

3. ENERGY IMPACT: THE PP SHOULD OUTLINE THE SOURCE OF ENERGY FOR POWER GENERATION AND THE LIKELY IMPACT OF INTRODUCTION OF ELECTRICITY ON RURAL ENERGY BALANCES. THE QUESTION OF CENTRALIZED POWER FED TO THE SYSTEM THROUGH A GRID VIS-A-VIS A DECENTRALIZED LOCAL GENERATING SOURCE SHOULD BE ADDRESSED. ALTERNATIVE SOURCES-OF LOCAL POWER GENERATION (MINIHYDRO, THERMAL, GAS, ETC.) SHOULD - BE EVALUATED AGAINST AVAILABILITY, COST AND RELIABILITY OF ELECTRICITY FROM THE NATIONAL GRID. THE ESTIMATED NET OIL SAVINGS FROM THE SUBSTITUTION OF ELECTRICITY FOR - KEROSENE AND DIESEL SHOULD BE CALCULATED AND WEIGHED AGAINST OVERALL COSTS, I.E., DOLLARS PER BARREL OF OIL

SAVED.

4. ECONOMIC ANALYSIS: THE ECONOMIC ANALYSIS OF THE PP SHOULD IDENTIFY PRODUCTIVE AND SOCIAL USES OF ELECTRICITY AND SHOULD PROJECT GROWTH TRENDS OF EACH USE FOR 20 YEARS OR SO. IN THAT REGARD, THE PP SHOULD DETERMINE IF INCENTIVE OR SUPPORT PACKAGES (HOUSEWIRING PROGRAMS, AVAILABILITY OF ELECTRIC MOTORS TO SUBSTITUTE FOR DIESEL MOTORS, PROMOTION/USER INFORMATION PROGRAMS, ELECTRIC — APPLIANCE/EQUIPMENT CREDIT,) SHOULD BE BUILT INTO THE PROJECT

5. IMPLEMENTATION ARRANGEMENTS: THE PP SHOULD DETAIL THE STAFFING NEEDS FOR IMPLEMENTING THIS PROGRAM AT THE MISSION LEVEL. DIRECT HIRE AND CONTRACT (ENGINEERING - AND TECHNICAL ASSISTANCE) NEEDS SHOULD BE INDICATED. TO THE EXTENT POSSIBLE, ANALYSIS SHOULD IDENTIFYEXACT SKILLS REQUIRED AND THE DURATION FOR WHICH SUCH SKILLS WILL BE NEEDED. THE ANALYSIS SHOULD ALSO OUTLINE THE RESPECTIVE ROLES ENVISIONED FOR THE STAFFING LEVELS - IDENTIFIED AND HOW THESE ROLES WILL INTERACT IN ENSURING SMOOTH, TIMELY PROJECT IMPLEMENTATION.

6. GAS TURBINE PROCUREMENT: THE PROJECT ENVISIONS REIMBURSEMENT OF WAPDA FOR UP TO DOLS 26 MILLION FOR GAS TURBINE GENERATORS NEEDED ON AN EMERGENCY BASIS. THE APAC SAW NO PROBLEM WITH THIS BUT RECOMMENDS CLOSE - COORDINATION TO ASSURE THAT AID PROCUREMENT REQUIREMENTS ARE OBSERVED. TO THAT END, WAIVER NEEDS SHOULD BE INCLUDED IN THE PP.

7. ENVIRONMENTAL ASSESSMENT: THE PREVIOUSLY COMPLETED ENVIRONMENTAL ASSESSMENT (ANNEX E OF 1978 PROJECT PAPER) WILL HAVE TO BE RE-EXAMINED TO DETERMINE ITS APPLICABILITY TO THIS NEW PROPOSED PROJECT. IN PARTICULAR, THE INCLUSION OF GAS TURBINE GENERATORS AS PROCUREMENT ITEMS IN THIS PROJECT MAY NEED ATTENTION IN THE EA.

8. PP PREPARATION: TDY REQUIREMENTS TO ASSIST MISSION IN PP PREPARATION WERE OUTLINED IN VAN RAALTE/LION MEMO OF OCTOBER 16, 1981. WE ARE MAKING PRELIMINARY INQUIRIES REGARDING AVAILABILITY OF RURAL ELECTRIFICATION SPECIALISTS. NRECA INDICATES GILBERT MOON MAY BE AVAILABLE. PLEASE ADVISE MISSION DESIRES SO THAT WE CAN SELECT TEAM AND BEGIN MAKING ARRANGEMENTS FOR TDY'S BEGINNING ABOUT MID-JANUARY 1982. HAIG

PT

#3888

5C(2) PROJECT CHECKLIST

Listed below are statutory criteria applicable to projects. This section is divided into two parts. Part A. includes criteria applicable to all projects. Part B. applies to projects funded from specific sources only: B.1. applies to all projects funded with Development Assistance Funds, B.2. applies to projects funded with Development Assistance loans, and B.3. applies to projects funded from ESF.

CROSS REFERENCES: IS COUNTRY CHECKLIST UP TO DATE? Yes
HAS STANDARD ITEM CHECKLIST BEEN REVIEWED FOR THIS PROJECT? Yes

A. GENERAL CRITERIA FOR PROJECT

1. FY 1982 Appropriation Act Sec. 523; FAA Sec. 634A; Sec. 653(b).

   (a) Describe how authorizing and appropriations committees of Senate and House have been or will be notified concerning the project; (a) Congressional Notification.

   (b) is assistance within (Operational Year Budget) country or international organization allocation reported to Congress (or not more than $1 million over that amount)? (b) Yes, assistance is within the 1982 operational year budget.

2. FAA Sec. 611(a)(1). Prior to obligation in excess of $100,00, will there be

(a) engineering, financial or other plans necessary to carry out the assistance and (b) a reasonably firm estimate of the cost to the U.S. of the assistance?	Yes, detailed engineering and financial plans are included in the Project Paper.
3. FAA Sec. 611(a)(2). If further legislative action is required within recipient country, what is basis for reasonable expectation that such action will be completed in time to permit orderly accomplishment of purpose of the assistance?	No further legislative action is required.
4. FAA Sec. 611(b); FY 1982 Appropriation Act Sec. 501. If for water or water-related land resource construction, has project met the standards and criteria as set forth in the Principles and Standards for Planning Water and Related Land Resources, dated October 25, 1973? (See AID Handbook 3 for new guidelines.)	N.A.
5. FAA Sec. 611(e). If project is capital assistance (e.g., construction), and all U.S. assistance for it will exceed $1 million, has Mission Director certified and Regional Assistant Administrator taken into consideration the country's capability effectively to maintain and utilize the project?	Yes, Mission Director's 611 (e) certification is included in the Project Paper.

BEST AVAILABLE DOCUMENT

6. FAA Sec. 209. Is project susceptible to execution as part of regional or multilateral project? If so, why is project not so executed? Information and conclusion whether assistance will encourage regional development program.

Complementary projects by the World Bank, the Canadian International Development Agency, the Overseas Development Agency, the Asian Development Bank, and the Federal Republic of Germany already have been approved or are in the design stage. The power generation component of the project is part of a multi-donor effort to support the construction of the Guddu Combined Cycle Gas Turbine Facility in Pakistan. The remaining components of the project relate directly to Pakistan's rural electrification system and are not susceptible to execution as part of a regional or multilateral project.

7. FAA Sec. 601(a). Information and conclusions whether project will encourage efforts of the country to: (a) increase the flow of international trade; (b) foster private initiative and competition; and (c) encourage development and use of cooperatives, and credit unions, and savings and loan associations; (d) discourage monopolistic practices; (e) improve technical efficiency of industry, agriculture and commerce; and (f) strengthen free labor unions.

(a) Yes; entrepreneurs in rural areas will be provided reliable power at a reasonable price, enabling them to produce exportable goods; rural inhabitants will be able to use imported appliances and communication equipment operated by electricity.
(b) Yes; private rural entrepreneurs and farmers will be provided an important means to increase production and improve the quality of produce and products which will foster a more perfect competitive market; this condition will encourage new business and facilitate existing businesses entering new fields.
(c) No
(d) No
(e) Yes; a reliable, efficient power supply is a major requirement for improving the technical efficiency of industry, agriculture and commerce.
(f) No

8. FAA Sec. 601(b). Information and conclusions on how project will encourage U.S. private trade and investment abroad and encourage private U.S. participation in foreign assistance programs (including use of private trade channels and the services of U.S. private enterprise).

Providing a reliable, efficient electric power supply will permit modernization of Pakistani rural industry and agriculture, make them attractive to U.S. investors, and encourage joint U.S.-Pakistan private investment opportunities. This project also provides numerous opportunities for participation by U.S. privately owned utilities, private electric utility oriented associations, and manufacturers of electric equipment used by utilities.

9. FAA Sec. 612(b), 636(h); FY 1982 Appropriation Act Sec. 507. Describe steps taken to assure that, to the maximum extent possible, the country is contributing local currencies to meet the cost of contractual and other services, and foreign currencies owned by the U.S. are utilized in lieu of dollars.	This project is financed by ESF funds. Nevertheless, the GOP will contribute the equivalent of about $ 136.1 million over the life of the project The equivalent of about $ 14.5 million (Rs 176 million) in U.S. owned rupees will be provided to finance technical assistance, training, commodities, and other local costs.
10. FAA Sec. 612(d). Does the U.S. own excess foreign currency of the country and, if so, what arrangements have been made for its release?	Yes (See 9 above)
11. FAA Sec. 601(e). Will the project utilize competitive selection procedures for the awarding of contracts, except where applicable procurement rules allow otherwise?	Yes
12. FY 1982 Appropriation Act Sec. 521. If assistance is for the production of any commodity for export, is the commodity likely to be in surplus on world markets at the time the resulting productive capacity becomes operative, and is such assistance likely to cause substantial injury to U.S. producers of the same, similar or competing commodity?	N.A.
13. FAA 118(c) and (d). Does the project comply with the environmental procedures set fo th in AID Regulation 16? Does	Yes. An Environmental Assessment is included in the Project Paper

the project or program take into consideration the problem of the destruction of tropical forests?	Yes. This project should impact on the problem of forest destruction by providing rural inhabitants with an alternative form of energy, electricity.
14. FAA 121(d). If a Sahel project, has a determination been made that the host government has an adequate system for accounting for and controlling receipt and expenditure of project funds (dollars or local currency generated therefrom)?	N.A.

B. FUNDING CRITERIA FOR PROJECT

1. Development Assistance Project Criteria	This is an ESF-funded project.
a. FAA Sec. 102(b), 111, 113, 281(a). Extent to which activity will (a) effectively involve the poor in development, by extending access to economy at local level, increasing labor-intensive production and the use of appropriate technology, spreading investment out from cities to small towns and rural areas, and insuring wide participation of the poor in the benefits of development on a sustained basis, using the appropriate U.S. institutions; (b) help develop cooperatives, especially by technical assistance, to assist rural and urban poor to help themselves toward better life, and	N.A.

otherwise encourage democratic private and local governmental institutions; (c) support the self-help efforts of developing countries; (d) promote the participation of women in the national economies of developing countries and the improvement of women's status; and (e) utilize and encourage regional cooperation by developing countries?

b. FAA Sec. 103, 103A, 104, 105, 106. Does the project fit the criteria for the type of funds (functional account) being used? N.A.

c. FAA Sec. 107. Is emphasis on use of appropriate technology (relatively smaller, cost-saving, labor-using technologies that are generally most appropriate for the small farms, small businesses, and small incomes of the poor)? N.A.

d. FAA Sec. 110(a). Will the recipient country provide at least 25% of the costs of the program, project, or activitiy with respect to which the assistance is to be furnished (or is the latter cost-sharing requirement being waived for a "relatively least developed" country)? N.A.

e. FAA Sec. 110(b). Will grant capital assistance be disbursed for project over more than 3 years? If so, has justification satisfactory to Congress been made, and efforts for other financing, or is the recipient country "relatively least developed"? (M.O. 1232.1 defined a capital project as "the construction, expansion, equipping or alteration of a physical facility or facilities financed by AID dollar assistance of not less than $100,000, including related advisory, managerial and training services, and not undertaken as part of a project of a predominantly technical assistance character." N.A.

f. FAA Sec. 122(b). Does the activity give reasonable promise of contributing to the development of economic resources, or to the increase of productive capacities and self-sustaining economic growth? N.A.

g. FAA Sec. 281(b). Describe extent to which program recognizes the particular needs, desires, and capacities of the people of the country; utilizes the country's intellectual resources to encourage N.A.

institutional development; and supports civil education and training in skills required for effective participation in governmental processes essential to self-government.

Development Assistance Project Criteria (Loans Only)

This is an ESF-funded project

a. FAA Sec. 122(b). Information and conclusion on capacity of the country to repay the loan, at a reasonable rate of interest. N.A.

b. FAA Sec. 620(d). If assistance is for any productive enterprise which will compete with U.S. enterprises, is there an agreement by the recipient country to prevent export to the U.S. of more than 20% of the enterprise's annual production during the life of the loan? N.A.

c. ISDCA of 1981, Sec. 724 (c) and (d). If for Nicaragua, does the loan agreement require that the funds be used to the maximum extent possible for the private sector? Does the project provide for monitoring under FAA Sec. 624(g)? N.A.

3. Economic Support Fund Project Criteria

a. FAA Sec. 531(a). Will this assistance promote economic or political

Yes. This program will increase the productivity of the rural poor, thereby effecting a more equitable income distribution conducive to political and economic stability.

The program focuses on helping the poor majority in rural areas by expanding

stability? To the extent possible, does it reflect the policy directions of FAA Section 102?	productive investment and services in rural areas, will encourage U.S. private investment in Pakistan, and, to the maximum extent possible, will involve the Pakistani private sector, both as a participant and beneficiary of this project, thereby reflecting the policy of directions of FAA Section 102.
b. FAA Sec. 531(c). Will assistance under this chapter be used for military, or paramilitary activities?	No
c. FAA Sec. 534. Will ESF funds be used to finance the construction of the operation or maintenance of, or the supplying of fuel for, a nuclear facility? If so, has the President certified that such use of funds is indispensable to nonproliferation objectives?	No
d. FAA Sec. 609. If commodities are to be granted so that sale proceeds will accrue to the recipient country, have Special Account (counterpart) arrangements been made?	N.A.

ANNEX C. 1

UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT
MISSION TO PAKISTAN

Cable : USAIDPAK

HEADQUARTERS OFFICE
ISLAMABAD

THE DIRECTOR

RURAL ELECTRIFICATION PROJECT, 391-0473

FAA SECTION 611 (e) CERTIFICATION

I, Donor M. Lion, principal officer of the Agency for International Development in the Islamic Republic of Pakistan, having taken into account, among other things, the maintenance and utilization of projects in the Islamic Republic of Pakistan previously financed or assisted by the United States, do hereby certify pursuant to Section 611(e) of the Foreign Assistance Act of 1961, as amended, that in my judgement the Islamic Republic of Pakistan has both the financial capability and the human resources capability to effectively implement, utilize and maintain the proposed Rural Electrification Project, 391-0473.

This judgement is based upon the project analysis as detailed in the Rural Electrification Project Paper and is subject to the conditions imposed therein.

Donor M. Lion

Donor M. Lion
Director
USAID/Paksitan

August 1, 1982

Date

UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT
MISSION TO PAKISTAN

Cable : USAIDPAK

HEADQUARTERS OFFICE
ISLAMABAD

THE DIRECTOR

RURAL ELECTRIFICATION PROJECT, 391-0473

FAA SECTION 612 (b) CERTIFICATION

A major purpose of the $1.625 billion economic assistance program negotiated between the Governments of the United States of America and Pakistan, acknowledged by both governments and a primary reason for both governments having decided to develop an economic assistance package, is to provide balance of payments assistance to Pakistan.

I have carefully reviewed the advisability of disbursing United States dollars in lieu of United States-owned excess foreign currency to pay for local costs of projects being implemented in Pakistan. In light of the United States Government's objectives concerning the program, I have determined that it would be prejudicial to U.S. interests and goals to pay for all local currency costs with United States-owned rupees. Such a procedure would prevent the U.S. from providing the maximum amount of balance of payments support under the economic assistance package, and would consequently undercut one of the basic objectives of the program. The objective of providing balance of payments assistance to Pakistan can best be achieved by disbursing United States dollars to pay for local costs of the program. Section 612(b) of the Foreign Assistance Act of 1961, as amended, authorizes the administrative official approving the voucher to determine that local costs will be funded with direct payment of dollars for the program. Pursuant to this provision, Handbook 19 requires that the Mission Director (or his designee) make a determination as to the reason in any instance where United States dollars are used (disbursed) when United States-owned foreign currency is available. Where dollars are used for local costs financing, USAID/Pakistan will, therefore, make disbursements to the Government of Pakistan in U.S. currency.

FAA Section 612(b) Certification (Continued)

In addition to disbursing United States dollars for local costs, USAID/Pakistan plans to use United States-owned excess rupees to finance some of the local costs associated with United States dollar-financed activities, thereby increasing the overall development impact of the proposed $1.625 billion economic assistance program.

In view of the above rationale, I, Donor M. Lion, principal officer of the Agency for International Development in Pakistan, pursuant to Section 612(b) of the Foreign Assistance Act of 1961, as amended, do hereby certify the need to disburse United States dollars to cover local currency costs in lieu of using United States-owned excess rupees under the Rural Electrification Project.

Donor M. Lion

Donor M. Lion
Director
USAID/Pakistan

August , 1982

Date

بسم الله الرحمن الرحيم

No. 1(22)CM-VI/81.
Government of Pakistan
MINISTRY OF FINANCE AND
ECONOMIC AFFAIRS
(ECONOMIC AFFAIRS DIVISION)

Telegram: ECONOMIC
Telex: ECDIV No. 05-634
SECRETARY.
Tele: 20629

Islamabad the 2 August 1982

Dear Mr. Lion,

As part of the agreement of our two governments on a six-year $ 1.625 billion economic assistance program, the Government of Pakistan formally requests from USAID/Pakistan one hundred and fifty-five million dollars ($ 155,000,000) in United States assistance and one hundred and seventy six million rupees (Rs. 176,000,000) to fund a Rural Electrification Project.

2. The Rural Electrification Project will assist the GOP to provide reliable and efficient electric service in rural areas, reduce voltage fluctuations and the necessity of load shedding, and decrease the need for imported kerosene and diesel fuel in electrified areas by strengthening the distribution function of the Water and Power Development Authority (WAPDA); establishing a comprehensive training program for personnel in the distribution function; reducing distribution system energy losses; increasing WAPDA's generating capacity; and expanding the rural power distribution system.

3. Subject to the availability of funds, one hendred and fiftyfive million dollars and one hundred and seventy six million rupees would be provided over a six-year period for:

a. Long and short-term technical assistance to assist WAPDA to:

i. Develop a comprehensive National Rural Electrification Master Plan;

ii Strengthen the organization, staff and management capabilities of its power distribution function including commercial, financial, technical and administrative policies, methods and procedures;

iii. Develop and initiate the implementation of a comprehensive long range training program for all power distribution function officers and employees;

iv. Develop and initiate the implementation of a comprehensive distribution system energy loss reducti on program;

v. Develop and implement selected rural distribution system expansion activities;

vi. Design and supervise the construction of a training center for distribution function officers and employees, warehouses to store power distribution equipment and materials, and rural administrative and customer service facilities; and

vii. Finalize the design of the Guddu Combined Power Generation Project, prepare the respective tender documents, evaluate tenders, and supervise the construction of Phase I of this generation Project.

b. Procurement of selected commodities.

C. Reimbursement of the Government of Pakistan for costs of energy loss reduction and rural system expansion activities.

d. Construction of a training center, warehouses, and rural administrative and customer service centers.

e. Procurement of commodities and construction of a portion of Phase I of the Guddu Combined Cycle Gas Turbine Power Generation Project.

4. The Government of Pakistan assures the United States Government of its full cooperation in carrying out the Rural Electrification Project. The manpower, financial, and other inputs required of us will be provided in an expeditious manner.

5. We look forward to a continued, combined effort by both our governments to yield a productive and beneficial program for the people of Pakistan.

Yours sincerely,

(EJAZ AHMAD MAIK)

Dr. Donor M. Lion
Director
USAID Mission
Islamabad.

UNCLASSIFIED
AID 7/30/82
DIR:DMLION
PDM:JDEFLER/LLION:SJ
1.PRO:LADEAN, 2.E&E:MCMOSELEY
AMB DCM ECON, D DD PDM, PRO E&E CONT, (AID-12)

AMEMBASSY ISLAMABAD
SECSTATE WASHDC

AIDAC

FOR ASIA/PD - VAN RAALTE

E.O.12065 N/A
SUBJECT: RURAL ELECTRIFICATION PROJECT (391-0473):
- DRAFT CONGRESSIONAL NOTIFICATION

1. THIS CABLE TRANSMITS DRAFT LANGUAGE FOR THE C.N. FOR THE SUBJECT PROJECT. MISSION WOULD APPRECIATE YOUR PROCESSING THIS C.N. ASAP AND ADVISING US WHEN FIFTEEN-DAY WAITING PERIOD EXPIRES. JAY CARTER WILL HAND-CARRY TWENTY-FIVE COPIES OF PP TO AID/W WHEN HE DEPARTS ISLAMABAD ON THURSDAY, AUGUST 5, 1982.

2. ACTIVITY DATA SHEET:

COUNTRY: PAKISTAN
TITLE: RURAL ELECTRIFICATION
NUMBER: 391-0473
NEW GRANT AND LOAN FUNDS: ESF
PRIOR REFERENCE: NONE
PROPOSED OBLIGATION: FY 82 - 8,000,000 GRANT
- LOP - 43,000,000 GRANT; 112,000,000 LOAN
INITIAL OBLIGATION: FY 82
ESTIMATED FINAL OBLIGATION: FY 86
ESTIMATED COMPLETION DATE OF PROJECT: FY 88

3. NARRATIVE IS AS FOLLOWS:

PURPOSE: TO ASSIST THE GOVERNMENT OF PAKISTAN (GOP) TO EXPAND RELIABLE ELECTRIC SERVICE TO PAKISTAN'S RURAL POPULATION FOR PRODUCTIVE AND SOCIAL USES, TO IMPROVE THE RURAL POOR'S ACCESS TO THAT SERVICE, AND TO ASSIST THE GOP TO OVERCOME A SHORTFALL IN ELECTRIC POWER GENERATING CAPACITY.

BACKGROUND: THE DISTRIBUTION OF ELECTRICITY TO RURAL AREAS HAS HIGH PRIORITY IN PAKISTAN. A NATIONAL RURAL ELECTRIFICATION MASTER PLAN IS CURRENTLY BEING DEVELOPED AND IS SCHEDULED FOR COMPLETION ABOUT MID-1983. THE POWER WING OF THE WATER AND POWER DEVELOPMENT AUTHORITY (WAPDA) IS RESPONSIBLE FOR GENERATION, TRANSMISSION, AND DISTRIBUTION OF ELECTRICITY INCLUDING RURAL ELECTRIFICATION. THE DEMAND FOR ELECTRICITY HAS GROWN BY A LARGE AMOUNT IN A RELATIVELY SHORT TIME, AND THE DISTRIBUTION FUNCTION OF WAPDA HAS HAD TO ASSUME GREATLY INCREASED RESPONSIBILITIES. THIS IMPORTANT FUNCTION IS HAMPERED BY SERIOUS MANAGERIAL, ADMINISTRATIVE, AND STAFFING PROBLEMS. IN ADDITION, POWER SUPPLY HAS NOT KEPT PACE WITH DEMAND. THE SUPPLY SHORTFALL IS ATTRIBUTABLE PRIMARILY TO INSUFFICIENT GENERATION CAPACITY AND ALSO TO VERY HIGH DISTRIBUTION SYSTEM ENERGY LOSSES. THE GAP BETWEEN ELECTRICITY DEMAND AND SUPPLY AND THE PROBLEMS OF THE DISTRIBUTION FUNCTION HAVE RESULTED IN POOR QUALITY ELECTRIC SERVICE CHARACTERIZED BY FREQUENT POWER DISCONNECTIONS DUE TO LOAD SHEDDING. UNDER THESE CIRCUMSTANCES, CONNECTING LARGE NUMBERS OF NEW CUSTOMERS SHOULD BE UNDERTAKEN ONLY WHEN THE QUALITY OF SERVICE TO EXISTING CUSTOMERS IS IMPROVED AND ONLY IF THE POWER DEMAND-SUPPLY GAP IS NOT EXACERBATED. THIS PROJECT WILL IMPROVE EXISTING SERVICE AND WILL CONTRIBUTE TO NARROWING THE DEMAND-SUPPLY GAP.

PROJECT DESCRIPTION: INITIALLY, THE PROJECT WILL FOCUS ON THE DEVELOPMENT OF A NATIONAL RURAL ELECTRIFICATION MASTER PLAN AND ON SERIOUS AND COSTLY INSTITUTIONAL, TECHNOLOGICAL, AND POWER GENERATION CAPACITY SHORTFALL PROBLEMS. ONCE THE PLAN HAS BEEN DEVELOPED AND APPROVED AND EFFECTIVE STEPS ARE BEING TAKEN TO RESOLVE THE ABOVE-MENTIONED PROBLEMS, THE PROJECT WILL ALSO PROVIDE FUNDS FOR THE EXPANSION OF THE RURAL ELECTRIC DISTRIBUTION SYSTEM AND FOR THE CONNECTION OF IRRIGATION PUMPS, AGRO-INDUSTRIES AND OTHER RURAL CUSTOMERS. THE PROJECT CONSISTS OF FIVE DISTINCT BUT CLOSELY LINKED INTERDEPENDENT COMPONENTS. THE FIRST COMPONENT ADDRESSES CRITICAL INSTITUTIONAL PROBLEMS WITHIN WAPDA. THE SECOND COMPONENT WILL FOCUS ON DISTRIBUTION FUNCTION TRAINING AND TECHNOLOGY TRANSFER. THE THIRD AND FOURTH COMPONENTS WILL DEAL WITH THE GENERATION CAPACITY SHORTFALL PROBLEM BY REDUCING ENERGY LOSSES AND BY FINANCING ADDITIONAL

ENERATION CAPACITY. THE FIFTH COMPONENT, RURAL ISTRIBUTION SYSTEM EXPANSION, DIRECTLY RESPONDS TO .I.D.'S COMMITMENT TO THE GOP TO ASSIST IT IN EXTENDING DDITIONAL ELECTRIC LINES INTO RURAL AREAS AND CONNECTING EW CUSTOMERS.

ELATIONSHIP OF THE PROJECT TO A.I.D. COUNTRY STRATEGY: .I.D'S STRATEGY IN PAKISTAN FOCUSES ON RURAL DEVELOPMENT ND AGRICULTURE SINCE THIS IS AN AREA WHICH AFFECTS THE AJORITY OF PAKISTAN'S POPULATION AND IN WHICH PAKISTAN'S REATEST POTENTIAL LIES. THIS PROJECT SUPPORTS THAT TRATEGY THROUGH ITS FOCUS ON THE COUNTRY'S ENERGY EQUIREMENTS. RELIABLE AND RELATIVELY INEXPENSIVE LECTRICITY IS NEEDED TO OPERATE IRRIGATION TUBEWELLS OR AGRICULTURAL PRODUCTION, TO CONDUCT AGRICULTURAL ESEARCH, TO OPERATE AGRO-BASED AND OTHER INDUSTRIES, ND TO ENABLE HEALTH, EDUCATIONAL, AND OTHER PUBLIC ERVICE FACILITIES TO PROVIDE SERVICES TO THE GENERAL OPULATION. THIS PROJECT WILL ALSO CONTRIBUTE TO THE BJECTIVES OF THE RENEWED U.S. ECONOMIC ASSISTANCE ROGRAM TO PAKISTAN AS THEY RELATE TO PROVIDING BALANCE F PAYMENTS SUPPORT, EXPANDING RESOURCE AVAILABILITY OR LOCAL COST FINANCING, COMPLEMENTING OTHER DONOR SSISTED ACTIVITIES, AND ADDRESSING KEY ECONOMIC PROBLEMS, F WHICH ENERGY IS PARAMOUNT. FINALLY THIS PROJECT, WITH TS EMPHASIS ON INSTITUTION-BUILDING, TRAINING, ECHNOLOGY TRANSFER, AND THE INCREASED INVOLVEMENT OF HE PRIVATE SECTOR AS BOTH A BENEFICIARY AND PARTICIPANT N THE DEVELOPMENT PROCESS, IS FULLY CONSISTENT WITH .I.D.'S OVERALL DEVELOPMENT STRATEGY.

ENEFICIARIES: THE PRIMARY DIRECT BENEFICIARIES OF THIS ROJECT WILL BE THE RURAL INHABITANTS (SMALL FARMERS AND THER RURAL POOR) WHO WILL HAVE IMPROVED ELECTRIC SERVICE OR THE FIRST TIME. OTHER DIRECT BENEFICIARIES WILL BE UBEWELL OWNERS, MERCHANTS, AGRO-INDUSTRIALISTS, SMALL ONSTRUCTION CONTRACTORS AND THEIR EMPLOYEES WHO WORK IN HE RURAL AREAS. THE LARGE NUMBER OF INDIVIDUALS WHO WILL E TRAINED UNDER THE PROJECT ALSO WILL BENEFIT DIRECTLY. INALLY, THE ENTIRE NATION WILL BENEFIT FROM THIS PROJECT O THE EXTENT THAT AGRICULTURAL PRODUCTIVITY IS INCREASED, EPENDENCE ON IMPORTED PETROLEUM IS REDUCED, AND PROGRESS S MADE IN ACHIEVING SOCIO-ECONOMIC GROWTH AND POLITICAL TABILITY.

HOST COUNTRY AND OTHER DONORS: THE TOTAL ESTIMATED COST OF THIS PROGRAM IS DOLS 381,043,000, OF WHICH A.I.D. WILL PROVIDE DOLS 155,000,000 IN ESF GRANT AND LOAN FUNDS, AND RS 176,000,000 (OR THE EQUIVALENT OF DOLS 14,474,000 IN U.S. OWNED RUPEES AT THE EXCHANGE RATE OF DOLS 1.00 EQUALS RS 12.16) UNDER THIS PROJECT. AN ADDITIONAL DOLS 15,000,000 HAS BEEN EARMARKED UNDER THE AGRICULTURAL COMMODITIES AND EQUIPMENT PROGRAM (391-0468) IN FY 1984 TO IMPORT TRANSFORMERS, CAPACITORS, METERS, AND OTHER EQUIPMENT TO CONNECT IRRIGATION TUBEWELL PUMPS AND OTHER RURAL CUSTOMERS UNDER THIS PROJECT. THE ASIAN DEVELOPMENT BANK IS EXPECTED TO CONTRIBUTE DOLS 60,500,000 TOWARD THE FOREIGN EXCHANGE COSTS OF PHASE I OF THE GUDDU COMBINED CYCLE GAS TURBINE POWER GENERATION PROJECT (THE REMAINING FOREIGN EXCHANGE COSTS TO BE FINANCED BY A.I.D.); AND, THE GOP WILL CONTRIBUTE THE EQUIVALENT OF DOLS 136,069,000 (AT THE EXCHANGE RATE OF DOLS 1.00 EQUALS RS 12.16) OR ABOUT 36 PERCENT OF TOTAL PROGRAM COSTS. THE GOP CONTRIBUTION WILL FINANCE SALARIES AND OPERATING COSTS; LOCALLY PROCURED COMMODITIES; LAND; CONSTRUCTION COSTS; AND IN-COUNTRY TRAINING COSTS. OTHER DONORS HAVE BEEN AND ARE PROVIDING CREDITS TO WAPDA FOR ELECTRIC POWER INVESTMENT BUT, WITH FEW EXCEPTIONS, THESE CREDITS ARE FOR GENERATION, TRANSMISSION, AND GRID STATIONS. RECENTLY, HOWEVER, OTHER DONORS HAVE BECOME MORE AWARE OF DISTRIBUTION NEEDS, ESPECIALLY IN RURAL AREAS. THE WORLD BANK FAMILY HAS STRONGLY SUPPORTED WAPDA WITH THREE PROJECTS: DOLS 23 MILLION IN 1970; DOLS 35 MILLION IN 1975; AND DOLS 45 MILLION IN 1979. THESE PROJECTS HAVE FOCUSED ON TRANSMISSION LINES AND GRID SUBSTATIONS AND ON FISCAL, OPERATIONAL, AND MANAGEMENT AREAS OF WAPDA. THE LATEST (MAY 1982) WORLD BANK INPUT, A STRUCTURAL ADJUSTMENT PROGRAM, PROVIDES A DOLS 80 MILLION CREDIT (SDR 71.9 MILLION CREDIT) AND DOLS 60 MILLION LOAN TO SUPPORT GOP STRUCTURAL REFORMS. THE WORLD BANK IS ALSO COORDINATING WITH THE UNDP IN CARRYING OUT STUDIES OF AREAS WITH POTENTIAL FOR INCREASED AGRICULTURAL PRODUCTION IF TUBEWELL IRRIGATION WERE PROVIDED. A.I.D. WILL COLLABORATE WITH THE GOP AND THE BANK TO FUND UNDER THIS PROJECT ELECTRIFICATION FOR TUBEWELLS AND SMALL INDUSTRIES IN AREAS WHERE ECONOMIC STUDIES INDICATE POSITIVE RETURNS ON INVESTMENTS. IN ADDITION TO ITS PROPOSED CONTRIBUTION TO THIS PROJECT, THE ADB IN 1981 PROVIDED A DOLS 35 MILLION LOAN TO ELECTRIFY 900 VILLAGES THROUGHOUT PAKISTAN BETWEEN 1982-84. THE GOVERNMENT OF

KUWAIT HAS PROVIDED A DOLS 15 MILLION LOAN TO ELECTRIFY 300 VILLAGES IN BALUCHISTAN BETWEEN 1982-84. THE CANADIAN INTERNATIONAL DEVELOPMENT AGENCY PROVIDED A DOLS 10 MILLION GRANT IN 1982 FOR AN ALUMINIUM INGOT COMMODITY IMPORT PROGRAM, THE SALES PROCEEDS OF WHICH ARE TO BE USED FOR BUILDING TRANSMISSION AND DISTRIBUTION LINES TO SUPPLY ELECTRICITY TO VILLAGES IN BALUCHISTAN BETWEEN 1983-85. THE WEST GERMAN GOVERNMENT IS FUNDING TRAINING ACTIVITIES WHICH WILL BE COORDINATED WITH THOSE FINANCED UNDER THIS PROJECT. SOME OF THESE AND OTHER DONORS ARE ALSO SUPPORTING GOP/WAPDA POWER GENERATING AND TRANSMISSION ACTIVITIES INCLUDING THE TARBELA HYDRO POWER GENERATING PROJECT.

- MAJOR OUTPUTS	ALL YEARS
RESIDENTIAL CUSTOMERS CONNECTED	185,000
COMMERCIAL CUSTOMERS CONNECTED	17,000
TUBEWELL CUSTOMERS CONNECTED	7,700
COMMUNITY CUSTOMERS CONNECTED	4,500
INDUSTRIAL CUSTOMERS CONNECTED	1,500
- TOTAL CUSTOMERS CONNECTED	215,700
ENERGY LOSSES REDUCED - - - -	3 PERCENT OR THE EQUIVALENT OF A 122 MW UNIT OPERATING CONTINUOUSLY AT A LOAD FACTOR OF 60 PERCENT
NEW POWER GENERATING CAPACITY	400 MW
PERSONNEL TRAINED	
- U.S. LONG-TERM	14
- U.S. SHORT-TERM	314
SISTER UTILITY INTERNSHIPS	160
IN-COUNTRY SHORT-TERM TRAINING	28,310
- TOTAL PERSONNEL TRAINED	28,798
TRAINING INSTITUTE FOR DISTRIBUTION FUNCTION PERSONNEL CONSTRUCTED	1
WAREHOUSE CONSTRUCTED	2 - 5

UNCLASSIFIED

RURAL CUSTOMER SERVICE CENTERS CONSTRUCTED 2 - 5

NATIONAL RURAL ELECTRIFICATION MASTER PLAN DEVELOPED 1

AID FUNDED INPUTS:

-	LIFE OF PROJECT (DOLS 000)
TECHNICAL ASSISTANCE	16,246
TRAINING	5,192
COMMODITIES	82,420
LOCAL WORKS	51,142
- TOTAL	155,000

U.S. FINANCING:

PROPOSED FY 82 OBLIGATIONS	8,000,000
FUTURE YEAR OBLIGATIONS	147,000,000
- ESTIMATED TOTAL	155,000,000

PRINCIPAL CONTRACTORS OR AGENCY: U.S. CONSULTING FIRMS AND ENTITIES, U.S. ENGINEERING FIRMS, AND PAKISTANI PRIVATE SECTOR ENGINEERING FIRMS AND CONSTRUCTION CONTRACTORS. SPIERS##

DRAFT PROJECT AUTHORIZATION

Name of Country: Pakistan

Name of Project: Rural Electrification

Number of Project: 391-0473

Number of Grant:

Number of Loan:

1. Pursuant to Section 531 of the Foreign Assistance Act of 1961, as amended, I hereby authorize the Rural Electrification Project for the Islamic Republic of Pakistan involving planned obligations of not to exceed U.S. Dollars One Hundred Fifty-Five Million ($155,000,000) and One Hundred Seventy-Six Million United States-owned Pakistani Rupees (Rs 176,000,000) in grant and loan funds over a six (6) year period from the date of authorization, subject to the availability of funds in accordance with the A.I.D. OYB/ allotment process, to help in financing foreign exchange and local currency costs for the Project.

2. The Project is designed to assist the Government of Pakistan (GOP) to expand reliable electric service to Pakistan's rural population for productive and social uses, to improve the rural poor's access to that service, and to assist the GOP overcome a shortfall in electric power generation capacity. Activities to be financed by A.I.D. include: (a) institutional strengthening of the distribution function within the Water and Power Development Authority (WAPDA) including the development of a National Rural Electrification Master Plan; (b) the design and implementation of a comprehensive distribution function training program; (c) the design and implementation of a comprehensive distribution system energy loss reduction program; (d) partial funding of Phase I of the Guddu Combined Cycle Gas Turbine Facility to assist Pakistan to narrow the existing power supply-demand gap; and, (e) the design and implementation of a rural electrification system expansion program.

3. The Project Agreement(s) which may be negotiated and executed by the officer(s) to whom such authority is delegated in accordance with A.I.D. regulations and Delegations of Authority shall be subject to the following essential terms and covenants and major conditions, together with such other terms and conditions as A.I.D. may deem appropriate.

a. Source and Origin of Goods and Service

Goods and services financed by A.I.D. under this Project shall have their source and origin in the Cooperating Country

or in the United States except as A.I.D. may otherwise agree in writing. Ocean shipping financed by A.I.D. under the Project shall, except as A.I.D. may otherwise agree in writing, be financed only on flag vessels of the United States and the Cooperating Country.

b. Conditions Precedent to Disbursement for Commodities and Construction Related to the Power Generation Component

i. Except as A.I.D. may otherwise agree in writing, prior to the disbursement under this project or to the issuance by A.I.D. of documentation pursuant to which disbursement will be made for commodities and construction under the Power Generation component of this project, the Borrower/Grantee, acting through WAPDA, shall furnish to A.I.D., in form and substance satisfactory to A.I.D. evidence that: (a) adequate and appropriately scheduled financing has been secured; and, (b) a contract has been executed for the construction of a completely operational Guddu IV Steam Generating Facility.

ii. Except as A.I.D. may otherwise agree in writing, prior to the disbursement under this project or to the issuance by A.I.D. of documentation pursuant to which disbursement will be made for commodities or construction under the Power Generation component of this project, the Borrower/Grantee, acting through WAPDA, shall furnish to A.I.D., in form and substance satisfactory to A.I.D. evidence that an updated feasibility study for Phases I and II of the Guddu Combined Cycle Gas Turbine Facility establishing the Facility's technical and economic feasibility has been prepared.

iii. Except as A.I.D. may otherwise agree in writing, prior to the disbursement under this project or to the issuance by A.I.D. of documentation pursuant to which disbursement will be made for commodities or construction under the Power Generation component of this project, the Borrower/Grantee, acting through WAPDA, shall furnish to A.I.D., in form and substance satisfactory to A.I.D., evidence that: (a) adequate and appropriately scheduled financing for Phase I of the Guddu Combined Cycle Gas Turbine Facility has been secured; and, (b) formal procedures are in progress to arrange adequate and appropriately scheduled financing for Phase II of the Guddu Combined Cycle Gas Turbine Facility.

c. Conditions Precedent to Disbursement for Fixed Amount Reimbursement of System Expansion Work Orders under the Rural Distribution System Expansion Component.

Except as A.I.D. may otherwise agree in writing, prior to the disbursement under this project or to the issuance by

A.I.D. of documentation pursuant to which disbursement will be made for fixed amount reimbursement (FAR) of System Expansion Work Orders under the Rural Distribution System Expansion component of this project, the Borrower/Grantee acting through WAPDA, shall furnish to A.I.D. in form and substance satisfactory to A.I.D., evidence that: (i) a comprehensive National Rural Electrification Master Plan has been developed and is being inplemented according to schedule; (ii) execution of plans for additional power generation capacity is proceeding satisfactorily; and, (iii) an economically feasible and administratively sound System Expansion Work Order Design and Management System consistent with the Master Plan has been developed based on accurate data.

d. Conditions Precedent to Disbursement for Fixed Amount Reimbursement for Work under the Energy Loss Reduction Component

Except as A.I.D. may otherwise agree in writing, prior to the disbursement under this project or to the issuance by A.I.D. of documentation pursuant to which disbursement will be made for fixed amount reimbursement (FAR) for work under the Energy Loss Reduction component of this project, the Borrower/Grantee, acting through WAPDA, shall furnish to A.I.D., in form and substance satisfactory to A.I.D., evidence that an economically feasible and administratively sound Rehabilitation Work Order Design and Management System has been developed based on accurate data.

e. Conditions Precedent to Disbursement for the New Comprehensive Training Program for Distribution Function Personnel of WAPDA under the Distribution Function Training Component

Except as A.I.D. may otherwise agree in writing, prior to the disbursement under this project or to the issuance by A.I.D. of documentation pursuant to which disbursement will be made for the New Comprehensive Training Program under the Distribution Function Training component of this project, the Borrower/Grantee, acting through WAPDA, shall furnish to A.I.D., in form and substance satisfactory to A.I.D., evidence that a feasible and effective New Comprehensive Training Program for distribution function personnel of WAPDA has been developed.

f. Conditions Precedent to Design and/or Construction of a Central Distribution Function Training Institute under the Distribution Function Training Component

i. Except as A.I.D may otherwise agree in writing, prior to the disbursement under this project or to the issuance by A.I.D. of documentation pursuant to which disbursement will be made for architectural and engineering services

to review the site of the construction of a Central Distribution Function Training Institute under the Distribution Function Training component of this project, the Borrower/Grantee acting through WAPDA, shall identify a proposed site for the Training Institute acceptable to A.I.D.; and,

ii. Except as A.I.D. may otherwise agree in writing, prior to the disbursement under this project or to the issuance by A.I.D. of documentation pursuant to which disbursement will be made for architectural and engineering services with respect to such Training Institute, other than site investigations, the Borrower/Grantee, acting through WAPDA, shall establish its right, in form and substance satisfactory to A.I.D., to ownership or adequate and sufficient use of occupancy of the proposed land site for the Training Institute.

g. Covenant as to Training

The Borrower/Grantee, acting through WAPDA, shall make every reasonable effort to require that each person trained under this Project works in electric utility, electricity distribution, and/or rural electrification activities in Pakistan for not less than three times the length of time of his or her training program provided, however, that in no event shall the individual be allowed to work for less than one year nor be required to work for more than five years from the date of the individual's completion of training.

h. Covenant as to Quarterly Reports

The Borrower/Grantee shall furnish to A.I.D. quarterly activity reports, the requirements of which shall be set forth by A.I.D. in periodic Project Implementation Letters. The requirements may include, but are not limited to, providing information concerning: (i) comprehensive distribution planning (financial, administrative, and technical), including development of a comprehensive National Rural Electrification Master Plan; (ii) the hierarchy, functions, responsibilities, authority, organization, and staffing of the Office of the General Manager of Distribution and other WAPDA administrative units sharing responsibility for electric power distribution and rural electrification; (iii) the functions, responsibility, autonomy, organization, staffing, and facilities of Area Electricity Boards; (iv) the duties, responsibility, and authority of the Rural Electrification Office (REO); (v) distribution function staffing and personnel administration, policies, and practices; (vi) improvements in customer service facilities and procedures; (vii) improvements in customer accounts management; (viii) rationalization of cost of service, rates, recurrent costs, and property valuation and depreciation practices; (ix) improvement in collection, dissemination, and utilization of statistics; and, (x) improvements in procurement and inventory management procedures.

4. The following waiver to A.I.D. regulations is hereby approved: A source/origin waiver from A.I.D. Geographic Code 000 to A.I.D. Geographic Code 935 to permit the purchase of 25 right-hand drive four-door sedans, 2 right-hand drive station wagons, and 2 right-hand drive utility vehicles and spare parts.

APPROVED: _____
M. Peter McPherson

DATE: _____

DRAFT PROJECT DESCRIPTION FOR INCLUSION IN PROJECT AGREEMENT

A. Project Goal and Purpose

The overall sector goal to which this project contributes is to improve the quality of life of the rural poor. The purpose of the project is to assist the GOP to expand reliable electric service to Pakistan's rural population for productive and social uses, to improve the rural poor's access to that service, and to assist the GOP to overcome a shortfall in electric generating capacity.

B. Project Components

This six-year project is designed to assist the Government of Pakistan to address the following constraints to the effective implementation of a National Rural Electrification Program: lack of trained staff; inability to retain qualified staff due to lack of career advancement incentives; need for improved staff selection procedures; growing backlog of power service applications; system load outstripping power generation capability; and, loss of energy due to overloaded distribution systems, lack of proper metering and pilferage. The project consists of five distinct but complementary and interrelated components. The fifth component, Rural System Expansion and Connections, will be deferred until August 1985 or until the Guddu Gas Turbine Units are operational.

1. Institutional Improvement

The objectives of this component are to assist WAPDA to : (a) prepare a comprehensive National Rural Electrification Master Plan; and, (b) strengthen its human and physical resources and management operations to implement the Plan and to operate the resultant rural distribution system in an efficient and financially sound manner. To achieve these objectives, funds will be provided for long and short-term technical assistance, training of WAPDA employees, including the establishment of a Sinter-Utility Exchange Program, commodities, and the design and construction of model warehouses and rural customer service centers.

2. Distribution Function Training

[illegible] over 67,000 distribution employees (many of them y[illegible]g, illiterate, and without the minimum aptitudes

and preparation required for the positions they occupy), the distribution function training requirements are of such a magnitude and diversity and are growing so fast that all of them simply cannot be attended to even within the six year life of this project. One of the first activities to be undertaken will be to establish training goals and objectives which are consistent with the basic institutional goals and objectives of WAPDA and the policies of the GOP. Once those goals and objectives are approved by WAPDA management and A.I.D., a Comprehensiv Training Program will be developed and its initial stages implemented, including the construction of a distribution fu training facility.

3. Distribution System Energy Loss Reduction

The objective of this component is to develop and initiate the implementation of a comprehensive distribution system technical energy loss reduction program. The program will include a management information system to collect and maintain reliable information about distribution circuit and circuit component capacities and loads, economic and financial costs of energy generated by WAPDA's different generating plants, peak demand load management, and economic criteria for selecting conductor and transformer sizes and for deciding when installed conductors and transformers should be changed. Energy and demand losses will be reduced by expanding the use of compression connectors, reducing loads on existing primary and secondary lines, replacing economically undersized conductors with larger sizes, installing capacitors (electric energy storage devices), installing voltage regulators, replacing underloaded and overloaded transformers, and by applying modern load control techniques. The administrative vehicle which will be used to implement the program will be an Energy Los" Reduction Work Order System.

4. Power Generation

Under this component, A.I.D. will assist the GOP and WAPDA to overcome a portion of Pakistan's severe power generation capability shortfall by providing $52 million toward the foreign exchange costs of Phase I of the Guddu Combined Cycle Gas Turbine Project. WAPDA anticipates that the balance of the currently estimated foreign exchange costs($60.5 million) of Phase I will be provided by the ADB and that all of the foreign exchange costs of Phase II ($84.17 million) will be financed by other donors. Of the $52 million to be provided by A.I.D., $50 million will be used for procurement of U.S. goods and equipment and $2 million wil finance technical assistance and training.

5. Rural System Expansion and Connections Program

A total of about $57 million will be made available under this component for Rural Distribution System Expansion and Connections. Subject to the availability of funds, an additional $15 million will be provided under the Agricultural Commodities and Equipment Program (391-0468) in FY 1984 to import transformers, energy (watt-hour) meters and other items required to connect privately owned irrigation tubewells, etc. Because of the severe generation capability shortfall, activities under this component are scheduled to begin about April 1985 after the National Rural Electrification Master Plan has been developed and approved and the additional power generation capacity (component 4) is in place.

Following approval of the Rural Electrification Master Plan, a Rural System Expansion and Connection Program will be developed in conformance with the Master Plan. As many as 215,700 new connections (residential, community, commercial, industrial, and tubewells) may be financed under this project. As in the case of the energy loss reduction activities, a Work Order System will be used to implement the approved Rural System Expansion and Connection Program.

C. Implementation Plan

1. Illustrative Implementation Schedule

All project activities, except for those under the Power Generation and Rural System Expansion Components, are scheduled to take place over a period of six years from the date of signing of the Project Agreement. Activities under the Power Generation Component will be started as soon as the Agreement is signed and are scheduled to be completed during the third project year. Activities under the Rural System Expansion Component will start the third project year and continue until the Project Assistance Completion Date (PACD), which is September 30, 1988.

As soon as possible after the Project Agreement is signed, short-term technical assistance will be provided to assist WAPDA to review and finalize the specifications, economic analysis and tender documents for the Guddu Combined Cycle Power Generation Facility. While the documents are being reviewed, WAPDA, in collaboration with the Mission, will finalize arrangements for financing of the balance of the foreign exchange costs of the Facility. Upon receipt of acceptable documents and

confirmation that the balance of funding has been secured, the Mission will authorize WAPDA to issue the tender documents for the items that will be financed with A.I.D. funds and a request for proposals for the provision of long-term technical assistance that will be required to approve as built drawings, inspect equipment, and monitor construction.

At the same time, the Mission will negotiate a direct A.I.D.contract for the Technical Assistance Team (TAT) required to implement components 1-4 and will place orders for the vehicles required by the TAT. The priority focus of the TAT will be the development of the Rural Electrification Master Plan which should be finished by June 1983. The TAT will also focus on the development of the Comprehens Training and Energy Loss Reduction Programs, the organizati of the Sister Utilities Exchange Program, arrangements to train WAPDA implementation staff, and the contracting and training of Pakistani TAT staff. All these activities should be completed within six months after the arrival of the TAT. Activities under the Comprehensive Training, Sister Utility Exchange and Energy Loss Reduction Programs will be phased in as each program is approved. Temporary quarters will be used for in-country training under the Comprehensive Training Program until the permanent facility is completed at the end of the third year of the project. The first activity under the Energy Loss Reduction Program will be the award of contracts for commodities that will have to be imported from the United States. Simultaneously, the preparation of energy loss reduction Work Orders will begin and a number of Work Orders will be approved and ready to execute as soon as the first materials arrive at the end of the first quarter of the second project year. Rural System Expansion activities will follow this same sequence with a lag of several months depending on the status of power generation construction and the National Rural Electrification Master Plan.

2. A.I.D. Responsibilities

A.I.D. will be responsible for : (a) contracting with all technical consultants except the long-term advisors to be provided under the Power Generation component; (b) purchasing all vehicles, computer hardware and software and other equipment to be funded under this project as may be mutually agreed between the parties; (c) advance approval of the design and cost estimates for all work orders under the Energy Loss Reduction and Rural System Expansion components, inspections of works, and certification for payment of all such works financed under this project; (d) arranging for short-term and long-term training in the United States; and, (e) providing

sufficient staff to participate in the scheduled project evaluations and to liaise with GOP/WAPDA staff in the implementation of this project.

3. GOP/WAPDA Responsibilities

GOP responsibility for each of the five components of the project will be as follows :

Project Component	Component Manager
Institutional Improvement	General Manager of Distribution
Distribution Function Training	Chief, Distribution Training (New Position
Distribution System Energy Loss Reduction	Chief Engineer, Design (Distribution)
Power Generation	Chief Engineer, Thermal Generation
Rural Distribution System Expansion	Chief Engineer, Rural Electrification

Each of the Component Managers in WAPDA will be responsible for : (a) all aspects of the implementation of the component assigned; (b) the timely coordination of the activities of their component with the Managers of the other four components and other officers and administrative units of WAPDA and the GOP; (c) providing adequate counterparts to work with consultants; (d) liaising on a day-to-day basis with A.I.D. representatives and members of the Technical Assistance Team; (e) assisting with the scheduling of and participating in project evaluations; (f) procuring commodities to be financed under this project as may be mutually agreed between the parties. The Chief Engineer, Thermal Generation will also be responsible for contracting for the long-term technical assistance programmed under the Power Generation component.

SUMMARY OF PROJECT COSTS
BY EXPENSE CATEGORY AND SOURCE OF FUNDING

(In 000s)

Expense Category	FY 1982						Life of Project Funding 2/					
	A.I.D. Dollars			U.S. Rupees (In Rs)	GOP (In Rs)	Other 1/ Donors (In $)	A.I.D. Dollars 3/			U.S. Rupees (In Rs)	GOP (In Rs)	Other 1/ Donors (In $)
	Loan (In $)	Grant (In $)	Total (In $)				Loan (In $)	Grant (In $)	Total (In $)			
1. Technical Assistance												
a. Short-Term	-	862	862	-	-	-	-	2,544	2,544	11,576	-	-
b. Long-Term	-	5,904	5,904	-	-	-	-	12,225	12,225	89,753	-	-
2. Training												
a. U.S.												
i. Short-Term	-	239	239	-	-	-	-	3,899	3,899	18,458	-	-
ii. Long-Term	-	-	-	-	-	-	-	821	821	.705	426	-
b. In-Country	-	-	-	-	-	-	-	-	-	-	71,014	-
3. Commodities												
a. Vehicles	-	268	268	-	-	-	-	268	268	-	-	-
b. Other	-	-	-	-	-	-	55,329	19,334	74,659	1,180	252,830	60,500
4. Other Costs												
a. Construction	-	-	-	-	-	-	-	-	-	38,572	945,672	-
b. Operating Costs	-	-	-	-	23,262	-	-	-	-	-	234,238	-
c. FAR 4/	-	-	-	-	-	-	46,493	-	46,493	-	-	-
Sub-Total	-	7,273	7,273	-	21,147	-	101,818	39,091	140,909	160,244	1,504,180	60,500
Contingency (10%)	-	727	727	-	2,115	-	10,181	3,909	14,091	15,756	150,420	-
TOTAL	-	8,000	8,000	-	23,262	-	112,000	43,000	155,000	176,000	1,654,600	60,500

1/ The ADB is expected to provide $60.5 million in FY 1983 to cover the balance of the foreign exchange costs of Phase I of the Guddu Combined Cycle Gas Turbine Power Generation Project.

2/ Subject to the availability of funds to A.I.D. for this purpose, and to the mutual agreement of the parties to proceed at the time of each subsequent increment.

3/ Does not include $1.[illegible] million earmarked under the Agricultural Commodities and Equipment Project (391-[illegible]) in FY 1984 to import transformers, capacitors, meters and other equipment to connect irrigation tubewell pumps and other rural customers under this project, subject to the availability of funds to A.I.D. for this purpose.

4/ Payments under Fixed Amount Reimbursement System for Energy Loss Reduction and Rural System Expansion components.

PROJECT DESIGN SUMMARY
LOGICAL FRAMEWORK

Date of Project: From FY 1982 to FY 1988
Total U.S. Funding $155,000,000 and
Date Prepared: [illegible] $126,[illegible]

Project Title & Number: Rural Electrification (391-0473)

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
Program or Sector Goal: The broader objective to which this project contributes: - To improve the quality of life of the rural poor	Measures of Goal Achievement Extent of increases in the following: -Agricultural production and productivity, especially in tubewell-irrigated areas - Quality of services provided by health, educational, and other public service facilities - Employment opportunities - Output of commercial enterprises - Use of electrical appliances and participation in social and cultural activities (continued on p. 2)	- GOP, IBRD, ADB and other donor records of Agricultural production and agro-industrial activity, employment statistics, health and education statistics, consumer purchases of electric appliances - GOP/WAPDA's distribution function records - Special surveys and studies including project evaluations	Assumptions for achieving goal targets: - GOP will continue to accord high priority to the energy and power sectors, in particular the distribution function within the power sector, as evidenced by adequate budgetary support - Other sectoral inputs such as water and fertilizer, health and educational facilities and capital for commercial enterprises will be available - Continued progress will be made in narrowing the power demand-supply gap
Project Purpose: -To assist the GOP to expand reliable electric service to Pakistan's rural population for productive and social uses, to improve the rural poor's access to that service, and to assist the GOP to overcome a shortfall in electric generating capacity	Conditions that will indicate purpose has been achieved: End of project status. - Phase I of the Guddu Combined Cycle Power Generation Facility is operational - A comprehensive National Rural Electrification Master Plan has been developed and is being implemented on schedule - Activities under the Rural System Expansion and the System Energy Loss Reduction Programs financed by this project have been completed and procedures have been institutionalized by WAPDA to continue these programs (continued on p.2)	-Site inspection at Guddu and WAPDA's generation records on Guddu -A.I.D. FAR records -WAPDA's personnel, management, customer service, and generation/distribution records -Site inspection of warehouses, customer service centers and training facility -Special surveys and studies including project evaluations -Consultant reports	Assumptions for achieving purpose: - Financing for Guddu IV and both Phases I and II of the Guddu Combined Cycle Gas Turbine facility has been secured by the GOP - WAPDA personnel at all organization levels are receptive and responsive to the policy and operational reforms required to improve the distribution function - Connections to be made and lines to be rehabilitated are selected on the basis of sound economic and technical criteria (continued on p.2)
Outputs: New customers connected consisting of: Residential Commercial Tubewells Community Industrial New power generating capacity at Guddu Personnel training, consisting of: U.S. Long-term U.S. Short-term (continued on p.2)	Magnitude of Outputs: = 215,700 = 185,000 = 17,000 = 7,700 = 4,500 = 1,500 = 400 MW = 28,798 = 14 = 314 (continued on p.2)	- Site inspection at Guddu, the Distribution Function Training Center, warehouses, customer service centers, and locations where work orders were implemented - GOP and A.I.D. program and financial records - Special surveys and studies including project evaluations - Consultant reports	Assumptions for achieving outputs: - U.S. electric utilities are willing to participate in a Sister Utility Exchange program - Qualified participants are selected for training - The FAR Work Order System is a feasible implementation procedure for local works - Adequate sites can be identified for facilities and construction proceeds on schedule and within the budget (continued on p.2)
Inputs: 1. A.I.D. - Short and long-term expatriate and Pakistani technical assistance - Short and long-term U.S. and in-country training and sister utility exchange program internships - Vehicles, gas turbines, computers, training materials, and other commodities - Construction of a training facility (continued on p. 2)	Implementation Target (Type and Quantity) See financial analysis, implementation schedule and commodity, technical assistance and training plans in the project paper	- A.I.D. and GOP project records and financial documents - Project evaluations	Assumptions for providing inputs: - A.I.D. and GOP proposed funding levels are approved by their respective governments and disbursements are made on a timely basis - Appropriate overseas training programs can be identified - Local works are undertaken according to agreed upon standards and procedures and are certified for reimbursement under the FAR system (continued on p.2)

BEST AVAILABLE DOCUMENT

ANNEX I

A.I.D. 1020-28 (1-78)

PROJECT DESIGN SUMMARY
LOGICAL FRAMEWORK

Life of Project:
From FY 1982 to FY 1988
Total U.S. Funding $155,000,000 and
Date Prepared 7/31/82 and Rs 176,000,000

Project Title & Number: Rural Electrification (391-0473)

NARRATIVE SUMMARY		OBJECTIVELY VERIFIABLE INDICATORS	IMPORTANT ASSUMPTIONS
Outputs:	Magnitude of Outputs:	Measures of Goal Achievement:	Assumptions for achieving goal targets:
-Sister Utility Exchange Program Internships	= 160	- Quality of electric service as evidenced by the frequency of load-shedding and blackouts and the degree of voltage regulation	—
-In-country training courses	= 28,310		
-Distribution Function Training facility constructed and operational	= 1		
-Model warehouses constructed and operational	= 2-5		
-Model customer service centers constructed and operational	= 2-5		
-Energy losses reduced	= 3 percent		
-National RE Master Plan developed and partially implemented	= 1	Conditions that will indicate purpose has been achieved: End of project status:	Assumptions for achieving purpose:
-Comprehensive Distribution Function Training Program developed and partially implemented	= 1	- A comprehensive Distribution Function Training Program has been developed and partially implemented and new training procedures have been institutionalized	- WAPDA receives adequate policy and budgetary support from the GOP to implement the National Rural Electrification Master Plan
-Work Orders Executed for Energy Loss Reduction Program	= Approx. 130	- New procedures and systems for procurement, inventory control, statistics, customer service, warehousing, transportation, and communications have been institutionalized	
-Work Orders Executed for Rural System Expansion Program	= Approx. 159	- New warehouses, customer service centers, and a distribution function training facility have been constructed	
-Work Order Management Systems established for Energy Loss Reduction and RE System Expansion	= 2	- Reduction in the time between date of application and date of actual connection for new customers	
-New procurement and inventory management system developed and institutionalized	= 1	- Reduction in the frequency of load-shedding and black-outs	
-Revised personnel administration policies and practices developed & institutionalized	= 1	- Reduction of kerosene and diesel consumption in electrified areas	
-New computerized management system installed and operational	= 1		Assumptions for achieving outputs:
-New communication and transportation systems developed and institutionalized	= 2		- Opium poppies are not grown in the project areas during the life of the project
-New customer services accounting, education, and management system developed and institutionalized	= 1		- New management systems and procedures are approved and adopted by WAPDA personnel at all levels of the organization
-Analysis of recurrent costs completed	= 1		- Technical consultants are effective in working with WAPDA personnel
-Review of valuation and depreciation practices and WAPDA's cost-price policies completed	= 1		- Training programs effectively transfer skills and technology
Inputs:	Implementation Target (Type and Quantity)		Assumptions for providing inputs:
- Local Works (FAR System)	—	—	- The GOP meets the conditions precedent for the power generation, training, system energy loss reduction, and system expansion components
2. GOP			- Appropriate consultants can be recruited to provide the required technical assistance
- Staff salaries and operating expenses			
- Land royalty			
- Construction of model warehouses and customer service centers			
- In-country training and travel costs of U.S. long-term training			
- Locally-procured commodities			

ACTION MEMORANDUM TO THE ASSISTANT ADMINISTRATOR FOR ASIA

From: ASIA/PD - G. Reginald Van Raalte

I. PROBLEM

To obtain a source/origin waiver from A.I.D. Geographic Code 000 (U.S. only) to A.I.D. Geographic Code 935 (Special Free World) to permit the purchase of twenty-five (25) right-hand drive four-door sedans, two (2) right-hand drive station wagons, and two (2) right-hand drive utility vehicles and spare parts under the Pakistan Rural Electrification Project (391-0473).

II. BACKGROUND

A. Cooperating Country	: Pakistan
B. Geographic Code of Project	: 000 and Pakistan
C. Importer of Commodity	: USAID/Paksitan on behalf of the Water and Power Development Authority (WAPDA), GOP.
D. Description of Commodity	: Twenty-five (25) right-hand drive four-door sedans; two (2) right-hand drive station wagons; and two (2) right-hand drive utility vehicles and spare parts.
E. Manufacturer of Commodity	: Probably Toyota, Mazda or Datsun since adequate spare parts and maintenance and repair facilities exist in Pakistan for these Japanese vehicles.
F. Approximate Value of Commodity	: $268,000 consisting of:

25 sedans at $7,500 each = $187,500

2 station wagons at $10,000 each = $ 20,000

2 utility vehicles at $11,000 each	=	$ 22,000
Total Vehicles	=	$229,500
Spare parts (approx. 17% of cost of vehicles)	=	$ 38,500
GRAND TOTAL	=	$268,000

G. Nature of Funding : ESF Grant

H. Procurement Source and Origin : Japan

I. Is the commodity sought from a sole source or from more than one source? : Bids will be solicited from multiple distributors.

III. DISCUSSION

Activities under the Pakistan Rural Electrification Project require that expatriate and Pakistani technical advisors, WAPDA personnel, and project staff be transported throughout Pakistan to work with personnel in WAPDA's decentralized distribution function entities: Area Electricity Boards, Circle Offices, Operations Divisions, and Construction Divisions. Transport also is required for advisors and personnel to inspect generation, transmission, and distribution facilities. Two components of the project, the Energy System Loss Reduction Program and the Rural Electrification Network Expansion Program, will use the Fixed Amount Reimbursement System for work undertaken pursuant to A.I.D. approved work orders, and extensive travel will be required to monitor and inspect these construction activities.

Some of the travel will be through rough terrain in remote regions and will require heavy duty suspension for carrying electrical gear and testing equipment. Utility vehicles are suitable for this purpose. Some travel will require seating capacity for up to eight persons plus luggage, and, for this purpose, station wagons are required. The remaining transport needs can be satisfied by four-door sedans.

In Pakistan, traffic moves forward on the left side of the road and, accordingly, right-hand drive is imperative for safety reasons to facilitate maximum visability, especially in passing situations. Road conditions are hazardous, driving often is reckless, and there is an unusually high number of deaths by vehicular accidents.

Another important consideration in vehicle procurement relates to the maintenance and repair capability and the availability of spare parts for vehicles in Pakistan. This consideration is especially relevant to this project because much of the transport will be in rural areas where vehicles break down easily but where only the most widely available spare parts can be obtained. Due to considerable imports of Japanese-made vehicles into Pakistan, an extensive service and repair network and an adequate spare parts inventory exist for Japanese vehicles throughout the country. There is no such comparable maintenance and repair capability and spare parts inventory for U.S. vehicles in Pakistan. This capability and inventory is essential to ensure adequate maintenance, especially in remote regions, and to facilitate timely project implementation by making it possible for training sessions, inspections, and other activities to be completed according to schedule.

At the present time, the American Motors Corporation (AMC) is the only U.S. automobile company which manufactures right-hand drive vehicles as part of its regular vehicle inventory. AMC does not currently manufacture the right-hand drive sedans, station wagons, or utility vehicles required for this project.

IV. JUSTIFICATION

Section 636 (i) of the Foreign Assistance Act of 1961, as amended, requires A.I.D. to procure U.S. manufactured vehicles but also provides for special circumstances that may justify waiving this requirement. The special circumstances which are directly applicable in this case are the inability of U.S. manufacturers to provide a particular type of needed vehicle, such as right-hand drive, (A.I.D. Handbook 1, Supplement B, Chapter 4C2d (1)(a)), and the lack of adequate service facilities and supplies of spare parts for U.S. manufactured vehicles (A.I.D. Handbook 1, Supplement B, Chapter 4C2d (1)(b)). Handbook 1, Supplement B, Chapter 4C2d (3) and Delegation of Authority No. 40 authorize Assistant Administrators to waive source/origin requirements in this instance.

V. ACTION REQUESTED

For the above reasons, it is recommended that you:

A. Waive the source/origin requirements set forth in Handbook 1, Supplement B, to permit the procurement of the above-mentioned vehicles from countries included in A.I.D. Geographic Code 935; and,

B. Certify by signature below that, pursuant to Section 5B4c of A.I.D. Handbook 1, Supplement B, exclusion of procurement of these project vehicles from Free World countries other than the Cooperating Country and countries included in A.I.D. Geographic Code 941 would seriously impede the attainment of U.S. foreign policy objectives and the objectives of the foreign assistance program.

Approved_____ _____

Disapproved_____

Date_____

UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT
MISSION TO PAKISTAN

Cable : USAIDPAK

HEADQUARTERS OFFICE
ISLAMABAD

THE DIRECTOR

USAID/PAKISTAN MISSION DIRECTOR'S WAIVER FOR A.I.D. PAYMENT OF INTERNATIONAL PARTICIPANT TRAVEL COSTS

A.I.D. Handbook 10, Chapter 15B1, provides that the cost of international travel, including incidental costs en route as well as the cost of travel between the participant's city and the points of departure and return in the participant's home country, shall be paid by the host government or other sponsor unless, in the case of Mission-funded programs, the Mission Director has justified and authorized full or partial waivers and has so notified S&T/IT.

Training and institution-building are important components of the $1.625 billion economic assistance program negotiated between the Governments of the U.S. and Pakistan. USAID/Pakistan's experience, however, has been that the Government of Pakistan (GOP), due to serious foreign exchange and budgetary constraints, has been historically unable to fund international travel costs for short-term training programs. The consequence has been that Pakistani participants have, on numerous occasions, been denied worthwhile and much needed training, inhibiting the achievement of project targets.

I have carefully reviewed the advisability of requiring full GOP funding for travel costs for participant training of one year or less and the alternative of funding such travel with grant and loan funds provided through USAID/Pakistan to the GOP. Recognizing the objectives of many of our projects and the fact that project success will be enhanced by encouraging opportunities for short-term training, I have determined that it would be prejudicial to U.S. interests to require that the GOP pay the entire international participant travel costs for training programs of one year or less.

Therefore, on all Mission-funded training programs up to and including one year, USAID/Pakistan shall be responsible for the entire cost of the round-trip economy class air ticket and other necessary incidental costs en route. Where a PIO/P has been originally written for a program of one year or less, but, after the participant has initiated his or her program, the program is extended so that it exceeds one year in total, USAID/Pakistan shall also fund the round-trip ticket. The justification for funding programs that are extended is to minimize administrative problems which are otherwise likely to occur.

On the basis of the above justification and pursuant to Handbook 10, Chapter 15B1a, I, Donor M. Lion, principal officer of the Agency for International Development in Pakistan, do hereby waive the requirement that the host government fully fund international travel for training courses of one year or less and authorize payment with USAID/Pakistan loan and grant funds for travel costs as specified above.

Donor M. Lion

Donor M. Lion
Director
USAID/Pakistan

March 17, 1982

Date

REVIEW OF THE ADP COMPONENT
OF THE RURAL ELECTRIFICATION PROJECT
391-0473
USAID/PAKISTAN

February 16, 1982

John S. Marshall
SER/DM

I. Purpose of Report

USAID/Pakistan requested SER/DM to provide System Analyst assistance to review the ADP component of the Rural Electrification Project, 391-0473 in accordance with HB-18 Part V. This report meets those requirements.

II. Background

USAID/Pakistan plans to assist the Water and Power Development Authority (WAPDA) develop its proposal into a comprehensive national rural electrification plan and to implement key components of the plan. The majority of the funds will cover commodity imports, technical assistance, training, construction and construction supervision. A.I.D. life of project funding totals $155 million and Rs 176 million U.S. owned rupees.

III. Current Environment

In order to support the large amount of electrical equipment to be financed under this project, the Mission has indicated that the present manual inventory system used by WAPDA is inadequate to maintain an accurate record of the new commodities to be procured under this project. Therefore the Mission envisions the use of a computer to maintain WAPDA's inventory. In addition to the need for tracking the commodities to be imported, attention must be given to other areas which should be automated such as : (A) financial; (B) billing; (C) technical; and, (D) construction.

At the present time, WAPDA has an IBM 370-115 servicing the Lahore area and an IBM System 34 at Peshawar processing only billings for that area. In discussions with several users of the WAPDA computer center, it was indicated that service was very slow and in several areas, such as Evaluation and Planning, they decided to do their tabulations manually. This effort took 10 months to complete.

WAPDA's organization is comprised of generation, transmission and distribution. It is further subdivided into eight Area Electricity Boards (AEB). Within the AEB, there are 28 circles, within the circles there are some 120 divisions, and within the divisions there are some 360 subdivisions. As the customer base increases, these organizations may subdivide. At the present time, the distribution division, with a staff of 66,000, provides service to a customer base of 3,400,000 that is growing at a rate of 250,000 customers per year. With A.I.D. and other donor projects, this rate will increase to well over 300,000 per year.

IV. Discussion

Given the above complex structure and the need to provide service to its customers, WAPDA should develop an automation plan. This plan should cover all areas that would benefit from automation. Only after such a study is completed can A.I.D. determine the computer equipment required to support an automated inventory system that would be compatible with WAPDA's overall automation plan. Attachment 1 describes a sample scope of work to accomplish the preparation of an ADP study of WAPDA. See Attachment 2 for estimated ADP budget.

At the present time, Peat, Marwick, Mitchell and Co., under a World Bank financed contract, are conducting a management study of WAPDA's inventory system. The results of this study should be made available to the contract team that would conduct the ADP study.

V. Recommendations

A. SER/DM concur with the ADP study of WAPDA. At a later date, SER/DM will review the results of the ADP study.

B. A.I.D. provide TA for the ADP study of WAPDA.

ATTACHMENT 1

SAMPLE SCOPE OF WORK

I. Objective

To provide technical assistance to study and assess the Automated Data Processing (ADP) needs of the Distribution Division of the Water and Power Development Authority (WAPDA) in Pakistan.

II. Description

The contractor shall study the ADP needs of WAPDA in terms of applications to be automated or enhanced, determine hardware, software and staffing requirements.

Specific Tasks

A. Review WAPDA's current computer hardware in terms of supporting existing applications.

B. Review current computer use in WAPDA centers in terms of applications that support WAPDA's Distribution Division.

C. Review future ADP plans of WAPDA, if any.

D. Review and document manual procedures of the Headquarters office of the Distribution Division of WAPDA and one of the semi-autonomous Area Electricity Boards and identify those that should be targeted for automation.

E. Review current Distribution Division staffing in terms of utilization, job knowledge and skills.

F. Based on the above, develop comprehensive short and long-term ADP plans for the Distribution Division. The short-term plan should cover the first 2 year period and the long-term plan should cover the next 5 years. The plan should recommend the number and types of computer hardware and software required, and the staffing and training required to to use the hardware and software. The plan should also cover the applications to be automated and their storage requirements. Special emphasis should be placed on the inventory system that A.I.D. is planning to finance and wishes to implement first.

III. Special Provisions

The contractors must have a broad, indepth working knowledge of both large and small size computer hardware and software. The contractor should also have a working knowledge of complex organizational structures and administrative procedures preferably with experience in electric utilities.

IV. Staffing

The contractor should provide the following type of personnel :

A. 2 Management Analysts
B. 2 Systems Analysts

ATTACHMENT 2

I. ESTIMATE OF SHORT TERM TECHNICAL ASSISTANCE COSTS a/

	Dollar Costs	Rupee Costs
A. Dollar Costs	$161,168	-
B. Rupee Costs	-	Rs 384,000
C. Trip Costs	1,600	100,000
D. Post Differential (325 days x $104)	33,800	-
Total cost of Short-Term Assistance	$196,568	Rs 484,000

II. ESTIMATED ADP BUDGET

1982	ADP	$196,658	Rs 484,000
1983	Initial Computer Equipment and Inventory System Development	250,000	-
1984	Computer Equipment Procurement	1,000,000	-
	Total	$1,446,658	Rs 484,000

a/ Estimates are based on four persons working 3 months each.

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ADM AID

E.O. 12065: N/A

TAGS:

SUBJECT: PROJECT 391-0473 RURAL ELECTRIFICATION

1. SER/DM MANAGEMENT HAS REVIEWED REPORT PREPARED BY JOHN MARSHALL, DATED 2/16/82.

2. SER/DM CONCURS WITH RECOMMENDATION PERTAINING TO ADP COMPONENT OF SUBJECT PROJECT. HAIG
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ENVIRONMENTAL ASSESSMENT

RURAL ELECTRIFICATION PROGRAM

PAKISTAN

APRIL 1978

Introduction
Preface

I. Project Description
   A. Purpose and Output
   B. Design and Construction
   C. Relationship to National Development

II. Description of Environment
   A. Description of the Provinces
   B. General Characteristics
   C. Fragile Ecosystems

III. Discussion of Environmental Impacts
   A. Direct Impacts
   B. Indirect, Secondary Impacts

IV. Adverse Impacts
   A. Unavoidable Adverse Impacts
   B. Avoidable Adverse Impacts

V. Alternatives to the Proposed Project
   A. No Project
   B. Increased Use of Other Fuel Sources
   C. Small Village Generation Plants

VI. The Relationship Between Short-term Use and Long-term Productivity

VII. Irreversible and Irretrievable Commitments of Resources

VIII. Summary and Recommendations

INTRODUCTION

By their nature, rural electrification programs have a small potential for direct impact on the human environment. The secondary or indirect impacts of these programs, however, are estimated to be considerable. This assessment examines both direct and secondary impacts of the proposed AID-assisted ten year rural electrification program in Pakistan.

The major part of the Environmental Assessment was prepared by Vickie L. Traxler, Environmental Planner, under a USAID contract. Ms. Traxler's educational background includes a Master of Science from Colorado State University in Regional Resource Planning and a Bachelor of Science degree from Grand Valley State Colleges, Michigan, in Environmental Science. Her experience includes work on a highway impact study for Oceana County Michigan and Western Michigan Regional Shoreline Development Commission and special training in the preparation of environmental impact statements at Colorado State University.

In addition, Ms. Traxler prepared the Mission's Environmental Assessment for the Rural Roads project which was authorized in FY-1977, and is in the process of completing an Environmental Assessment for the Rural Clean Water program which is scheduled for authorization in FY-1978. Several members of the Mission staff worked with Ms. Traxler assisting her with some of technical description of the program and in reviewing her drafts and suggesting modification and additions.

PREFACE

The Environmental Assessment of the Rural Electrification program will provide USAID and the Government of Pakistan with a comprehensive understanding of the reasonably foreseeable positive and negative environmental effects of the proposed program Once identified, these impacts may be brought into the decision-making process in the same manner that traditional elements are considered. Note that an assessment is not a panacea for all of the program's problems but rather ensures a "common-sense" approach to problem solving efforts. An assessment proposes reasonable alternatives so that their respective impacts may be weighed and the best possible course of action determined. Environmental assessments identify appropriate protection and mitigation measures for negative impacts so that these may also be incorporated into the project design. The rural electrification environmental assessment fulfills the above objectives.

The environmental assessment for the rural electrification project draws its framework from the following guidelines: USAID "Environmental Procedures (Regulation 216.1-8)", World Bank Environmental, Health and Human Ecologic Considerations in Economic Development Projects, and USAID Environmental Guidelines Manual. Local experts were consulted for discussion of potential environmental impacts of the proposed project and mitigation measures for adverse impacts. Mr. Z. A. Mirza of World Wildlife Fund, Pakistan identified potential impacts on wildlife and wildlife habitat from the project. Assistance with soils, agriculture, forests, and wildlands came from Dr. M. Bashir and Dr. Muhammad Alim Mian, of the Soil Survey Directorate, Pakistan. Mr. Durrani, Director Rural Electrification Cell and the engineering consultant firms of NESPAK, FACE and ICE provided information concerning the proposed project areas.

I. PROJECT DESCRIPTION

A. Purpose and Output

The Rural Electrification program is one of a cluster of proposed activities which support the Government of Pakistan's (GOP) strategy to promote the economic and social advancement of its rural population.

It is a ten year program to achieve wider, more equitable, more reliable and more productive use of electricity in selected rural areas of Pakistan. Up to twenty areas will receive electric power distribution under the program. The distribution systems assisted by this project will be less centralized, more service oriented, self-financing, and replicable on a national basis.

B. Design and Construction

The program will be implemented over a 10 year period with the initial tranchebegining in 1978 and obligations completed by 1983. Up to twenty project areas will eventually be electrified. Fourteen areas have already been tentatively chosen for study by the provincial governments of which feasibility studies have been completed for three and six more are under consideration.

The program consists of the installation of 11 KV primary system distribution lines, 400 and 230 volt secondary distribution lines, transformers, insulators, individual service connections and meters. Components of the program include wire conductors (steel reinforced aluminum cable), transformers, lattice steel poles, ceramic insulators, and meters. Approximately twenty feet of land will be required for line right of way. Grid stations will be supplied by WAPDA.

The major bulk of electric power is expected to come from hydroelectric sources (e.g. Tarbela Dam). No thermal generation plants or high voltage transmission lines will be constructed for the project.

II. DESCRIPTION OF ENVIRONMENT

Fourteen areas have been tentatively selected by the provincial governments of Pakistan for in-depth rural electrification coverage. Feasibility studies have been completed on three of the fourteen areas, Pindi Gheb, Dera Ghazi Khan and Nowshera Virkan. A total of fourteen such areas will eventually be studied.

As it is not possible to give a detailed description in this report, this section will give a brief description of the natural environment of Pakistan in general terms.

A. Description of the Provinces

Pakistan's four provinces roughly correspond to three distinct geographic regions. Baluchistan Province is a high desert plateau with a base elevation of 4-5000 feet. Less than five inches of rain per year favor the growth of xerophytic vegetative types except where the land is irrigated. Wind blown deposits (loess) are common among the soils of Baluchistan.[1/]

The North West Frontier Province includes parts of the high plains and the mountain ranges and foothills of the Himalayan system. The mountain systems of Pakistan are the result of geological recent lifting, folding, and faulting of old sedimentary rocks. The sedimentary rocks vary from shales, slates, sandstone and limestone. The high plains are the result of an ancient period of erosion, alluviation and loessal deposition, and rest on the structural depression of the Potwar Plateau. The Potwar and its associated landforms extend into Punjab Province. Vegetation varies but is generally heavier than elsewhere due to the increased rainfall ranging from 20 to 50 inches per year.[2/]

The Indus Plains (Sind and Punjab Province) consist of sand, silt, and clay alluviums hundreds to thousands of feet thick overlying old sedimentary rocks. The pedocal soils of the plains, high in calcium carbonate and low inorganic matter, have resulted from the gradual deposition of sediment from the River Indus and its five main tributaries, Ravi, Sutlej, Chenab, Jhelum and Beas. Rainfall ranges from less than 10 inches in

Sind Province in the south to 40 inches in the northern areas of Punjab Province. Although forests once covered most of the plains, due to extensive cultivation and low rainfall, existing vegetation consists of hardy grasses, bushes, and scrub trees.[3]

B. General Characteristics

The climate of Pakistan is characterized by scarce and irregular rainfall, low relative humidity and extreme temperatures. The relatively low rainfall falling mostly in high-intensity rainstorms, associated with a very high evapotranspiration rate determines an essentially arid region.[4]

The primary use of land in Pakistan is agriculture and grazing. At least 80% of Pakistan's agricultural land is irrigated in some form to supplement low rainfall. Runoff water from rainfall and surface water supplies most irrigation canals. Irrigation has transformed the Indus Basin into a highly productive agricultural area. However, the Indus Plain has a seaward slope averaging less than one foot per mile and improper irrigation practices and poor drainage have resulted in salinized and waterlogged lands in large parts of Punjab and Sind Provinces.[5]

Groundwater is a valuable resource. The irrigated plains of Punjab and Sind, extending from the edge of the mountains in the north and west to the Arabian Sea in the south, as well as parts of Peshawar and Bannu basins, are underlain by an extensive groundwater aquifer. The extent of the aquifer is of the order of 40 million acres, and it probably exceeds 1,000 feet in thickness under most of the area. About 14 million acres of the Indus plains are underlain by fresh groundwater, with less than 1000 parts per million (ppm) total dissolved solids; about five million acres have groundwater of moderate salinity with 1000 to 3000 ppm, and the remainder is very saline, containing more than 3000 ppm total dissolved solids.[6]

The total population of Pakistan is more than 75 million with an annual rate of increase of over 3%. Projections from the 1972 population census indicate that in 1977 the population densities of the various provinces were Punjab 530 people/square mile; NWFP 328/sq. mi.; Sind 288/sq. mi.; Baluchistan 20/sq.mi.

and the Tribal Areas were 268/sq. mi.[7]

During the 1960's the urban population increase was greater than any previous decade. Estimates predict that the country will be 2/3 urbanized by the year 2000. Despite this predicted trend, 74% of Pakistan's population was classified as rural in 1972. Nearly 55 million people live in rural areas and are directly or indirectly dependent on agriculture for a livelihood. About 50% of the total labor force is employed directly in crop and livestock production and nearly 20% in marketing and processing of agricultural service activities. In addition to its importance as an employer, the agricultural industry is the major foreign exchange earner, in a typical year accounting for about three fourths of the total value of exports.[8]

C. Fragile Ecosystems

Particular areas, landforms or geographic regions may be sensitive to increased development and in-migration because of the nature of the landform or certain forces of nature. These areas are described below.

1. Landforms with high erosion potential.

   These areas include hilly or mountainous regions with steep slopes, coastal and desert sand dunes with unstable soils, and young alluvial and loessal deposits lacking a developed soil profile. Erratic, intense rainfall and sparse vegetation act as severe erosive forces. Overgrazing, deforestation, cultivation and clearing of land for human settlement may exacerbate erosion problems.[9]

2. Areas with significant wildlife resources.

   Much of Pakistan's wildlife is subject to competition with man and his livestock, to loss of habitat and poaching. Areas with significant wildlife resources include the National Park, Forest and Game Sanctuary system. Other areas include inaccessible mountain or desert regions with low agricultural potential and, therefore, sparse human habitation.[10]

3. Areas with high flooding potential.

   Riverine and floodplain areas are frequently inundated during monsoon seasons. Concentrations of development in these areas would result in loss of life and property.

4. Zone of pronounced seismic activity.

A zone of pronounced seismic activity passes through areas of Baluchistan, Kashmir, and NWFP. Loss of life and property may result from increased development in this belt.[11]

5. Forests and forested areas.

Forested areas in Pakistan are generally at high elevations with difficult accessibility. Forest areas are coming under increased pressure due to increased population. Harvesting of fuel wood, overgrazing, cultivation and clearing of land for human settlement increase as population increases and can lead to deforestation and denudation of slopes. Deforestation and subsequent loss of soil cover and animal habitat is a serious problem in Pakistan.[12]

DISCUSSION OF ENVIRONMENTAL IMPACTS

The program will essentially service rural agricultural areas which are ecosystems significantly modified by man. Major components of those systems are man, and his associated infrastructure, the crops cultivated in the region, the topography and the climate, and those wild flora and fauna of the area able to adapt to a man-modified environment. The following discussion describes the environmental impacts likely to occur from the proposed rural electrification project.

The twelve criteria for project area selection are: availability of grid stations, population and population density, number of villages, number of houses, number of customers, land use, potential uses of electrical energy by consumers, miles of roads, access to industry and markets, capital requirements for the system, irrigation potential from tubewells and land ownership by small farmers. The program is not expected to have significant negative impacts because of these selection criteria and additional feasibility studies each area must undergo.

The nature of the program excludes any significant disruptive direct impact on the environment. However, the program may have some important indirect impacts.

A. Direct Impacts

Transmission lines will require a twenty foot right of way. However, the right of way does not preclude continued use for agricultural.

Transmission lines will alter the character of the natural landscape from a short distance perspective.

The economics of the program exclude sensitive ecosystems such as river beds, marshes, mountainous areas, etc., which would require extensive costly support structures and additional machinery for installation.

Installation of poles will necessarily require a small disturbance of soil with a localized and temporary impact. National Forest areas will not be electrified due to low density of population. Some removal of solitary trees may be necessary. Small amounts of grasses or bushes may be removed during pole installation. Trees may also require pruning so as not to interfere with line transmission. Disturbance of wildlife habitat except for small amounts of tree pruning and removal is expected to be temporary and minimal.

Construction, operation and maintenance of the rural electrification project will have direct effects on the economy of the area served as well as the country as a whole. During construction the acquisition of materials and machinery may increase business activity and stimulate the local economy through payments received by service industries. The program will also require employment of local day laborers.

Public safety is always a problem where unfamiliar technologies are introduced. Engineers and contractors responsible for the construction of rural electrification lines will take all safety precautions during work in project areas.

B. Indirect, Secondary Impacts

Electrification of a rural area has the potential to significantly increase development through increased agricultural and industrial activity. Increased production implies increased employment requiring increased housing, service and infrastructure facilities.

There are several possible development alternatives once electrification is underway in a rural area:

Scenario 1: Low Development Profile

This alternative consists mainly of household connections for illumination, radios and appliances. Existing diesel motors will be exchanged for electric motors, for example tubewell motors, diesel engines for rice husking, flour milling, etc. New development does not occur immediately. Over a 5-10 year period a few small industries, sawmills, smithys locate in some larger villages. Tubewells increase in number and more land is irrigated. Food processing industries increase accordingly. In-migration does not occur. New development absorbs available labor. Electrified tubewells for public water supplies become available.

Scenario 2: Moderate Development Profile

Moderate development will most likely be located in the vicinity of the market town. Here small industries will locate to accomodate the collective increased production of many villages. Industries included are listed in Table 2. Repair industries may also locate here. Excess population at the village level may migrate to the market town for employment. Service industries, housing, education, and health facilities are upgraded with electric machines and increase in number as population increases. In highly productive agricultural areas without canal irrigation, private tubewells may increase significantly in a short period of time. Electrified tubewells will also provide adequate water supplies for the village and market population.

Scenario 3: High Development Profile

Rural electrification produces immediate and intensive development under this alternative. Large factories locate in the rural areas and urbanization encroaches on adjacent productive agricultural land. In-migration strains services and infrastructure facilities (roads, utilities, education, health, etc.).

Of these alternatives, the program is expected to generate growth in most areas similar to Scenario # 1; that of low development. Market towns and areas with high agricultural growth potential (fertile soils with little or no canal irrigation) may undergo the moderate development described in Scenario # 2.

The following table lists those industries or businesses most likely to benefit by or increase from rural electrification:

1. Agriculture:	Irrigation from electrified tubewells in those areas with sufficient groundwater resources.
2. Food Processing Industries:	Flour and rice milling, sugar processing, oil seed extracting, etc.
3. Textile & Textile Related:	Electrified power looms especially.
4. Machine and Woodworking:	Smithy, furniture making, sawmills, repairing.
5. Cottage Industries:	Handicrafts, sewing, knitting, traditionally done in the home.
6. Refrigeration and Icemaking:	Keeno, mango, milk, other food preservation.
7. Mineral Development:	Rock sorting and crushing, limestone, gypsum, etc.
8. Small manufacturing operations:	Tanneries, ceramics, etc.

Motors used by these industries will usually be less than 10 horsepower. In small shops 3-5 horsepower is the average size motor currently used. Large textile operations, rice and flour milling machines, mining operations and tubewells may require from 10-15 horsepower.

It is not necessary to detail each industry's specific impact. However, the impacts will be discussed in more general terms according to certain factors.

Impact on Agriculture. Agriculture will most likely be affected by the installation of electrically operated tubewells. This increase may modify some ecosystems in currently irrigated areas. Type of crops grown may change or more crops may be produced in a given season. In those areas with significant amounts of canal irrigation small numbers of tubewells, increased installation of tubewells will assist in the control of waterlogging and salinity problems. Continuous pumping of tubewells will lower the water table which is the major factor in waterlogging and salinity problems. Food processing industries will benefit by the increased agricultural production and electrification. Therefore waste materials from these industries may increase also. Rice and flour milling wastes may increase. However, these wastes are currently utilized for fodder, fertilizer or other purposes.

Industrial Pollution. Industrial growth will be low to moderate. Therefore waste generated will also be low. As in most developing countries solid waste or scrap material is reclaimed and recycled for further use. Chemical wastes from tanneries, textile industries, etc. are contained in small private oxidation ponds. Electric power is relatively cleaner as a fuel than diesel power and would,therefore,decrease existing air pollution problems from diesel fuel sources.

Population Increases. There will be little in-migration to the project areas as a result of electrification. Market towns may experience in-migration from surrounding villages. Newly irrigated lands from tubewell installation will not bring in new farmers as the land is already being farmed. Requirements for housing, utilities, and other services will not increase dramatically a short time but rather will occur in small dispersed amounts. Previous projects in other countries indicate a trend towards reduction in local birth rates shortly after electrification.

Public Health and Education. The rural electrification program will positively impact the public health and education facilities in a project area. Health centers will be able to provide patient care in the evenings and may purchase special equipment, especially refrigeration and heating. General education and technical institutions may procure special equipment for training.

Forests and Wildlife. Negative impacts on wildlife resources and forested areas from electrification may be caused by increased development activities. This negative impact, however, is a short term phenomenon. In the long term, authorities from various institutions in Pakistan state that electrification will be an ally of forests/and wildlife in remote areas. As the consumption of electric power increases and electric consumers include the electric heating and cooking ranges in their daily routine, these consumers would have less need for firewood. As a result, problems with deforestation and loss of wildlife habitat should decrease.

In general, economic impact is expected to be beneficial, while there is expected to be little negative environmental impact. As dealt with in the Social Analysis of the project paper, social and cultural impacts are expected to be largely positive.

IV. ADVERSE IMPACTS

A. Unavoidable Adverse Impacts

Unavoidable adverse impacts of the program include a temporary disruption of the soil for post holes and human activity. The poles will constitute a change of the landscape and associated scenic resources from a short distance perspective.

B. Avoidable Adverse Impacts and Mitigation Measures

1. Vegetation will be removed and the soil exposed to erosion during excavation and installation of poles.

Mitigation: Lines will be routed to by-pass trees except where necessary solitary trees may be pruned or removed. Only vegetation in the immediate area of the post hole will be removed.

2. Land in the right of way of conductor lines will not be available for crop production.

Mitigation: Only land immediately used by the post holes will be taken out of production. The remainder may be used for crop production and grazing.

3. The program will cause safety problems due to the unfamiliar and dangerous nature of electrical energy.

Mitigation: Most villagers are aware of this danger and experience has shown that they are careful around electric outlets. WAPDA employees who install service connections explain to domestic consumers what little safety measures should be taken on a routine basis. Large motors are normally installed by skilled technicians and operated by knowledgeable persons.

4. Increased development and in-migration from electrification into a program area will result in destruction of fragile ecosystems.

Mitigation: None of the areas selected for electrification are likely to have fragile ecosystems that can be adversely affected by the program. Such areas fall out during the selection process for economic reasons (costly support structures and insufficient numbers and density of customers).

5. Electrification of a market town will immediately increase development activity by increased employment and production (i.e. housing, utilities, waste, generation, etc.).

Mitigation: Market towns in program areas are already electrified to some degree. Increased electric connections in those towns will not immediately result in a pronounced increase in activity that will have adverse environmental impact. The growth is expected to be rather gradual which would result in environmental accommodations and adjustments.

V. ALTERNATIVES TO THE PROPOSED PROJECT

A. No Project

The "no program" alternative implies continued consumption of other fuel sources and static social and economic levels of living. Electrical power has the potential to raise the living standard substantially. The "no program" alternative is considered unacceptable.

B. Increased Use of Other Resources

Electrical power is more cost-effective for lighting, heating, and power than the existing sources of kerosene lanterns, candles, wood, petroleum products, and animal power. Increased or even continued use of these other fuel sources would have severe negative impacts. Deforestation due to harvesting of wood as fuel is a problem throughout Pakistan. Increased use of petroleum products requires increased foreign exchange expenditures. Fodder for animals, used as a power source, consumes land which may be used for food crops. This alternative has a low benefit-cost ratio from a national resource perspective and is therefore unacceptable.

C. Small Village Generation Plants

This alternative requires higher levels of capital investme on an individual village basis, costly petroleum fueling products, and localized knowledge of electrical technology. Village generators may be cost-effective in mountain regions where transmission over mountain terrain is difficult and hydroelectric power potential abundant. However, small village generation plants do not fulfill the objectives of the Rural Electrification Program, i.e. to stimulate regional rural development.

VI. THE RELATIONSHIP BETWEEN SHORT-TERM USE AND LONG-TERM PRODUCTIVITY

The program will not sacrifice the productivity of the land resource over the long run. Lines require a maximum twenty foot right of way which will continue in use for agriculture.

The Tarbela Dam project is expected to provide a large portion of Pakistan's electrical energy requirements for over 75 years. The GOP has planned construction of other hydroelectric sources which will supply the project after that time.[13/]

VII. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

The component structures of the program are not expected to require significant amounts of resource commitments. Steel will be required for poles and cable strength. Aluminum and copper will also be consumed. These materials can be dismantled and reused. The amount of resources used per area will vary according to the size of the individual area. The total amount of these resources that will be used is not known at this time.

VIII. SUMMARY AND RECOMMENDATIONS

Based on the discussion of environmental impacts and their respective mitigation measures, the environmental impacts of the proposed project are considered acceptable. Potentially adverse impacts include temporary disruption caused by pole installation and alteration of landscape horizon characteristics by electric wires and support poles. Electrified areas are not expected to suffer negative impacts as these areas are capable of sustaining increased development based on their suitability criteria.

The criteria used to select areas to be electrified under the program emphasize agricultural and agro-industrial potential, availability of power from grid stations, population density and the

availability of rural infrastructure such as roads. Areas that meet these criteria are not likely to be habitats for ecosystems on which rural electrification would have a negative impact.

In areas and zones of pronounced seismic activity, particularly in the Baluchistan and Northwest Frontier Provinces, systems design will take into consideration seismic factors. Engineering safegaurds will be built into the design of structural and electrical components of the systems.

FOOTNOTES

1/ Richard F. Nyrop, Area Handbook for Pakistan, pp. 66-74.

2/ Nyrop, pp. 66-74.
Nazir Ahmad, Groundwater Resources For Pakistan, pp. 19-22.

3/ Nyrop, pp. 66-74
Ahmad, pp. 19-22.

4/ FAO, "Soil Survey Project Pakistan", pp. 37-40.

5/ Nyrop, pp. 66-74.

6/ FAO, pp. 51-52.

7/ Nyrop, pp. 76-83.
Personal Communication with Mr. Manzur, Population, USAID.

8/ Nyrop, pp. 76-83.
USAID, Pakistan Development Data.

9/ FAO, pp. 72-86.
Eric P. Eckholm, Losing Ground, pp. 58-100.

10/ Conversations with World Wildlife Fund, and Directorate Soil Survey Pakistan.

11/ Nyrop, pp. 66-74.

12/ Eckholm, pp. 74-100.
Conversations with World Wildlife Fund and Soil Survey Directorate, Pakistan.

13/ Conversation with Harza Engineering.

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TECHNICAL ANALYSIS ANNEX

TABLE M-1

HISTORICAL LOAD GROWTH OF WAPDA'S POWER SYSTEM

Fiscal Year (19__)	Historical Maximum Demand usually in June (MW)	Percent Increase (decrease) over previous (year)	System Energy Losses as a Percent of Gross Energy Generation
59/60	131	-	22.79
60/61	171	30.5	24.42
61/62	245	43.3	27.65
62/63	312	27.3	27.14
63/64	391	25.3	26.05
64/65	447	14.3	26.09
65/66	517	15.7	28.19
66/67	476	(8.0)	30.47
67/68	625	31.3	31.85
68/69	735	17.6	32.76
69/70	834	13.5	30.26
70/71	948	13.6	30.91
71/72	1,024	8.0	31.38
72/73	1,148	12.1	32.72
73/74	1,242	8.2	33.95
74/75	1,396	12.4	35.18
75/76	1,437	2.9	35.78
76/77	1,620	12.7	37.58
77/78	1,836	13.3	35.67
78/79	1,972	7.4	34.14
79/80	2,076	5.3	32.69
80/81	2,473	19.9	31.33
	Average Annual Increase	15.6	

Source: WAPDA'S Power System Statistics, Sixth Issue dated November 1981

TABLE M-2

ENERGY LOSS REDUCTION CALCULATIONS FOR ILLUSTRATIVE WORK ORDER NO.1

DISTRIBUTION SYSTEM ENERGY LOSS REDUCTION COMPONENT

Description of Activity

Change of ten miles of Primary (11,000 VOLTS) three phase line conductor from #5 SWG Copper to RABBIT (Equivalent to 1/0 ACSR)

1. Formula:

$$\text{Energy Loss Reduction} = \text{KWh Saved/Year} = 8.76\ F_1\ (N)\ I^2\ (R_1 - R_2)\ (L)$$

2. Given:
   a. $R_1 = 1.51$ Ohm/mile/phase
   b. $R_2 = 0.54$ " " "
   c. $N = 3$
   d. $L = 10$ miles

3. Variables:

a. Current in Line I (amps.)	130	130	100	100	80	80	70	70
b. Loss Factor (F_1)	0.5	0.25	0.5	0.25	0.5	0.25	0.5	0.25

4. Results:

a. KWh Saved each year	2,154,040	1,077,020	1,274,580	637,290	851,731	425,867	624,544	312,272
b. Dollar Value of KWh saved @ $0.05/KWh	107,702	53,851	63,729	31,865	40,787	21,293	31,277	15,614
c. Cost of Changing Conductors ($)	32,243	32,243	32,243	32,243	32,243	32,243	32,243	32,243

TABLE M-3

ENERGY LOSS REDUCTION CALCULATIONS FOR ILLUSTRATIVE WORK ORDER NO.2

DISTRIBUTION SYSTEM ENERGY LOSS REDUCTION COMPONENT

Description of Activity

Change of ten miles of Primary (11,000 VOLTS) three phase lines conductor from #3 SWG Copper to DOG (Equivalent to 4/0 ACSR)

1. Formula:

$$\text{Energy Loss Reduction} = 8.76\ F_1\ (N) I^2\ (R_1 - R_2)\ (L)$$

2. Given:

a. $R_1 = 1.07$ Ohm/mile/phase

b. $R_2 = 0.54$ " " "

c. N = 3

d. L = 10 miles

3. Variables:

Current in Line I(amps.)	170	170	150	150	130	130	120	120
Loss Factor (F_1)	0.5	0.25	0.5	0.25	0.5	0.25	0.5	0.25

4. Results:

a. Energy Loss Reduction) KWh)	2,012,654	1,006,327	1,566,945	783,473	1,176,950	588,475	1,002,845	501,423
b. Value of KWh saved @ $0.05/KWh	100,633	50,316	78,347	39,174	58,847	29,424	50,142	25,071
c. Cost of Changing Conductors($)	58,277	58,277	58,277	58,277	58,277	58,277	58,277	58,277
d. KWh saved per	35	17	27	13	20	10	17	9

TABLE M-4

ENERGY LOSS REDUCTION CALCULATIONS FOR ILLUSTRATIVE WORK ORDER NO.3

DISTRIBUTION SYSTEM ENERGY LOSS REDUCTION COMPONENT

Description of Activity

Change of ten miles of Secondary (230/400 VOLTS) three phase lines conductor from 5/0.104 Copper to ANT (equivalent 1/0 AAC)

1. Formula:

$$\text{Energy Loss Reduction} = 8.76\ F_1\ (N)I^2(R_1-R_2)\ (L)$$

2. Given:

a. $R_1 = 2.12$

b. $R_2 = 1.07$

c. $N = 3$

d. $L = 10$ miles

3. Variables:

a. Current in Line I (amps.)	100	100	80	80	75	75	70	70
b. Loss Factor (F_1)	0.5	0.25	0.5	0.25	0.5	0.25	0.5	0.25

4. Results:

a. Energy Loss Reduction (KWh)	1,379,700	689,850	883,008	441,504	776,081	388,041	676,053	338,027
b. Value of KWh saved @ $0.05/KWh	68,985	34,493	44,150	22,075	38,804	19,402	33,803	16,902
c. Cost of Changing Conductors ($)	35,524	35,524	35,524	35,524	35,524	35,524	35,524	35,524

TABLE M-5

ENERGY LOSS REDUCTION CALCULATIONS FOR ILLUSTRATIVE WORK ORDER NO.4

DISTRIBUTION SYSTEM ENERGY LOSS REDUCTION COMPONENT

Description of Activity:

Change of ten miles of Secondary (230/400 VOLTS) three phase lines conductor from 3/0.147 Copper to WASP (Equivalent to 3/0 ACC)

1. Formula:

$$\text{Energy Loss Reduction} = 8.76\ F_1\ (N)\ I^2\ (R_1 - R_2)\ (L)$$

2. Given:

a. $R_1 = 1.07$

b. $R_2 = 0.53$

c. $N = 3$

d $L = 10$ miles

3. Variables:

a. Current in Line I(amps.)	150	150	140	140	130	130
b. Loss Factor (F_1)	0.5	0.25	0.5	0.25	0.5	0.25

4. Results:

a. Energy Loss Reduction (KWh)	1,596,510	798,255	1,390,738	695,369	1,199,156	599,578
b. Value of KWh saved @ $0.05/KWh	79,826	39,913	69,537	34,769	59,958	29,979
c. Cost of Changing	60,980	60,980	60,980	60,980	60,980	60,980

TABLE M-6

GENERAL EXPRESSION FOR CALCULATING ENERGY LOSS REDUCTION ACHIEVABLE BY CHANGING CONDUCTORS

Instantaneous Energy Loss Reduction/Phase/Mile $= I^2R_1 - I^2R_2$ (Watt

$= I^2(R_1 - R_2)$

Where:

I = Maximum current in section of conductor to be changed

R_1 = Resistance of old conductor (ohms/mile/phase)

R_2 = " " new " (ohms/mile/phase)

Let:

N = no. of phases

F_1 = Loss factor (based on Annual Load Factor)

L = Length of Conductor in miles

Total hours in a year = 8,760

Total effective hours in a year = 8,760 (F_1)

Therefore:

$$\text{Energy Loss Reduction} = 8760\ F_1\ (N)\ .\ I^2\ (R_1 - R_2)\ (L)$$

or,

$$\boxed{\text{Energy Loss Reduction} = 8.76\ F_1\ (N)\ I^2\ (R_1 - R_2)\ (L)}$$

TABLE M-7

GENERAL EXPRESSION FOR CALCULATING ENERGY LOSS REDUCTION THROUGH APPLICATION OF FEEDER CAPACITOR BANKS

Loss Reduction/Phase/Mile is given by

$$L_R = I_R^2 \; X$$

where:

L_R = Loss reduction achieved by reactive flow (in watts)

X = Reactance of feeder (in Ohms/Mile/Phase)

I_R = Reactive current pumped by each capacitor bank (in amps)

$$= \frac{KVAR}{\sqrt{3}\;KV}$$

Let: N = No. of Phases

F_{VAR} = System VAR Factor

L = Location of capacitor banks for optimum benefit (in miles)

Therefore;

$$L_R = \left(\frac{KVAR}{\sqrt{3}KV}\right)^2 (X)\;(N)\;(L) \quad \text{(Watts)}$$

Total Hours in a year = 8,760

Total Effective hours in a year = 8,760 (F_{VAR})

$$\therefore \text{ Loss Reduction} = L_R \quad (8{,}760)(F_{VAR})$$

$$= \left(\frac{KVAR}{\sqrt{3}KV}\right)^2 (X)\;(N)\;(L)\;(8.76)\;(F_{VAR}) \quad \text{(KWh)}$$

FOR 11 KV, 600KVAR Feeder Capacitor Banks;

$$\text{Loss Reduction} = \left(\frac{600}{\sqrt{3}\times 11}\right)^2 (X)\;(N)\;(L)\;(8.76)\;(F_{VAR})$$

$$\boxed{\text{Loss Reduction} = 8{,}688\;(X)\;(N)\;(L)\;(F_{VAR})} \quad \text{(KWh)}$$

TABLE M-8

BREAKDOWN OF ACTUAL WAPDA DAILY LOAD (DEMAND) CURVE

(September 1, 1981)

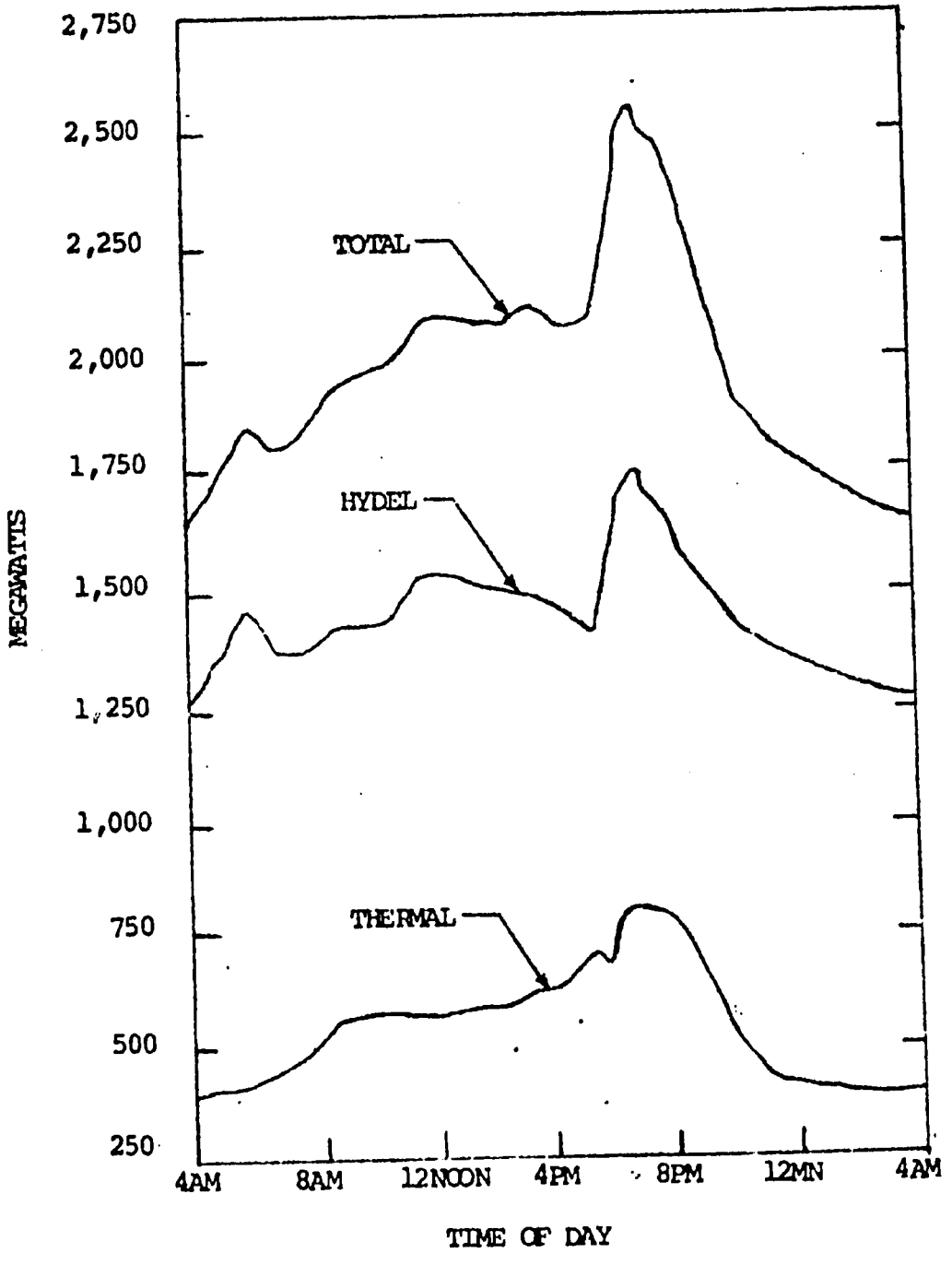
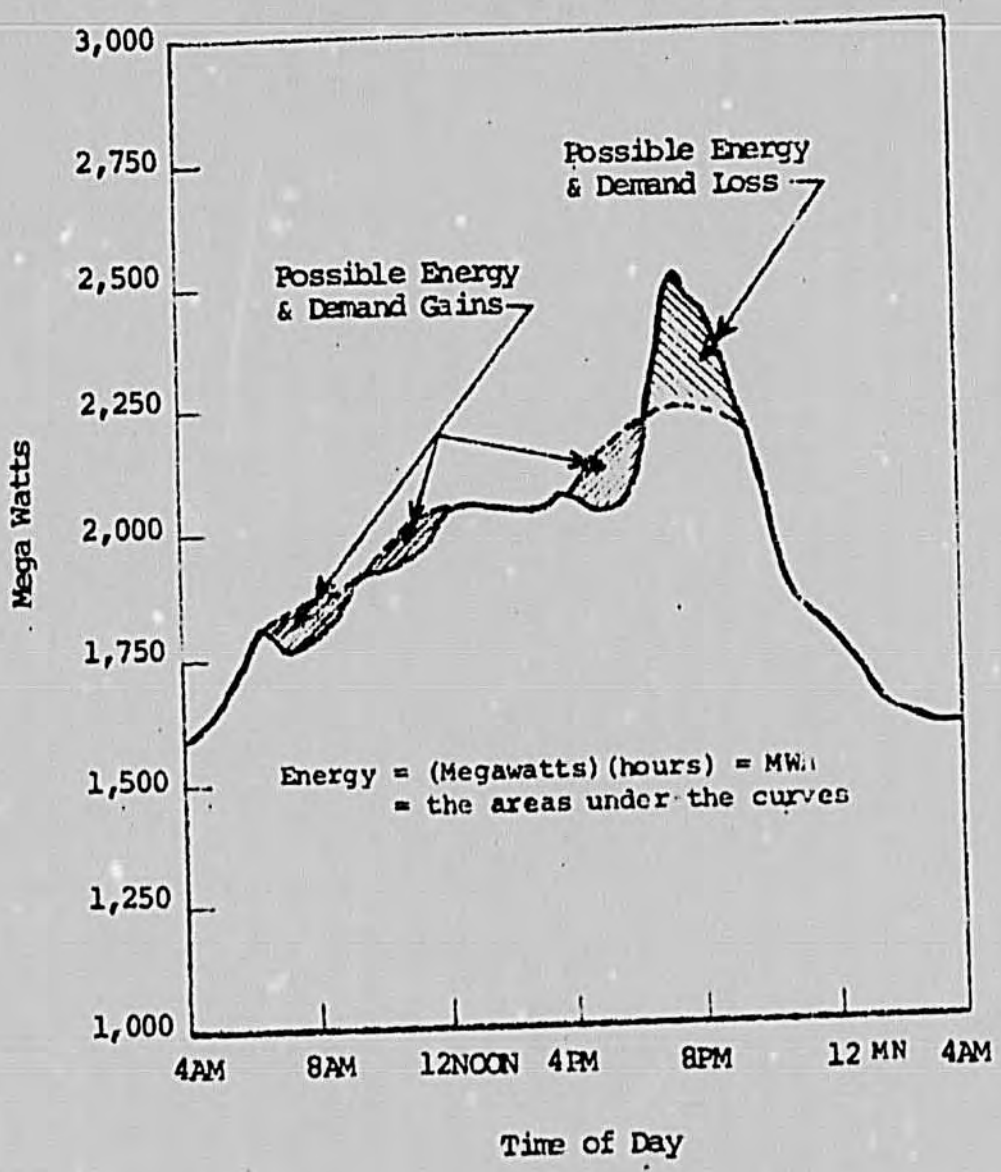


TABLE M-9

THE POTENTIAL BENEFIT OF LOAD MANAGEMENT

TYPICAL WAPDA DAILY LOAD (DEMAND) CURVE



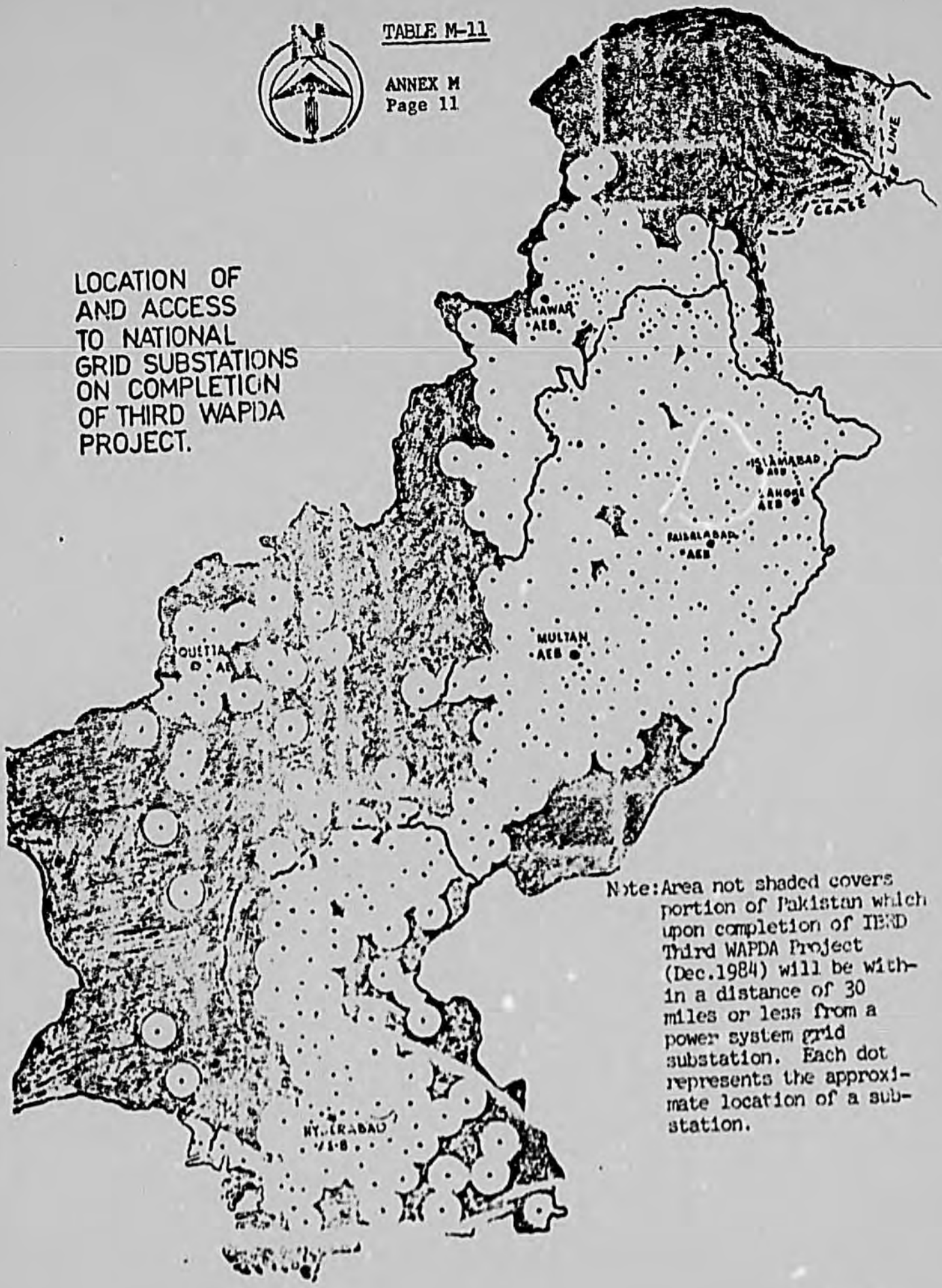
Energy deferred from the peak period by automatically disconnecting selected types of customers (tubewells for example) reduces the peak power generation capacity requirements of the system. Customers then operate their pumps, motors and other devices at other times of the day (or night) in such a way that total KWH consumption remains the same.

TABLE M-10
WORLD BANK FUNDED
THIRD WAPDA PROJECT GRID STATIONS
AND TRANSMISSION LINES

Voltage Type	No. of grid stations	No. of transmission lines	Year of completion
66 KV	2	-	
132 KV	13	-	1981
220 KV	1	-	
Sub-Total:	16	-	
66 KV	4	5	
132 KV	52	28	
220 KV	1	2	1982
500 KV	-	1	
Sub-Total:	57	36	
66 KV	31	5	
132 KV	91	57	1983
220 KV	8	1	
Sub-Total:	130	63	
66 KV	10	31	
132 KV	9	40	1984
Sub-Total:	19	71	
220 KV	-	1	1985
Sub-Total:	-	1	
220 KV	-	2	
500 KV	-	2	1986
Sub-Total:	-	4	
220 KV	-	1	1988
Sub-Total:	-	1	
220 KV	-	1	1989
500 KV	-	1	
Sub-Total:	-	2	
220 KV	-	3	1990
500 KV	-	2	
Sub-Total:	-	5	
Grand Total:	222	183	

TABLE M-11

ANNEX M
Page 11



LOCATION OF AND ACCESS TO NATIONAL GRID SUBSTATIONS ON COMPLETION OF THIRD WAPDA PROJECT.

Note: Area not shaded covers portion of Pakistan which upon completion of IBRD Third WAPDA Project (Dec.1984) will be within a distance of 30 miles or less from a power system grid substation. Each dot represents the approximate location of a substation.

Table M-12

Estimated Cost of Material for Domestic Residential, Community and Commercial Connections

Quantity	Item	Unit Cost	Total Cost
1 each	Meter, single-phase (10-40A)	$ 20.00	$ 20
1 each	Meter board and bolts	1.90	2
100 ft	PVC cable 2/C (7/0.052")	0.18	18
1 each	Service mast (1.5" dia.)	18.00	18
10 lbs	G.S.L. supporting wire (4 mm.)	0.50	5
-	Miscellaneous (H clip, tape etc.)	8.00	8
		Total:	$ 71

Estimated Cost of Material for an Industrial Connection

Quantity	Item	Unit Cost	Total Cost
1 each	Meter, three-phase (20-80A)	$ 137.50	$ 138
1 each	Meter board and bolts	3.90	4
100 ft	PVC cable 4/C (19/0.083)	2.43	243
1 each	Service mast (2" dia.)	25.00	25
10 lbs	G.S.L. supporting wire (4 mm.)	0.50	5
-	Miscellaneous (H clip, tape etc.)	10.00	10
		Total:	$ 425

Estimated Cost of Materials for a Tubewell Installation

Quantity	Item		Total Cost
1/4 Mile	Primary (11,000 Volt) line extension		$ 1,812
1 each	25 KVA, three-phase distribution transformer installation		1,485
1 each	Meter, three-phase (20-80A) and service drop connection		425
		Total:	$ 3,722
Maximum amount paid by WAPDA (Rs.15,000)			1,438
Average cost to Tubewell owners			$ 1,684

Table M-13
Estimated Cost of Material for a 50 KVA Pole-Mounted Distribution Transformer, Three -.Phase 11,000 - 400/230 V, 50 Hz

Quantity	Item	Unit Cost	Total Cost
1 each	50 KVA transformer	$ 1,654.00	$ 1,654
1 each	Pole-mounted platform	76.36	76
4 each	11 KV pin insulators and pin	5.45	22
2 each	Wood cross arm	16.74	33
3 each	Fused Cutout	73.62	221
1 each	Concrete pole (31 ft)	127.60	128
-	Miscellaneous (jumper, nuts, bolts etc.)	51	51
		Total:	$ 2,185
Cost per KVA			$ 44

Estimated Cost Material for a 50 KVA Pole-Mounted Distribution Transformer, Single-Phase 6,350 - 230/460 V 50 Hz

Quantity	Item	Unit Cost	Total Cost
1 each	50 KVA transformer	827.10	827
1 each	Fused Cutout and support bracket	87.75	88
2 each	Pole bands	5.76	11
2 each	Pole gains	3.37	7
-	Miscellaneous (Jumper, nuts, bolts etc.)	37.00	37
		Total:	$ 970
Cost per KVA			$ 20

Table M-14

Estimated Cost of Material for one Mile of Primary (11,000 Volt) Three-Phase Line assuming One Cut-off per mile and a span of 450 ft. (RABBIT conductor equivalent to 1/0 ACSR)

Quantity	Item	Unit Cost	Total Cost
14 each	Pre-stressed concrete pole (36 ft)	$ 198.67	$ 2,791
19 each	Wood Cross arm	16.74	318
42 each	11 KV pin type insulator and pin	4.45	229
12 each	11 KV disc type insulator & dead-end clamp	13.34	161
38 each	Cross arm brace	1.30	49
10 each	Anchor and stay wire	9.77	98
3.15 Miles	Rabbit conductor	1,127.31	3,551
1 set	Cut-off equipment and accessories	58.50	59
-	Miscellaneous (Pole bands, nuts & bolts)	9.00	90
		Totoal:	$ 7,346

Estimated Cost of Material for One Mile of Primary (11,000 Volt) Single-Phase, Line assuming One Cut-off per Mile and a span of 450 ft. (RABBIT conductor equivalent to 1/0 ACSR)

12 each	Pre-stressed Concrete Pole	$ 198.67	$ 2,384
14 each	11 KV pin type insulator and pole top pin	7.65	107
4 each	11 KV disc type insulator & dead-end clamp	13.45	54
10 each	Anchor and stay wire	9.77	89
1.05 Mile	RABBIT conductor	1,127.31	1,184
1 set	Cut-off equipment & accessories	20.70	21
-	Miscellaneous (pole bands, nuts & bolts)	90.00	90
		Total:	$ 3,938

Table M-15

Estimated Cost of Material for one Mile of Secondary (230/400 Volt) Three-Phase Line assuming 170 ft span of ANT Conductor (equivalent to # 1/0 AAC)

Quantity	Item	Unit Cost	Total Cost
30 each	Concrete pole (31 ft.)	$ 127.60	$ 3,828
160 each	Spool insulator	0.66	106
120 each	D strap with pin	1.20	144
32 each	Loop dead-end clamp	1.78	57
250 each	M.S. bolt, eye screw type	0.18	45
6 each	Anchor and stay wire	6.05	36
4.20 Miles	ANT conductor	962.48	4,042
-	Miscellaneous (nuts, bolt and binding wire)	90.00	90
		Total:	$ 8,348

Estimated Cost of Material for One Mile of Secondary (230/400 Volt) Single-Phase Line assuming 170 ft spans of ANT conductor (equivalent to # 1/0 AAC)

Quantity	Item	Unit Cost	Total Cost
30 each	Concrete Pole (31 ft)	$ 127.60	$ 3,828
120 each	Spool insulator	0.66	79
120 each	D strap with pin	1.20	144
24 each	Loop dead-end clamp	1.78	13
175 each	M.S. bolt, eye screw type	0.18	31
3.30 Miles	ANT conductor	962.48	3,176
6 each	Anchor and stay wire	6.05	36
-	Miscellaneous (nuts, bolt and binding wire)	90.00	90
			$ 7,427

Table M-16

Estimated Cost of Material for a 25 KVA Pole-Mounted Distribution Transformer, Three-Phase 11,000 - 400/230 V, 50 Hz

Quantity	Item	Unit Cost	Total Cost
1 each	25 KVA Transformer	$ 951.00	$ 951
1 each	Pole-mounted Platform	76.36	76
4 each	11 KV pin insulators and pin	5.45	22
2 each	Wood cross arm	16.74	33
3 each	Fused Cutout	73.62	221
1 each	Concrete pole (31 ft)	127.60	128
-	Miscellaneous (jumper, nuts, bolts etc.)	54.00	54
		Totoal:	$1,485
Cost per KVA			$ 60

Estimated Cost of Material for a 25 KVA Pole-mounted Distribution Transformer, Single-Phase 6,350 - 230/460V, 50 Hz

Quantity	Item	Unit Cost	Total Cost
1 each	25 KVA transformer	$ 526.00	$ 526
1 each	Fused Cutout and support bracket	87.75	88
2 each	Pole bands	5.76	11
2 each	Pole gains	3.37	7
-	Miscellaneous (jumper,	36.00	36
		Total:	$ 668
Cost per KVA			$ 27

TABLE M-17

ESTIMATED COST OF ILLUSTRATIVE WORK ORDER NO. 1

DISTRIBUTION SYSTEM ENERGY LOSS REDUCTION COMPONENT

CHANGE OF TEN MILES OF PRIMARY (11,000 VOLTS) THREE PHASE LINE CONDUCTOR FROM #5 SWG COPPER TO RABBIT (EQUIVALENT TO 1/0 ACSR)

1. Estimated Cost of Materials

Quantity	Description	Unit Cost $	Total Cost $
40 each	Wooden Cross Arm (Replacement of broken pieces)	16.74	670
40 each	Cross Arm braces	1.30	52
60 each	11 KV Pin type insulator and pin	5.45	327
60 each	11 KV Disc type insulator and dead-end clamp	13.45	807
1 set	Miscellaneous (clamps, bolts, nuts, binding wires, jumper etc)	90.00	90
31 miles	New Conductor	928.00	28,768
		Total	30,714
	Less Salvage value of 31 miles of replaced Conductor (#5 SWG Copper)	252.00	- 7,812

2.	Net cost of materials	22,902
3.	Warehouse charge (1% of line 2)	229
4.	Labor (10% of line 2)	2,290
5.	Tools & instruments (1% of line 2)	229
6.	Transportation (6% of line 2)	1,374
7.	Engineering & Supervision (10% of line 2)	2,290
8.	Sub-total (line 2 to 7)	29,314
9.	Contingency (10% of line 8)	2,931
10.	Estimated Total Cost FY - 82	32,245
11.	Estimated Total Cost of FY-83 a/ Work Orders	35,470
12.	" " " " FY-84 a/ " "	39,016
13.	" " " " FY-85 a/ " "	42,918
14.	" " " " FY-86 a/ " "	47,210
15.	" " " " FY-87 a/ " "	51,931

a/ Assumes inflation of 10 percent per annum

TABLE M-18

ESTIMATED COST OF ILLUSTRATIVE WORK ORDER NO.2

DISTRIBUTION SYSTEM ENERGY LOSS REDUCTION COMPONENT

CHANGE OF TEN MILES OF PRIMARY (11,000 VOLTS) THREE PHASE LINE CONDUCTOR FROM #3 SWG COPPER TO DOG (EQUIVALENT TO 4/0 ACSR)

1. Estimated Cost of Materials

Quantity	Description	Unit Cost $	Total Cost $
40 each	Wooden Cross Arm (Replacement of broken pieces)	16.74	670
40 each	Cross Arm braces	1.30	52
60 each	11 KV Pin type insulator & pin	5.45	327
60 each	11 KV Disc type insulator and dead-end clamp	13.45	807
1 set	Miscellaneous (clamps,bolts, binding wires etc)	90.00	90
31 miles	New Conductor	1,776.40	55,068
		Total:	57,014
	Less Salvage value of 31 miles of replaced conductor (#3 SWG Copper)	504.00	- 15,624

2.	Net cost of materials		41,390
3.	Warehouse charge	(1% of line 2)	414
4.	Labor	(10% of line 2)	4,139
5.	Tools & instruments	(1% of line 2)	414
6.	Transportation	(6% of line 2)	2,483
7.	Engineering & Supervision	(10% of line 2)	4,139
8.	Sub-total:	(lines 2 to 7)	52,979
9.	Contingency	(10% of line 8)	5,298
10.	Estimated total Cost FY - 82		58,277
11.	Estimated total cost of FY-83* Work Orders		64,105
12.	" " " " FY-84* " "		70,515
13.	" " " " FY-85* " "		77,567
14.	" " " " FY-86* " "		85,323
15.	" " " " FY-87* " "		93,856

*Assumes inflation of ten percent per annum.

TABLE M-19

ESTIMATED COST OF ILLUSTRATIVE WORK ORDER NO.3

DISTRIBUTION SYSTEM ENERGY LOSS REDUCTION COMPONENT

CHANGE OF TEN MILES OF SECONDARY (230/400 VOLTS) THREE PHASE LINE CONDUCTOR FROM 3/0.104 COPPER TO ANT (EQUIVALENT TO 1/0 AAC)

1. Estimated Cost of Materials

Quantity	Description	Unit Cost $	Total Cost $
100 each	Secondary Spool Insulator (to place broken pieces)	0.66	66
10 each	Stay - Anchor Assembly	6.05	61
1 set	Miscellaneous clamp,bolts, nuts, Jumper etc.)	90.00	90
41.2 miles	New Conductor	847.00	34,896
		Total:	35,113
	Less Salvage value of 41.2 miles of replaced Conductor (3/0.104 Copper)	240.00	- 9,888

2.	Net cost of materials		25,225
3.	Warehouse charge	(1 % line 2)	252
4.	Labor	(10% of line 2)	2,523
5.	Tools & instruments	(1 % of line 2)	252
6.	Transportation	(6% of line 2)	1,514
7.	Engineering & Supervision	(10% of line 2)	2,523
8.	Sub-total	(line 2 to 7)	32,289
9.	Contingency	(10% of line 8)	3,229
10.	Estimated Total Cost FY - 82		35,518
11.	Estimated Total Cost of FY-83* Work Orders		39,070
12.	" " " " FY-84* " "		42,977
13.	" " " " FY-85* " "		47,274
14.	" " " " FY-86* " "		52,002
15.	" " " " FY-87* " "		57,202

*Assumes inflation of Ten percent per annum.

TABLE M-20

ESTIMATED COST OF ILLUSTRATIVE WORK ORDER NO.4

DISTRIBUTION SYSTEM ENERGY LOSS REDUCTION COMPONENT

CHANGE OF TEN MILES OF SECONDARY (230/400 VOLT) THREE PHASE LINE CONDUCTOR FROM 3/0.147 COPPER TO WASP (EQUIVALENT TO 3/0 AAC)

1. Estimated Cost of Materials

Quantity	Description	Unit Cost $	Total Cost $
100 each	Secondary Spool Insulator (to place broken insulators)	0.66	66
10 each	Stay - Anchor Assembly	6.05	61
1 set	Miscellaneous (clamps, bolts, Nuts, Jumper etc.)	90.00	90
41.2 miles	New Conductor	1,526.00	62,871
		Total	63,088
	Less Salvage value of 41.2 miles of replaced Conductor (3/0.147 Copper)	480.00	- 19,776

2.	Net Cost of Materials	43,312
3.	Warehouse charge (1% of line 2)	433
4.	Labor	4,331
5.	Tools and instruments (1% of line 2)	433
6.	Transportation (6% of line 2)	2,599
7.	Engineering & Supervision (10% of line 2)	4,331
8.	Sub-total (line 2 to 7)	55,439
9.	Contingency (10% of line 8)	5,544
10.	Estimated Total Cost FY-82	60,983
11.	Estimated Total Cost of FY-83* Work Orders	67,081
12.	" " " " FY-84* " "	73,789
13.	" " " " FY-85* " "	81,168
14.	" " " " FY-86* " "	89,285
15.	" " " " FY-87* " "	98,214

*Assumes inflation of ten percent per annum

TABLE M-21

ESTIMATED COST OF ILLUSTRATIVE WORK ORDER NO.5

DISTRIBUTION SYSTEM ENERGY LOSS REDUCTION COMPONENT

INSTALLATION OF TEN (11,000 VOLTS) FEEDER CAPACITOR BANKS

1. Estimated Cost of Materials

Quantity	Description	Unit Cost $	Total Cost $
10 each	600 KVAR Capacitor Banks	1,600	16,000
10 sets	Mounting and connection accessories	160	1,600

2.	Total cost of materials	17,600
3.	Warehouse charge (0.5 % line 2)	88
4.	Labor (5% of line 2)	880
5.	Tools & instruments (0.5% of line 2)	88
6.	Transportation (3% of line 2)	528
7.	Engineering & Supervision (10% of line 2)	1,760
8.	Sub-total (line 2 to 7)	20,944
9.	Contingency (10% of line 8)	2,094
10.	Estimated Total Cost FY-82	23,038
11.	Estimated Total Cost of FY-83* Work Orders	25,342
12.	" " " " FY-84* " "	27,876
13.	" " " " FY-85* " "	30,664
14.	" " " " FY-86* " "	33,730
15.	" " " " FY-87* " "	37,103

*Assume inflation of ten percent per annum

TABLE M-22

Estimated Cost of an Illustrative Rural System Expansion Work Order for Punjab Province

Item, Quantity and Unit Cost		Extended Cost
1. Primary (11,000 Volts) Lines		
a. Single-Phase	4.4 miles @ $3,938/mile	$ 17,327
b. Three-Phase	8.6 miles @ $7,346/mile	63,176
2. Secondary (230/400 Volts) Lines		
a. Single-Phase	3.1 miles @ $7,427/mile	23,024
b. Three-Phase	0.4 miles @ $8,348/mile	3,339
3. Distribution Transformers		
a. Single-Phase Capacity	700 KVA @ $27/KVA	18,900
b. Three-Phase Capacity	150 KVA @ $44/KVA	6,600
4. Number of Connections		
a. Residential	1344 @ $71/each	95,424
b. Community	30 @ $71/each	2,130
c. Commercial	198 @ $71/each	14,058
d. Industrial	16 @ $425/each	6,800
e. Tubewell	75 @ $1,438/each	107,850
f. Total	1,663	
5. Sub-Total (Items 1 to 4)		$358,628
6. Regulators, Capacitors and Other Special Items (1% of Item 5)		3,586
7. Total Direct Cost of distribution material and equipment (Items 5 and 6)		$362,214
8. Warehouse charge (1% of Item 7)		3,622
9. Labor (6% of Item 7)		$ 21,733
10. Tools (1% of Item 7)		3,622
11. Transportation (6% of Item 7)		21,733
12. Engineering and Supervision (2% of Item 7)		7,244
13. Sub-Total (Item 7 to 12)		$420,168
14. Contingency (10% of Item 13)		42,017
15. Total Cost Per FY-82 Work Order		$462,185
16. Total Cost per FY-83 Work Order		$508,404 a/
17. Total Cost per FY-84 Work Order		$559,244 a/

a/ Assumes 10% inflation compounded annually.

TABLE M-22 (contd.)

Item, Quantity and Unit Cost	Extended Cost
18. Total Cost per FY-85 Work Order	$615,168 a/
19. Total Cost per FY-86 Work Order	$676,685 a/
20. Total Cost per FY-87 Work Order	$744,354 a/
21. Total Cost per FY-88 Work Order	$818,789 a/

a/ Assumes 10% inflation compounded annually.

TABLE M-23

Estimated Cost of an Illustrative Rural System Expansion Work Order for Sind Province

	Item, Quantity and Unit Cost		Extended Cost
1.	Primary (11,000 Volts) Lines		
	a - Single-Phase	6 miles @ $ 3,938/mile	$ 23,628
	b - Three-Phase	14 miles @ $ 7,346/mile	102,844
2.	Secondary (230/400 Volts) Lines		
	a - Single-Phase	1.5 miles @ $ 7,427/mile	11,141
	b - Three-Phase	0.2 miles @ $ 8,348/mile	1,670
3.	Distribution Transformers		
	a - Single-Phase Capacity	400 KVA @ $ 27/KVA	10,800
	b - Three-Phase Capacity	100 KVA @ $ 44/KVA	4,400
4.	Number of Connections		
	a - Residential	1,240 @ $ 71/ea.	88,040
	b - Community	41 @ $ 71/ea.	2,911
	c - Commercial	66 @ $ 71/ea.	4,686
	d - Industrial	8 @ $ 425/ea.	3,400
	e - Tubewell	50 @ $1,438/ea.	71,900
	f - Total	1,405	
5.	Sub-Total (Item 1 to 4)		$ 325,420
6.	Regulators, Capacitors & others Special Items (1% of Item 5)		3,254
7.	Total Direct Cost of distribution material and equipment (Item 5 and 6)		328,674

TABLE M-23 (Contd.)

Item, Quantity and Unit Cost	Extended Cost
8. Warehouse Charge (1% of Item 7)	$ 3,287
9. Labor (6% of Item 7)	19,720
10. Tools (1% of Item 7)	3,287
11. Transportation (6% of Item 7)	19,720
12. Engineering & Supervision (2% of Item 7)	6,573
13. Sub-Total (Item 7 to 12)	$ 381,261
14. Contingency (10% of Item 13)	$ 38,126
15. Total Cost per Work Order in FY-82	$ 419,387
16. Total Cost per Work Order in FY-83	$ 461,326 (a)
17. Total Cost per Work Order in FY-84	$ 507,458 (a)
18. Total Cost per Work Order in FY-85	$ 558,204 (a)
19. Total Cost per Work Order in FY-86	$ 614,024 (a)
20. Total Cost per Work Order in FY-87	$ 675,427 (a)
21. Total Cost per Work Order in FY-88	$ 742,969 (a)

(a) Includes 10 percent inflation factor.

TABLE M-24

Estimated Cost of an Illustrative Rural System Expansion Work Order for Northwest Frontier Province

	Item, Quantity and Unit Cost		Extended Cost
1.	Primary (11,000 Volts) Lines		
	a - Single-Phase	6 miles @ $ 3,938/mile	$ 23,628
	b - Three-Phase	14 miles @ $ 7,346/mile	102,844
2.	Secondary (230/400 Volts) Lines		
	a - Single-Phase	1.3 miles @ $ 7,427/mile	9,655
	b - Three-Phase	0.1 miles @ $ 8,348/mile	835
3.	Distribution Transformers		
	a - Single-Phase Capacity	175 KVA @ $ 27/KVA	4,725
	b - Three-Phase Capacity	50 KVA @ $ 44/KVA	2,200
4.	Number of Connections		
	a - Residential	918 @ $ 71/ea.	65,178
	b - Community	19 @ $ 71/ea.	1,349
	c - Commercial	26 @ $ 71/ea.	1,846
	d - Industrial	4 @ $ 425/ea.	1,700
	e - Tubewell	18 @ $1,438/ea.	25,884
	f - Total	985	
5.	Sub-Total (Item 1 to 4)		$ 239,844
6.	Regulators, Capacitors and other Special Items (1% of Item 5)		2,398
7.	Total Direct Cost of distribution material and equipment (Item 5 and 6)		$ 242,242

TABLE M-24 (Contd.)

Item, Quantity and Unit Cost	Extended Cost
8. Warehouse charge (1% of Item 7)	$ 2,422
9. Labor (6% of Item 7)	$ 14,535
10. Tools (1% of Item 7)	$ 2,422
11. Transportation (6% of Item 7)	$ 14,535
12. Engineering & Supervision (2% of Item 7)	$ 4,845
13. Sub-Total (Item 7 to 12)	$ 281,001
14. Contingency (10% of Item 13)	$ 28,100
15. Total Cost per Work Order in FY-82	$ 309,101
16. Total Cost per Work Order in FY-83	$ 340,011 (a)
17. Total Cost per Work Order in FY-84	$ 374,012 (a)
18. Total Cost per Work Order in FY-85	$ 411,413 (a)
19. Total Cost per Work Order in FY-86	$ 452,555 (a)
20. Total Cost per Work Order in FY-87	$ 497,810 (a)
21. Total Cost per Work Order in FY-88	$ 547,591 (a)

(a) Includes 10 percent inflation factor.

TABLE M-25

Estimated Cost of an Illustrative Rural System Expansion Work Order for Baluchistan Province

	Item, Quantity and Unit Cost		Extended Cost
1.	Primary (11,000 Volts) Line		
	a - Single-Phase	10 miles @ $ 3,938/mile	$ 39,380
	b - Three-Phase	15 miles @ $ 7,249/mile	108,735
2.	Secondary (230/400 Volts) Lines		
	a - Single-Phase	1.3 miles @ $ 7,427/mile	$ 9,655
	b - Three-Phase	0.1 miles @ $ 8,438/mile	844
3.	Distribution Transformers		
	a - Single-Phase Capacity	175 KVA @ $ 27/KVA	$ 4,725
	b - Three-Phase Capacity	50 KVA @ $ 44/KVA	2,200
4.	Number of Connections		
	a - Residential	714 @ $ 71/ea.	50,694
	b - Community	19 @ $ 71/ea.	1,349
	c - Commercial	18 @ $ 71/ea.	1,278
	d - Industrial	3 @ $425/ea.	1,275
	e - Tubewell	5 @ $1,438/ea.	7,190
	f - Total	759	
5.	Sub-Total (Item 1 to 4)		$ 227,325
6.	Regulators, Capacitors & others Special Items (1% of Item 5)		2,273
7.	Total Direct Cost of distribution material and equipment (Item 5 & 6)		229,598
8.	Warehouse charge (1% of Item 7)		2,296
9.	Labor (6% of Item 7)		13,776

TABLE M-25 (Contd.)

Item, Quantity and Unit Cost	Extended Cost
10. Tools (1% of Item 7)	2,296
11. Transportation (6% of Item 7)	13,776
12. Engineering & Supervision (2% of Item 7)	4,592
13. Sub-Total (Item 7 to 12)	$ 266,334
14. Contingency (10% of Item 13)	$ 26,633
15. Total Cost per Work Order in FY-82	$ 292,967
16. Total Cost per Work Order in FY-83	$ 322,264 (a)
17. Total Cost per Work Order in FY-84	$ 354,490 (a)
18. Total Cost per Work Order in FY-85	$ 389,939 (a)
19. Total Cost per Work Order in FY-86	$ 428,933 (a)
20. Total Cost per Work Order in FY-87	$ 471,826 (a)
21. Total Cost per Work Order in FY-88	$ 519,009 (a)

(a) Includes 10 percent inflation factor.

TABLE M-26

ILLUSTRATIVE NUMBER OF CONNECTIONS
PER MODEL WORK ORDER a/

Type Connection	Present Potential Number per Area b/	Target End-of-Project Saturation	Estimated Number Already Connected	Estimated Number of New Connections
		PUNJAB		
Residential	6,400	30%	576	1,344
Community	142	30%	13	30
Commercial	330	90%	99	198
Industrial	27	90%	8	16
Tubewell	120	95%	39	75
			Total	1,663
		SIND		
Residential	4,000	40%	360	1,240
Community	133	40%	12	41
Commercial	102	95%	31	66
Industrial	13	95%	4	8
Tubewell	78	95%	24	50
			Total	1,405
		NORTHWEST FRONTIER PROVINCE		
Residential	1,800	60%	162	918
Community	36	60%	3	19
Commercial	40	95%	12	26
Industrial	6	95%	2	4
Tubewell	27	95%	8	18
			Total	985
		BALUCHISTAN		
Residential	1,400	60%	126	714
Community	37	60%	3	19
Commercial	27	95%	8	18
Industrial	4	95%	1	3
Tubewell	7	95%	2	5
			Total	759

a/ Based on data from 1978 A.I.D. Financed Rural Electrification Feasibility Studies and GOP supplied information about number, types and geographical distribution of tubewells.

b/ Assumes that each Work Order will provide connections in ten or eleven villages, some already electrified and some that will be electrified under this project.

TABLE-27

ILLUSTRATIVE ANNUAL DISTRIBUTION OF WORK ORDERS OF THE RURAL DISTRIBUTION SYSTEM EXPANSION PROGRAM BY PROVINCE

U.S. Fiscal Year	Number of Work Orders	Unit Cost of Work Orders (In $)	Total Cost (In $)
	PUNJAB		
'86	26	676,685	17,593,810
'87	42	744,354	31,262,868
Sub-Total:	68	-	48,856,678
	SIND		
'86	8	614,024	4,912,192
'87	12	675,427	8,105,124
'88	15	742,969	11,144,535
Sub-Total:	35	-	24,161,851
	NORTHWEST FRONTIER PROVINCE		
'86	13	452,555	5,883,215
'87	16	497,810	7,964,960
'88	18	547,591	9,856,638
Sub-Total:	47	-	23,704,813
	BALUCHISTAN		
'86	1	428,933	428,933
'87	3	471,826	1,415,478
'88	5	519,009	2,595,045
Sub-Total:	9	-	4,439,456
	SUMMARY ALL PROVINCES		
'86	48	-	28,818,150
'87	73	-	48,748,430
'88	38	-	23,596,218
GRAND TOTAL:	159	-	101,162,798

FINANCIAL ANALYSIS ANNEX

TABLE M-28

ILLUSTRATIVE DISTRIBUTION AND
ESTIMATE OF COST OF IMPORTED COMMODITIES FOR
RURAL DISTRIBUTION SYSTEM EXPANSION COMPONENT

(in U.S. Dollars)

Item	Quantity per Sub-Project	Number of Sub-Projects	Total Quantity	FY 1982 Unit Cost	Total Estimated FY 1982 Cost
Single-Phase Energy (Watt-hour) Meters					
Punjab	1,572	68	106,896	$ 20	2,137,920
Sind	1,347	35	47,145	20	942,900
N.W.F.P.	963	47	45,261	20	905,220
Baluchistan	751	9	6,759	20	135,180
Sub-Total	-	159	-	-	4,121,220
Three-Phase Energy (Watt-hour) Meters					
Punjab	91	68	6,188	$138	853,944
Sind	58	35	2,030	138	280,140
N.W.F.P.	22	47	1,030	138	142,692
Baluchistan	8	9	72	138	9,936
Sub-Total	-	159	-	-	1,286,712
Single-Phase Distribution Transformers					
Punjab	700 KVA	68	47,600	$ 27	1,285,200
Sind	400 KVA	35	14,000	27	378,000
N.W.F.P.	174 KVA	47	8,178	27	220,806
Baluchistan	175 KVA	9	1,575	27	42,525
Sub-Total	-	159	-	-	1,926,531
Regular Three-Phase Distribution Transformers					
Punjab	150 KVA	68	10,200	$ 44	448,800
Sind	100 KVA	35	3,500	44	154,000
N.W.F.P.	50 KVA	47	2,350	44	103,400
Baluchistan	50 KVA	9	450	44	19,800
Sub-Total	-	159	-	-	726,000
Tubewell Three-Phase Distribution Transformers					
Punjab	1,875 KVA	68	127,500	$ 60	765,000
Sind	1,280 KVA	35	44,800	60	2,688,000
N.W.F.P.	450 KVA	47	21,150	60	1,269,000
Baluchistan	125 KVA	9	1,125	60	67,500
Sub-Total	-	159	-	-	11,674,500
Regulators, Capacitors, Tools and other Special Items					
Punjab	1 set	68	68	$ 7,280	495,040
Sind	1 set	35	35	6,541	228,935
N.W.F.P.	1 set	47	47	4,820	226,540
Baluchistan	1 set	9	9	4,569	41,121
Sub-Total	-	159	-	-	991,636

FINANCIAL ANALYSIS ANNEX

TABLE M-28 (Continued)

7.	Total FY 1982 Cost	=	$ 20,726,599
	15% inflation	=	3,108,990
8.	Total FY 1983 Cost	=	23,835,589
	15% inflation	=	3,575,338
	Total	=	27,410,927
9.	Purchased in FY 1984	=	15,000,000 a/
	Balance FY 1984	=	12,410,927
	15% inflation	=	1,861,639
	Total	=	14,272,566
10.	Purchased in FY 1985	=	8,915,000
	Balance FY 1985	=	5,357,566
	15% inflation	=	803,635
	Total	=	6,161,201
11.	Purchased in FY 1986	=	6,161,201
	Balance	=	0
12.	Total Cost (Line,9,10 & 11	=	30,076,201
13.	10% Contingency	=	3,007,620
	Grand Total (Line 12 & 13)		33,083,821

a/ Includes $15 million that has been earmarked under the Agricultural Commodities and Equipment Project (391-0468) to import transformers, capacitors, meters and other equipment to connect irrigation tubewell pumps and other rural customers under this project.

TABLE M- 29

NUMBER OF VILLAGES ELECTRIFIED

Period	Punjab	N.W.F.P.(a)	Sind	Baluchistan	Total
Pre- WAPDA	100	509	-	-	609
1959-60	177	116	2	-	295
1960-61	241	109	1	-	351
1961-62	182	50	4	-	236
1962-63	84	45	20	-	149
1963-64	14	56	15	-	85
1964-65	81	34	13	5	133
1965-66	89	38	22	3	152
1966-67	37	23	21	1	82
1967-68	35	12	49	1	97
1968-69	41	17	32	-	90
1969-70	55	34	21	-	110
1970-71	20	60	17	1	98
1971-72	16	44	6	-	66
1972-73	77	101	114	3	295
1973-74	307	144	119	10	580
1974-75	379	155	277	42	853
1975-76	339	227	280	22	868
1976-77	428	178	223	25	854
1977-78	850	342	371	43	1,606
1978-79	586	348	259	53	1,246
1979-80	651	329	271	55	1,306
1980-81	550	344	247	40	1,181
1981-82(estimated)	1169	380	302	62	1,913
Total Already Electrified:	6,508	3,694	2,686	366	13,255
Total Number of Villages:	25,001	6,686	5,988	5,632	43,321(b)
			Villages to be electrified :		30,066
Percent of Villages Already Electrified:	26%	55%	45%	6%	31%

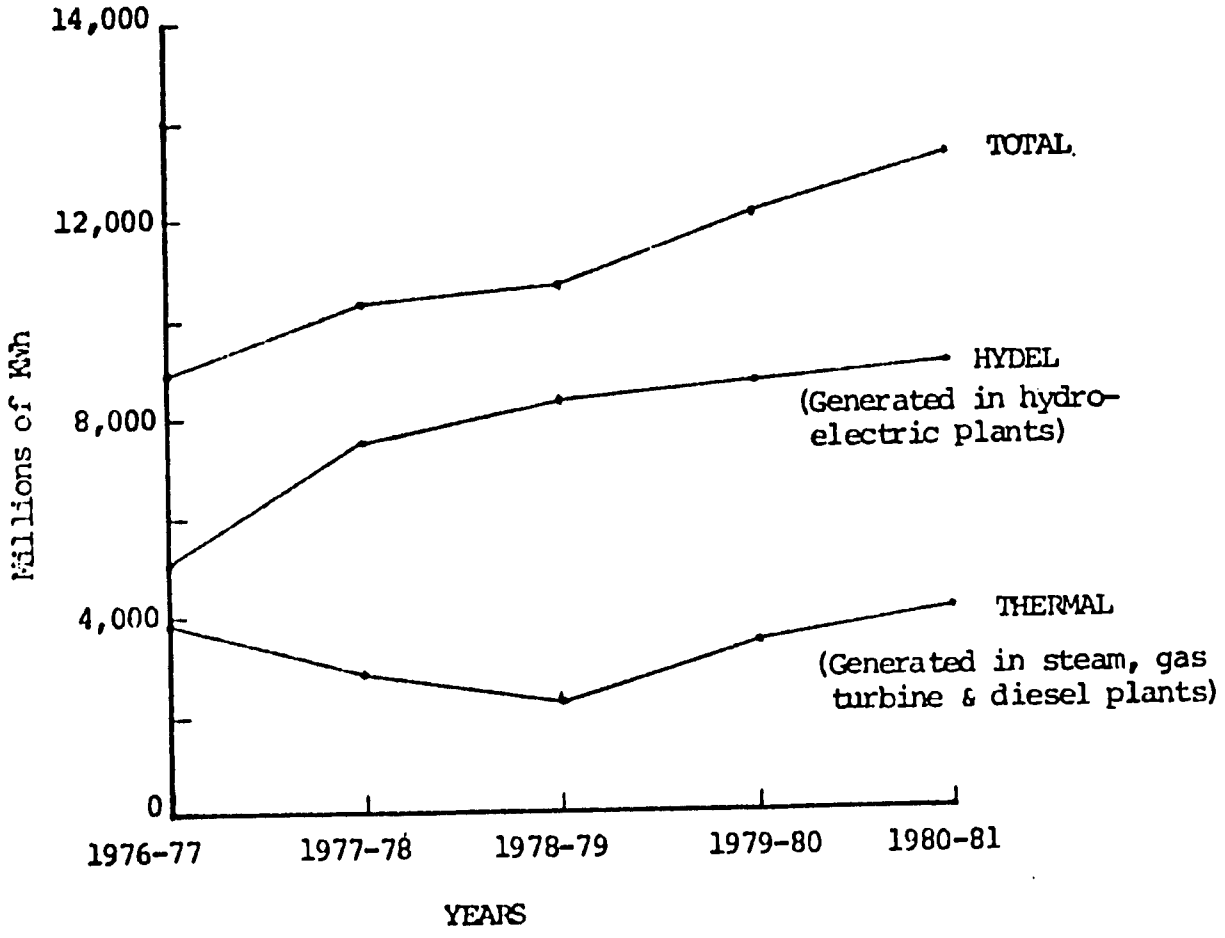
(a) Includes the Federally administered Tribal Areas.

(b) Based on 1972 Census. Total villages are now estimated to be 45,000.

TABLE M- 30

BREAKDOWN OF WAPDA POWER GENERATION

BY TYPE OF GENERATION PLANT



SOURCE : WAPDA ANNUAL REPORT, 1980-81

TABLE M-31

FREQUENCY DISTRIBUTION OF NUMBER OF VILLAGES BY TOTAL POPULATION IN EACH PROVINCE

POPULATION PER VILLAGE 1972	POPULATION %				
	PUNJAB	N.W.F.P. & FATA	SIND	BALUCHISTAN	TOTAL
Less than 500	30.9	39.9	18.4	73.1	36.1
501 - 1,000	24.6	18.5	25.0	12.3	22.1
1,001 - 2,000	23.0	19.6	31.3	6.0	21.4
2,001 - 3,000	9.1	8.8	13.2	1.3	8.6
3,001 - 4,000	3.6	4.2	4.9	0.3	3.4
4,001 - 5,000	1.5	2.2	2.4	0.2	1.6
5,001 - 6,000	0.8	1.5	1.0	0.1	0.9
6,001 - 7,000	0.5	1.0	0.7	0.09	0.5
7,001 - 8,000	0.3	1.0	0.4	0.05	0.4
8,001 - 9,000	0.2	0.4	0.3	-	0.2
9,001 - 10,000	0.2	0.4	0.2	-	0.2
More than 10,000	0.8	1.2	1.1	0.04	0.8
Population not known	4.5	1.3	1.1	6.5	3.8
Total:	100.0	100.0	100.0	100.0	100.0

Note: Above data is based on info. from WAPDA's Action Plan for Rural Electrification in Pakistan, February 1980

TABLE M- 32

NUMBER OF VILLAGES BY
POPULATION AND PROVINCE (a)

POPULATION PER VILLAGE	NUMBER OF VILLAGES				
	PUNJAB	N.W.F.P. & FATA	SIND	BALUCHISTAN	TOTAL
Less than 500	7,728	2,667	1,101	4,133	15,629
501 - 1,000	6,155	1,236	1,502	698	9,591
1,001 - 2,000	5,751	1,314	1,877	331	9,274
2,001 - 3,000	2,279	591	790	76	3,736
3,001 - 4,000	898	281	292	19	1,490
4,001 - 5,000	378	147	142	9	676
5,001 - 6,000	214	99	59	8	380
6,001 - 7,000	117	69	40	5	231
7,001 - 8,000	70	68	25	3	156
8,001 - 9,000	44	30	17	-	91
9,001 - 10,000	40	24	10	-	74
More than 10,000	203	82	67	2	354
Population not known	1,124	88	66	368	1,646
Total:	25,001	6,686	5,988	5,652	43,321
%	57.7	15.4	13.8	13.1	100.0

(a) This above data is based on information from WAPDA's Action Plan for Rural Electrification in Pakistan, February, 1980, which in turn is based on the 1972 census. It is estimated that the total number of villages has increased since then to approximately 45,000.

TABLE M-33

KILOMETERS OF PRIMARY (11,000 VOLT) AND SECONDARY (230/400 VOLT) POWER DISTRIBUTION LINES INSTALLED BY WAPDA

Area Electricity Board	Added during 1980-81		Total as of 6/30/81	
	Primary	Secondary	Primary	Secondary
Lahore	76	59	6,696	4,448
Gujranwala	143	99	10,793	4,600
Multan	1,434	312	17,590	5,039
Faisalabad	295	221	13,317	4,240
Islamabad	2,294	1,913	7,346	6,232
Punjab	4,242	2,604	55,742	24,559
Peshawar	592	575	9,314	7,030
Hyderabad	761	405	13,981	5,640
Quetta	213	130	2,629	1,395
Total	5,808	3,714	81,666	38,624

SOURCE : Statistical Data, WAPDA GMD

TABLE M-34

NUMBER OF TUBEWELLS BY OWNERSHIP AND PROVINCE IN PAKISTAN
(As of 6/30/75)

DISTRICT	Public	Private	Total
PUNJAB PROVINCE			
Rawalpindi	11	162	173
Attock	26	680	703
Jhelum	17	853	870
Gujrat	939	4,822	5,761
Sargodha	939	2,088	3,027
Mianwali	192	2,813	3,005
Faisalabad	434	6,732	7,166
Lahore	269	8,408	8,677
Sheikhupura	1,856	4,811	6,667
Gujranwala	552	18,121	18,673
Sialkot	14	15,874	15,888
Multan	207	22,502	22,709
Sahiwal	131	18,167	18,298
Muzaffargarh	1,322	4,904	6,226
D.G. Khan	34	3,745	3,779
Bahawalpur	68	3,429	3,497
Bahawal Nagar	23	1,831	1,854
Rahim Yar Khan	151	4,597	4,748
Sub-Total	8,058	131,166	139,224

TABLE M-34 (CONTINUED)

NUMBER OF TUBEWELLS BY OWNERSHIP AND PROVINCE IN PAKISTAN
(As of 6/30/75)

DISTRICT	Public	Private	Total
SIND PROVINCE			
Hyderabad	59	1,391	1,450
Badin	-	152	152
Thatta	-	468	468
Sanghar	4	243	247
Dadu	7	430	437
Tharparkar	-	115	115
Sukkur	106	1,307	1,413
Khairpur	535	367	902
Nawabshah	566	1,032	1,598
Larkana	4	269	273
Jaccobabad	2	327	329
Karachi	2	609	611
Sub-Total	1,285	6,710	7,995

TABLE M-34 (CONTINUED)

NUMBER OF TUBEWELLS BY OWNERSHIP AND PROVINCE IN PAKISTAN
(As of 6/30/75)

DISTRICT	Public	Private	Total
NORTHWEST FRONTIER PROVINCE			
Peshawar	82	1,302	1,384
Hazara	18	117	135
Mardan	30	1,359	1,389
Kohat	8	663	671
D.I. Khan	103	762	865
Bannu	8	81	89
Swat	0	138	138
Dir	0	27	27
Agency	0	39	39
North Waziristan	3	38	41
South Waziristan	0	8	8
Malakand Agency	0	129	129
Special Areas	3	214	217
Sub-Total	252	4,663	4,915

TABLE M-34 (CONTINUED)

NUMBER OF TUBEWELLS BY OWNERSHIP AND PROVINCE IN PAKISTAN
(As of 6/30/75)

DISTRICT	Public	Private	Total
BALUCHISTAN PROVINCE			
Quetta	3	564	567
Pishin	9	691	700
Loralai	32	155	187
Zhob	-	174	174
Chagi	1	145	146
Sibi	-	32	32
Nasirabad	2	40	42
Kachhi	-	25	25
Marri Bughti	-	29	29
Kalat	1	1,319	1,320
Makran	4	82	86
Lasbela	-	214	214
Sub-Total	52	3,662	3,714
Grand Total	9,647	146,201	155,848

TABLE M-35

NUMBER OF TUBEWELLS (SHALLOW AND DRILLED) BY TYPE OF POWER
(As of 6/30/75)

DISTRICT	Public		Private		Total		
	Electric	Diesel	Electric	Diesel	Electric	Diesel	Grand Total
PUNJAB PROVINCE							
Rawalpindi	9	2	112	50	121	52	173
Attock	26	-	578	102	604	102	706
Jhelum	15	2	236	617	251	619	870
Gujrat	937	2	2,535	2,228	3,472	2,289	5,761
Sargodha	933	6	622	1,426	1,595	1,432	3,027
Mianwali	180	12	1,140	1,673	1,320	1,685	3,005
Jhang	872	1	2,159	4,468	3,031	4,469	7,500
Faisalabad	429	5	2,110	4,622	2,539	4,627	7,166
Lahore	265	4	5,742	2,666	6,007	2,670	8,677
Sheikhupura	1,856	-	2,421	2,390	4,277	2,390	6,667
Gujranwala	550	2	6,482	11,639	7,032	11,641	18,673
Sialkot	10	4	4,126	11,748	4,136	11,752	15,888
Multan	167	40	4,427	18,075	4,594	18,115	22,709
Sahiwal	92	39	4,971	13,196	5,063	13,253	18,298
Muzaffargarh	1,302	20	425	4,479	1,727	4,499	6,226
D.G. Khan	15	19	153	3,592	168	3,611	3,779
Bahawalpur	57	11	570	2,859	627	2,870	3,497
Bahawalnagar	22	1	196	1,635	218	1,636	1,854
R.Y. Khan	135	16	589	4,008	724	4,024	4,748
Sub-Total	7,872	186	39,634	91,532	47,506	91,718	139,224

TABLE M-35 (Contd.)

DISTRICT	Public		Private		Total		
	Electric	Diesel	Electric	Diesel	Electric	Diesel	Grand Total
SIND PROVINCE							
Hyderabad	57	2	1,037	354	1,094	356	1,450
Badin	-	-	86	66	86	66	152
Thatta	-	-	53	415	53	415	468
Sanghar	4	-	185	58	189	58	247
Nadu	7	-	154	276	151	276	437
Tharparker	-	-	60	55	60	55	115
Sukkur	87	19	810	497	897	516	1,413
Khairpur	528	7	250	117	778	124	902
Nawabshah	566	-	457	575	1,023	575	1,598
Larkana	4	-	92	177	96	177	273
Jacoobabad	2	-	131	196	133	196	329
Karachi	2	-	357	252	359	252	611
Sub-Total	1,257	28	3,672	3,038	4,929	3,066	7,995

TABLE M-35 (Contd.)

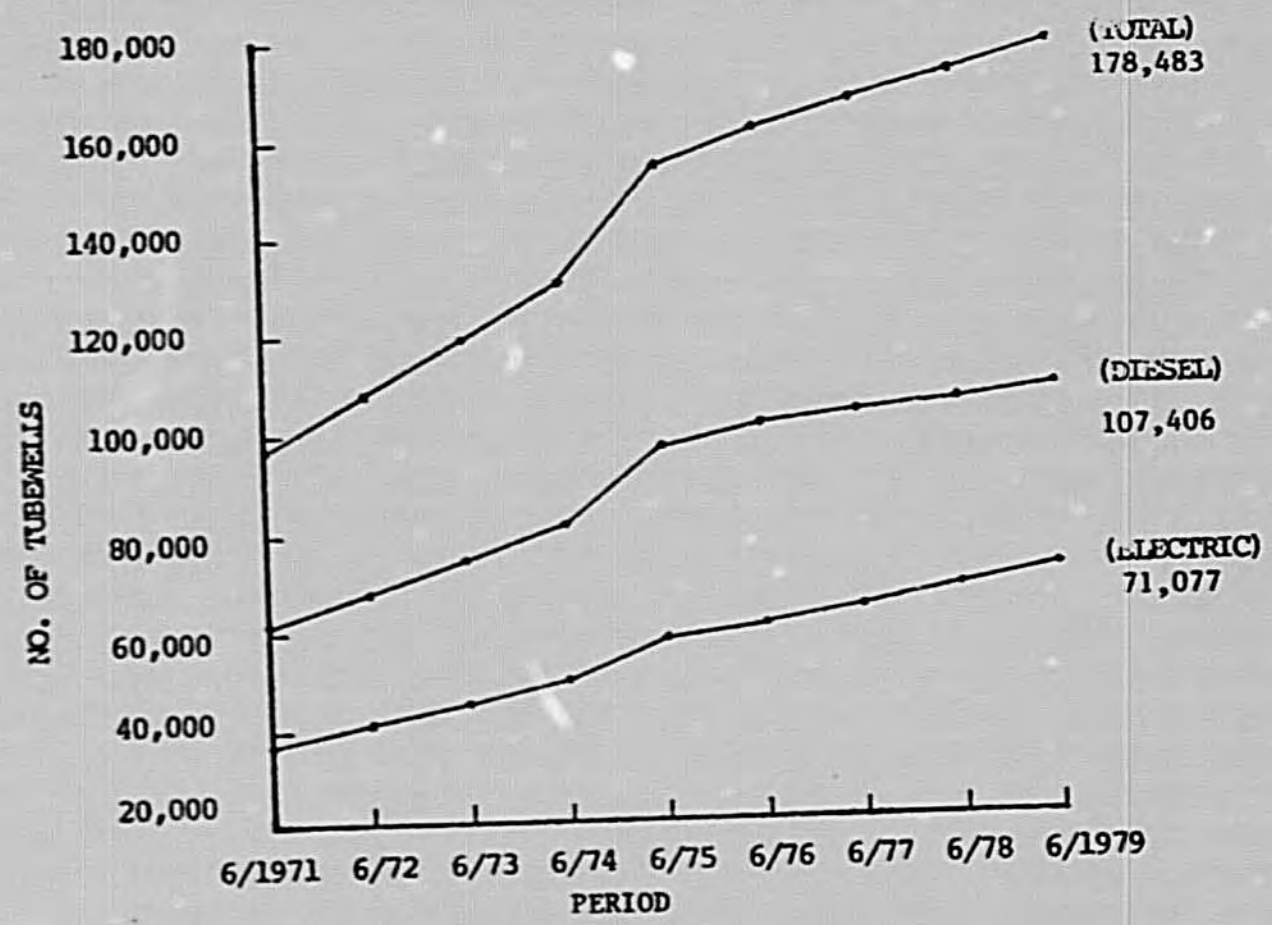
DISTRICT	Public		Private		Total		
	Electric	Diesel	Electric	Diesel	Electric	Diesel	Grand Total
NORTHWEST FRONTIER PROVINCE							
Peshawar	82	-	1,370	14	1,370	14	1,384
Hazara	18	-	114	3	132	3	135
Mardan	30	-	1,345	14	1,375	14	1,389
Kohąt	8	-	645	18	653	18	671
D.I. Khan	103	-	582	180	685	180	865
Bannu	8	-	71	10	79	10	89
Swat	-	-	116	22	116	22	138
Dir	-	-	27	-	27	-	27
Khyber Agency	-	-	39	-	39	-	39
N.Waziristan Agency	3	-	36	2	39	2	41
S.Waziristan Agency	-	-	-	8	-	8	8
Malakand Agency	-	-	128	1	128	1	129
Special Areas	3	-	203	11	206	11	217
Sub-Total	252	-	4,391	272	4,643	272	4,915

TABLE M-35 (Contd.)

DISTRICT	Public		Private		Total		
	Electric	Diesel	Electric	Diesel	Electric	Diesel	Grand Total
BALUCHISTAN PROVINCE							
Quetta	3	-	537	27	540	27	567
Pishin	-	6	460	231	463	237	700
Loralai	-	32	20	135	20	167	187
Zhob	-		-	174	-	174	174
Chagai	-	1	-	145	-	146	146
Sibi	-	-	2	30	2	30	32
Nasirabad	1	1	6	34	7	35	42
Kachhi	-	-	2	23	2	23	25
Bughti	-	-	-	29	-	29	29
Kalat	-	1	524	795	524	796	1,320
Khuzdar	3	1	-	82	3	83	86
Mekran	-	-	-	192	-	192	192
Lasbella	-	-	-	214	-	214	214
Sub-Total	10	42	1,551	2,111	1,561	2,153	3,714
Grand-Total	9,391	256	49,248	96,953	58,639	97,207	155,848

TABLE M-30

GROWTH TREND OF TUBEWELLS IN PAKISTAN BY TYPE OF POWER, 1971-1979

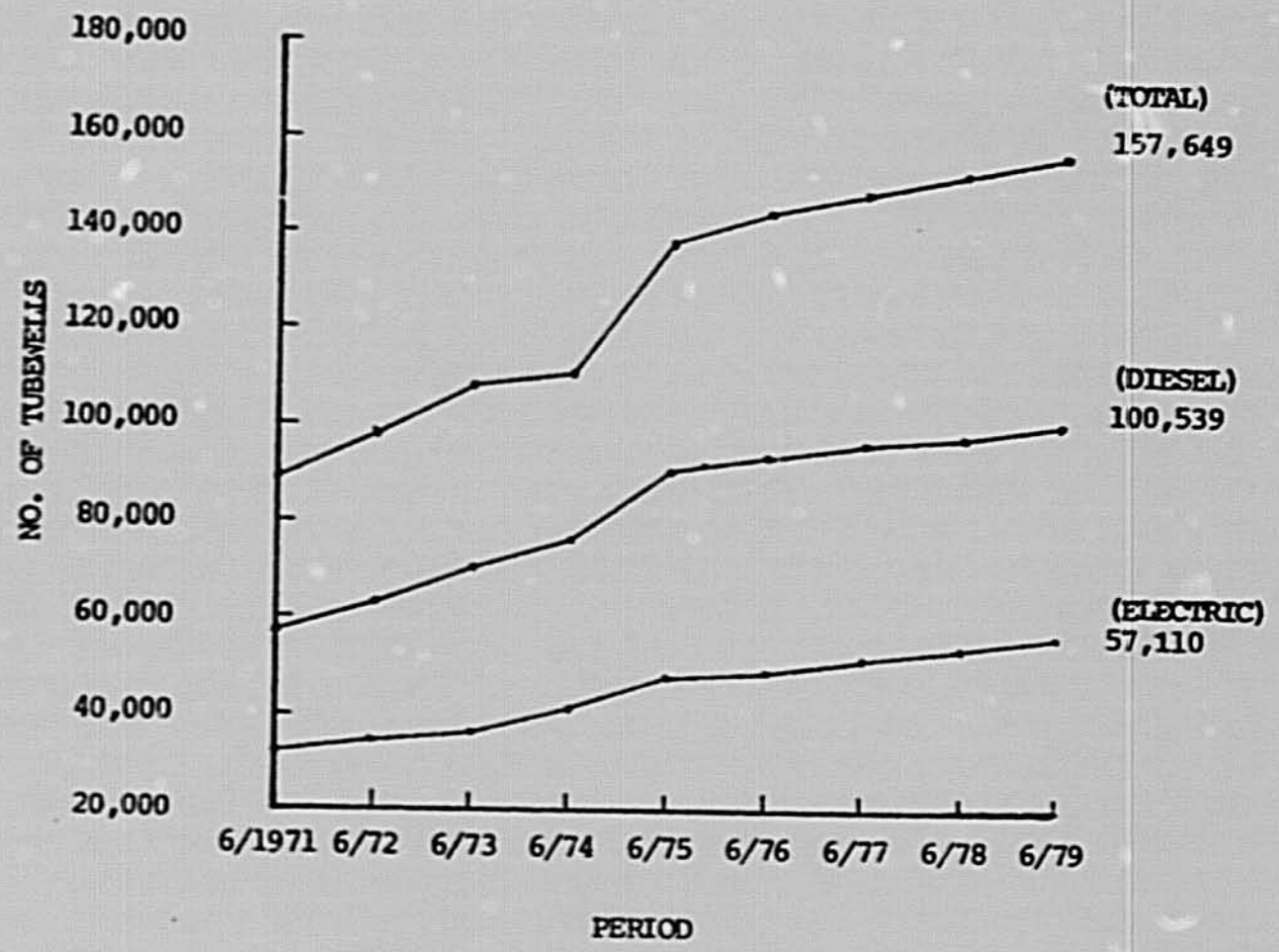


Source: GOP, Agricultural Statistics of Pakistan 1980.

NOTE: WAPDA disagrees with these Ministry of Agriculture Statistics. According to WAPDA, the total number of wells (tubewells and dug wells) was about 208,000 as of 6/30/80 and from 5,000 to 8,000 new wells were being added annually. About 95% (195,000) of the wells are privately operated while the balance (about 13,000) are publicly operated. Of that total number of wells, WAPDA indicates that about 53% (110,000) are electrified and 47% (98,000) are powered by diesel motors.

TABLE M-37

GROWTH TREND OF TUBEWELLS IN PUNJAB PROVINCE BY TYPE OF POWER, 1971-1979

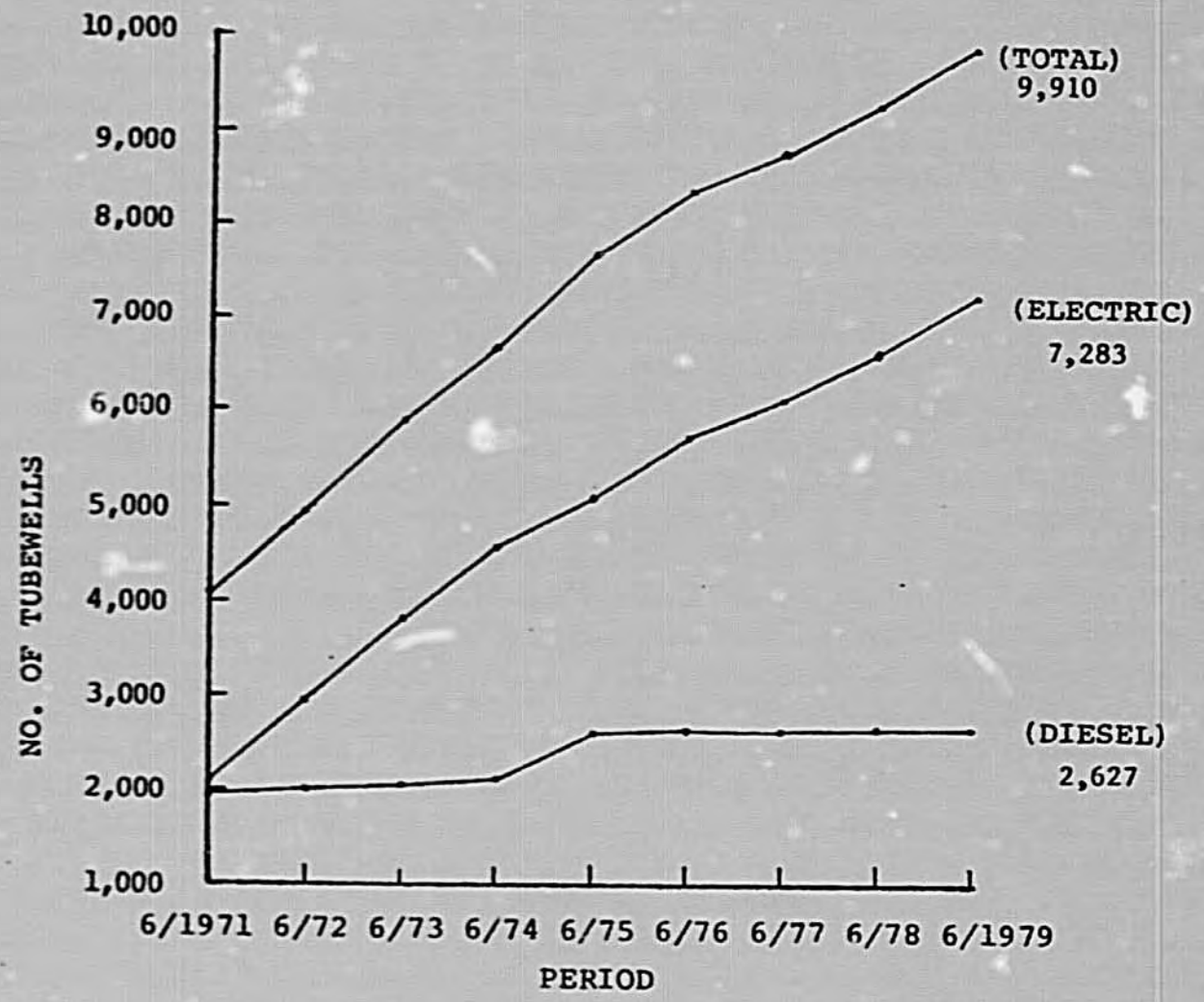


Source : GOP, Agricultural Statistics of Pakistan 1980.

Note: See NOTE on TABLE M-36

TABLE M-38

GROWTH TREND OF TUBEWELLS IN SIND PROVINCE BY TYPE OF POWER, 1971-1979

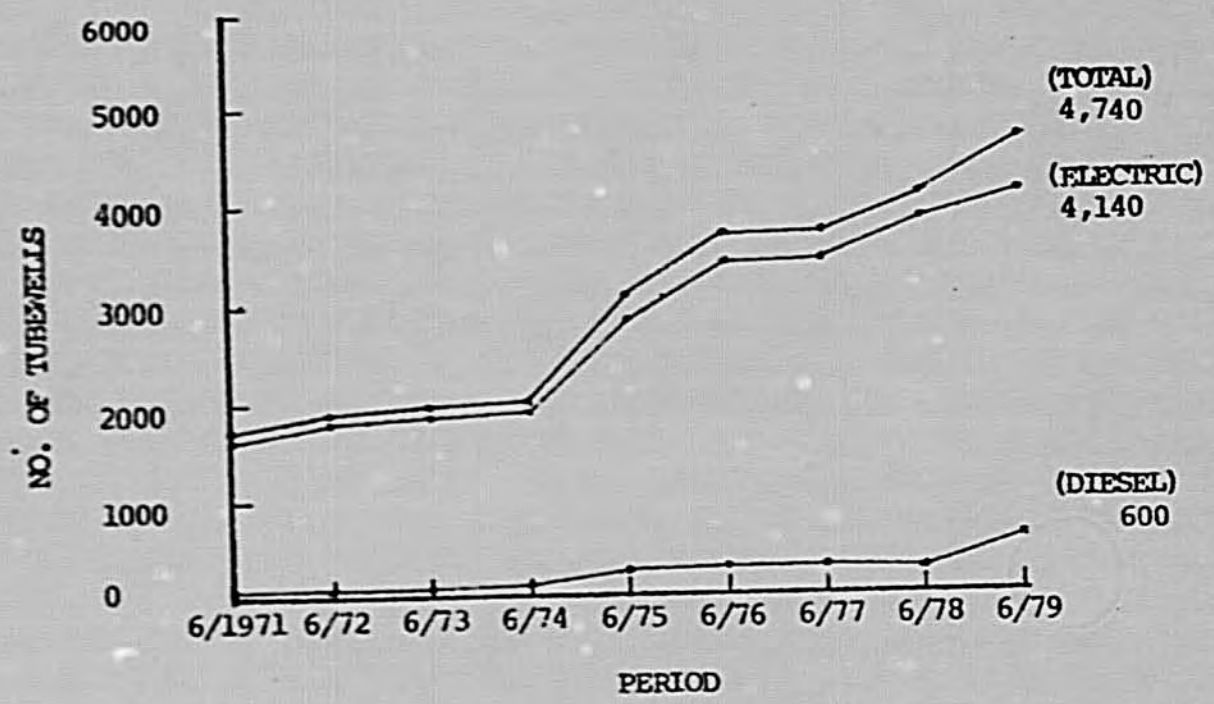


Source: GOP, Agricultural Statistics of Pakistan 1980.

Note: See NOTE on TABLE M-36

TABLE M-39

GROWTH TREND OF TUBEWELLS IN NORTHWEST FRONTIER PROVINCE BY TYPE OF POWER, 1971-1979

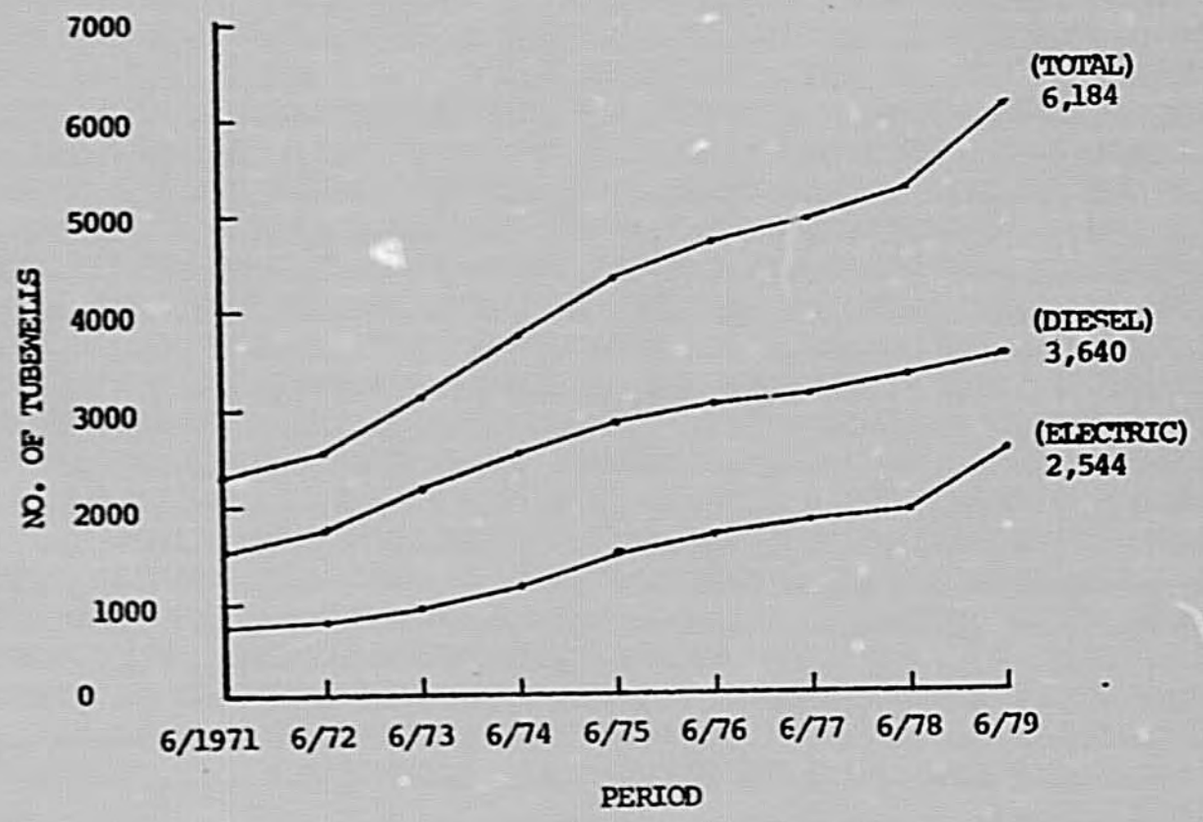


Source: GOP, Agricultural Statistics of Pakistan 1980.

Note: See NOTE on TABLE M-36

TABLE M-40

GROWTH TREND OF TUBEWELLS IN BALUCHISTAN PROVINCE BY TYPE OF POWER, 1971-1979



Source: GOP, Agricultural Statistics of Pakistan 1980.

Note: See NOTE on TABLE M-36

ADMINISTRATIVE ANALYSIS ANNEX

Table N-1
Basic Information

GUJRANWALA AREA ELECTRICITY BOARD

No.	Description/Indicator	Gujranwala Circle	Sialkot Circle	Sheikhupura Circle	Circle	AEB TOTAL
1.	Area (Sq. Miles)	2,303	2,060	2,300		6,663
2.	Population (In 000s)	2,049	2,705	2,454		7,208
3.	*N.C. Maximum Demand (M.W.) 6/82	185	72	123		380
4.	No. of 11KV Feeder	97	59	99		255
5.	Unit Received (GRHr) 7/81-6/82	396	188	424		1,008
6.	Unit Sold -do-	321	156	375		852
7.	Percentage of Loss	19	17	12		16
8.	Net fixed Assets (as of 6/82)	Rs (M) 192	108	154		454
9.	Total Value of Energy Billing during past 12 months (7/81-6/82)	Rs(M) 318	134	343		795
10.	Total Operating Expenses during past 12 months (7/81-6/82)	Rs(M) 14	10	8		32
11.	Consumers : Domestic	158	116	85		359
12.	(In 000s) Commercial	27	20	11		58
13.	Community					
14.	Tubewell	11	7	6		24
15.	Small Industries	10	6	3		19
16.	Large Industries	-	-	-		-
17.	Grand Total	206	149	105		460
18.	Total No. of Villages	1,257	2,895	1,097		5,249
19.	No. of Villages Electrified (estimated as of June, 1982)	487	654	576		1,717
20.	No. of Operation Divisions	5	4	3		12
21.	No. of Opr. Sub-Divisions	23	20	14		57
22.	No. of Construction Divisions	2	-	-		2
23.	No. of Const. Sub-Divisions	7	-	-		7
24.	Total No. of Personnel	3,326	2,192	1,458		7,330
25.	Total No. of Heavy Vehicles	14	10	6		30
26.	Total No. of Light Vehicles	32	23	26		81

* Non-Coincidental Maximum Demand

SOURCE: Gathered at the AED by a USAID/WAPDA Team

Table N-2
Basic Information

LAHORE AREA ELECTRICITY BOARD

No.	Description/Indicator	Lahore I Circle	Lahore II Circle	Lahore III Circle	Lahore IV Circle	AEB Circle Total
1.	Area (Sq.Miles)	60	59	488	1,192	1,799
2.	Population (In 000s)	800	800	800	2,459	4,859
3.	*N.C. Maximum Demand(M.W.)6/82	148	138	200	147	633
4.	No. of 11KV Feeder	58	63	76	59	256
5.	Unit Received(GWHr) 7/81-6/82	738	434	788	536	2,496
6.	Unit Sold -do-	548	333	640	376	1,897
7.	Percentage of Loss	26	23	19	30	24
8.	Net fixed Assets (as of 6/82)	Rs(M) 128	312	358	369	1,166
9.	Total Value of Energy Billing during past 12 months(7/81-6/82)	Rs(M) 522	230	408	232	1,392
10.	Total Operating Expenses during past 12 months (7/81-6/82)	Rs(M) 32	23	9	30	94
11.	Customer : (In 000s) Domestic	100	92	93	82	367
12.	Commercial	48	27	19	15	109
13.	Community	-	-	1	1	2
14.	Tubewell	1	1	3	10	15
15.	Small Industries	8	4	4	5	21
16.	Large Industries					
17.	Grand Total	157	124	120	113	514
18.	Total No. of Villages					
19.	No. of Villages Electrified (estimated as of June, 1982)					
20.	No. of Operation Division	4	4	4	4	16
21.	No. of Opr. Sub-Divisions	22	19	19	24	84
22.	No. of Construction Division			1	1	2
23.	No. of Const. Sub-Divisions			5	7	12
24.	Total No. of Personnel	2,480	2,215	2,426	2,807	10,369
25.	Total No. of Heavy Vehicles	12	2	-	13	27
26.	Total No. of Light Vehicles	47	66	70	82	265

* Non-Coincidental Maximum Demand

SOURCE: Gathered at the AEB by a USAID/WAPDA Team

Table N-3
Basic Information

FAISALABAD AREA ELECTRICITY BOARD

No.	Description/Indicator		Jhung Circle	Faisal-abad Circle	Sar-godha Circle	Circle	Circle	AEB TOTAL
1.	Area (Sq. Miles)		5,380	1,457	10,060			16,897
2.	Population (In 000s)		3,350	2,500	3,200			9,050
3.	*N.C. Maximum Demand (M.W.) 6/82		84	143	120			347
4.	No. of 11KV Feeder		88	82	120			290
5.	Unit Received (GWHr) 7/81-6/82		552	819	576			1,947
6.	Unit Sold -do-		480	704	540			1,724
7.	% of Loss		13	14	6			11
8.	Net fixed Assets (as of 6/82)		Rs(M) 488	488	488			1,464
9.	Total Value of Energy Billing during past 12 months (7/81-6/82)		Rs(M) 223	438	271			932
10.	Total Operating Expenses during past 12 months (7/81-6/82)		Rs(M) 23	34	31			88
11.	Consumers : (In 000s)	Domestic	78	173	110			361
12.		Commercial	17	39	24			80
13.		Community	-	-	-			-
14.		Tubewell	6	3	5			14
15.		Small Industries	3	15	3			21
16.		Large Industries						
17.		Grand Total	104	230	141			475
18.	Total No. of Villages		1,902	526	1,874			4,302
19.	No. of Villages Electrified (estimated as of June, 1982)		335	268	428			1,031
20.	No. of Operation Divisions		4	5	6			15
21.	No. of Opr. Sub-Divisions		17	23	25			65
22.	No. of Construction Divisions		-	1	1			2
23.	No. of Const. Sub-Divisions		-	2	4			6
24.	Total No. of Personnel		2,429	2,658	3,298			8,385
25.	Total No. of Heavy Vehicles		4	5	6			15
26.	Total No. of Light Vehicles		29	27	36			92

* Non-Coincidental Maximum Demand

SOURCE: Gathered at the AEB by a USAID/WAPDA Team

Table N-4
Basic Information

MULTAN AREA ELECTRICITY BOARD

No.	Description/Indicator	Bahawalpur Circle	Sahiwal Circle	Multan Circle	Circle	Circle	AEB TOTAL
1.	Area (Sq. Miles)	10,478	5,632	18,624			34,734
2.	Population (In 000s)	3,823	3,711	5,561			13,095
3.	*N.C. Maximum Demand (M.W.)6/82	128	199	219			546
4.	No. of 11KV Feeder	67	78	142			287
5.	Unit Received(GWHr)7/81-6/82	493	773	820			2,086
6.	Unit Sold - do -	370	584	651			1,605
7.	% of Loss	25	25	21			23
		Rs.(M)					
8.	Net fixed Assets(as of 6/82)	194	291	302			787
		Rs.(M)					
9.	Total Value of Energy Billing during past 12 months(7/81-6/82)	240	304	421			965
10.	Total Operating Expenses during past 12 months(7/81-6/82)	6	8	11			25
11.	Consumers: Domestic(In 000s)	92	109	169			370
12.	Commercial	28	23	43			94
13.	Community	-	-	-			-
14.	Tubewell	4	10	6			20
15.	Small Industries	3	4	9			16
16.	Large Industries	-	-	-			-
17.	Grand Total	128	146	228			502
18.	Total No. of Villages	3,295	2,818	4,041			10,184
19.	No. of Villages Electrified (estimated as of June, 1982)	540	693	676			1,909
20.	No. of Operation Divisions	3	4	6			13
21.	No. of Opr. Sub-Divisions	16	18	31			65
22.	No. of Construction Divisions	1	1	1			3
23.	No. of Const. Sub-Divisions	2	2	2			6
24.	Total No. of Personnel	1,722	2,092	2,236			6,050
25.	Total No. of Heavy Vehicles	6	14	10			30
26.	Total No. of Light Vehicles	27	19	35			81

*Non-Coincidental Maximum Demand

SOURCE: Gathered at the AEB by a USAID/WAPDA Team

Table N-5
Basic Information
ISLAMABAD AREA ELECTRICITY BOARD

No.	Description/Indicator	RAWAL-PINDI Circle	Islam-bad Circle	Gujrat Circle	Rawal-pindi City Circle	- Circle	AEB TOTAL
1.	Area (Sq. Miles)	7,808	362	2,278	1,200		11,648
2.	Population (In 000s)	2,908	235	1,899	874		5,916
3.	*N.C. Maximum Demand (M.W.)6/82	125	45	82	75		327
4.	No. of 11KV Feeder	115	26	46	24		211
5.	Unit Received(GWHr) 7/81-6/82	674	225	346	307		1,552
6.	Unit Sold -do-	641	207	339	261		1,448
7.	% of Loss	5	8	2	15		7
		Rs(M)					
8.	Net fixed Assets (as of 6/82)	245	615	173	8		1,041
		Rs(M)					
9.	Total Value of Energy Billing during past 12 months(7/81-6/82)	396	138	166	82		782
		Rs(M)					
10.	Total Operating Expenses during past 12 months (7/81-6/82)	41	22	28	15		106
11.	Consumer : (In 000s) Domestic	171	33	95	81		380
12.	Commercial	24	4	14	30		72
13.	Community						
14.	Tubewell	2		5	-		7
15.	Small Industries	3	-	4	1		8
16.	Large Industries	-	-	-	-		-
17.	Grand Total	200	37	118	112		467
18.	Total No. of Villages	2,827	227	1,532			4,586
19.	No. of Villages Electrified (estimated as of June, 1982)	1,017	105	393			1,515
20.	No. of Operation Division	5	2	3	3		13
21.	No. of Opr. Sub-Divisions	23	7	14	10		54
22.	No. of Construction Divisions	1	1		1		3
23.	No. of Const. Sub-Divisions	2	2		3		7
24.	Total No. of Personnel	2,815	925	2,026	1,799		7,876
25.	Total No. of Heavy Vehicles	11	7	3	7		28
26.	Total No. of Light Vehicles	33	15	22	29		99

* Non-Coincidental Maximum Demand

SOURCE: Gathered at the AEB by a USAID/WAPDA Team

Table N-6

Basic Information

QUETTA AREA ELECTRICITY BOARD

No.	Description/Indicator	*Quetta - 1 - Circle	*Quetta - 2 - Circle	AEB TOTAL
1.	Area (Sq. Miles)	47,278	86,772	134,050
2.	Population (In 000s)	1,470	670	2,140
3.	*N.C.Maximum Demand(M.W.)6/82	105	19	124
4.	No. of 11KV Feeder	56	4	60
5.	Unit Reveived(GWHr)7/81-6/82	458	13	471
6.	Unit Sold - do -	302	9	311
7.	% of Loss	34	30	32
8.	Net fixed Assets(as of 6/82)	Rs.(M) 262	116	378
9.	Total Value of Energy Billing during past 12 months(7/81-6/82)	Rs.(M) 121	6	127
10.	Total Operating Expenses during past 12 months(7/81-6/82)	Rs.(M) 19	39	58
11.	Consumers: Domestic (In 000s)	45	10	55
12.	Commercial	13	4	17
13.	Community	-	-	-
14.	Tubewell	4	-	4
15.	Small Industries	1	-	1
16.	Large Industries	-	-	-
17.	Grnad Total	63	14	77
18.	Total No. of Villages	3,605	2,047	5,652
19.	No. of Villages Electrified (estimated as of June, 1982)	273	18	291
20.	No. of Operation Divisions	3	2	5
21.	No. of Opr. Sub-Divisions			
22.	No. of Construction Divisions			
23.	No. of Const. Sub-Divisions			
24.	Total No. of Personnel	1,558	577	2,305
25.	Total No. of Heavy Vehicles	17	2	19
26.	Total No. of Light Vehicles	42	12	54

*Non-Coincidental Maximum Demand

SOURCE: Gathered at the AEB by a USAID/WAPDA Team.

Table N-7
Basic Information

HYDERABAD AREA ELECTRICITY BOARD

No.	Description/Indicator	Sukkur Circle	Hyder-abad Circle	Nawab-shah Circle	AEB TOTAL
1.	Area (Sq. Miles)	17,626	21,758	13,661	53,045
2.	Population (In 000s)	3,822	3,622	3,105	10,549
3.	*N.C.Maximum Demand(M.W.)6/82	169	226	71	466
4.	No. of 11KV Feeder	90	91	75	256
5.	Unit REceived(GWHr)7/81-6/82	461	716	357	1,534
6.	Unit Sold - do -	332	577	272	1,181
7.	% of Loss	28	19	24	23
8.	Net fixed Assets(as of 6/82)	Rs.(M) 388	324	331	1,043
9.	Total Value of Energy Billing during past 12 months(7/81-6/82)	Rs.(M) 219	379	159	757
10.	Total Operating Expenses during past 12 months(7/81-6/82)	Rs.(M) 61	62	44	167
11.	Consumers: Domestic (In ooos)	104	110	72	286
12.	Commercial	35	33	22	90
13.	Community	-	-	-	-
14.	Tubewell	5	2	4	11
15.	Small Industries	4	4	3	11
16.	Large Industries	-	-	-	-
17.	Grand Total	148	150	101	399
18.	Total No. of Villages	2,544	2,271	1,276	6,091
19.	No. of Villages Electrified (estimated as of June, 1982)	1,065	646	802	2,513
20.	No. of Operation Divisions	5	5	4	14
21.	No. of Opr. Sub-Divisions	25	25	17	67
22.	No. of Construction Divisions	1	1	1	3
23.	No. of Const. Sub-Divisions	3	5	3	11
24.	Total No. of Personnel	2,218	2,218	1,590	6,026
25.	Total No. of Heavy Vehicles	19	23	12	54
26.	Total No. of Light Vehicles	69	111	50	230

*Non-Coincidental Maximum Demand

SOURCE: Gathered at the AEB by a USAID/WAPDA Team

Table N-8
Basic Information

PESHAWAR AREA ELECTRICITY BOARD

No.	Description/Indicator	Pesha-war Circle	Mar-dan Circle	Abott-abad Circle	Khy-ber Circle	Ban-nu Circle	AEB TOTAL
1.	Area (Sq. Miles)	841	4,829	10,654	2,110	11,645	30,079
2.	Population (In 000s)	1,680	5,146	4,045	1,895	2,940	15,706
3.	*N.C.Maximum Demand(M.W.)6/82	108	61	73	85	42	369
4.	No. of 11KV Feeder	60	63	40	69	44	276
5.	Unit Received(GWHr)7/81-6/82	460	304	277	485	215	1,741
6.	Unit Sold - do -	317	213	246	335	129	1,240
7.	% of Loss	31	30	11	31	40	29
8.	Net fixed Assets(as of 6/82) Rs.(M)	191	230	109	195	135	860
9.	Total Value of Energy Billing during past 12 months (7/81-6/82) Rs.(M)	5	4	9	3	6	27
10.	Total Operating Expenses during past 12 months (7/81-6/82) Rs.(M)	22	25	10	17	12	86
11.	Consumers: Domestic (In 000s)	114	144	60	99	60	477
12.	Commercial	28	19	10	13	13	83
13.	Community	-	-	-	-	1	1
14.	Tubewell	1	7	-	4	2	14
15.	Small Industries	4	5	1	3	2	15
16.	Large Industries	-	-	-	-	-	-
17.	Grand Total	147	175	71	119	77	589
18.	Total No. of Villages	697	3,429	1,422	937	803	7,288
19.	No. of Villages Electrified (estimated as of June, 1982)	675	1,027	563	637	632	3,534
20.	No. of Operation Divisions	3	5	3	3	2	16
21.	No. of Opr. Sub-Divisions	16	22	11	15	9	73
22.	No. of Construction Divisions	-	-	1	1	1	3
23.	No. of Const. Sub-Divisions	1	-	2	2	3	8
24.	Total No. of Personnel	1,847	2,564	1,270	1,747	1,533	9,48[illegible]
25.	Total No. of Heavy Vehicles	4	7	8	11	13	43
26.	Total No. of Light Vehicles	27	33	24	32	22	13[illegible]

*Non-Coincidental Maximum Demand

SOURCE: Gathered at the AEB by a USAID/WAPDA Team

FIGURE N-1

TYPICAL ORGANIZATION OF ONE OF WAPDA'S EIGHT AREA ELECTRICITY BOARDS

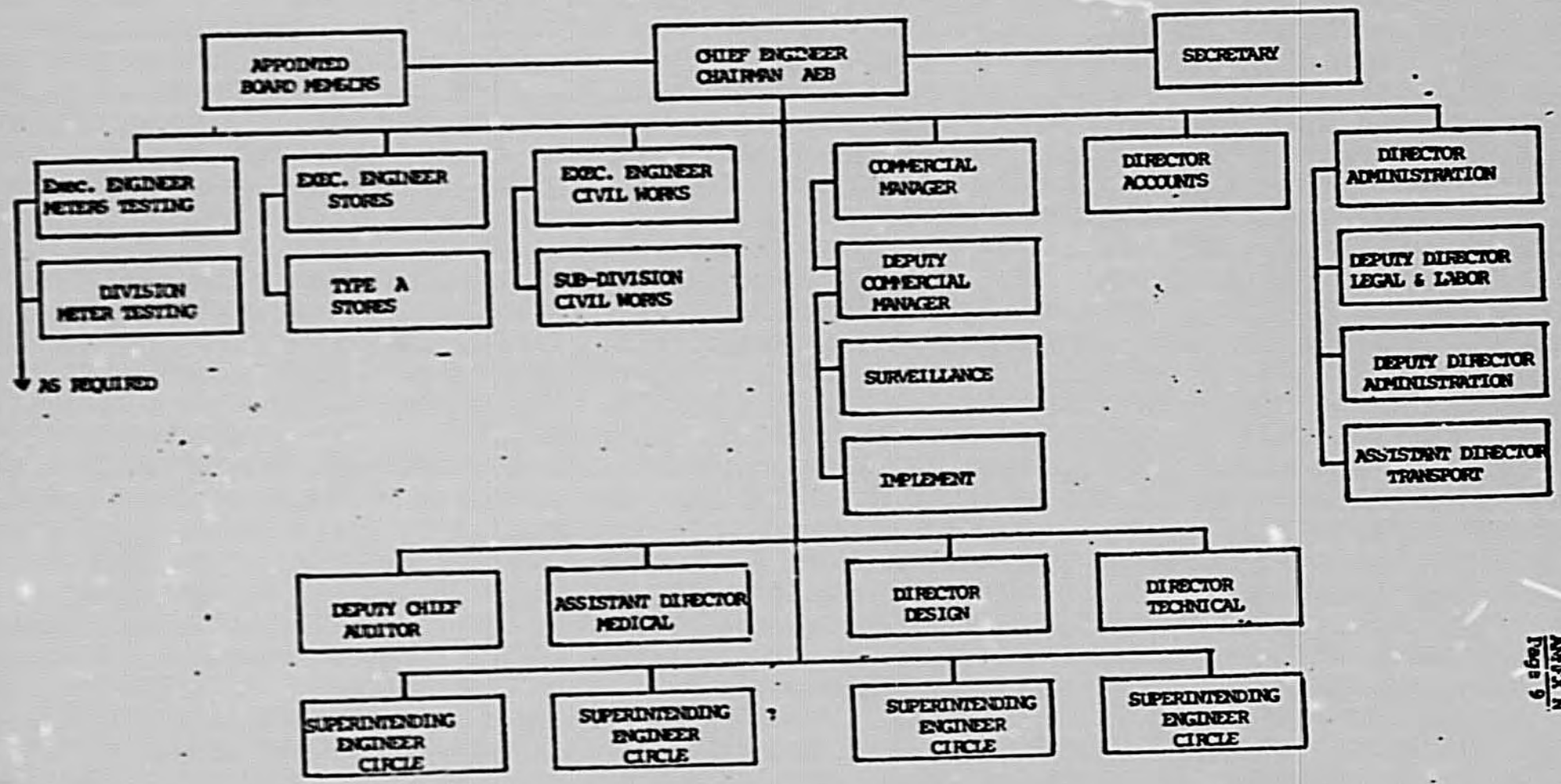
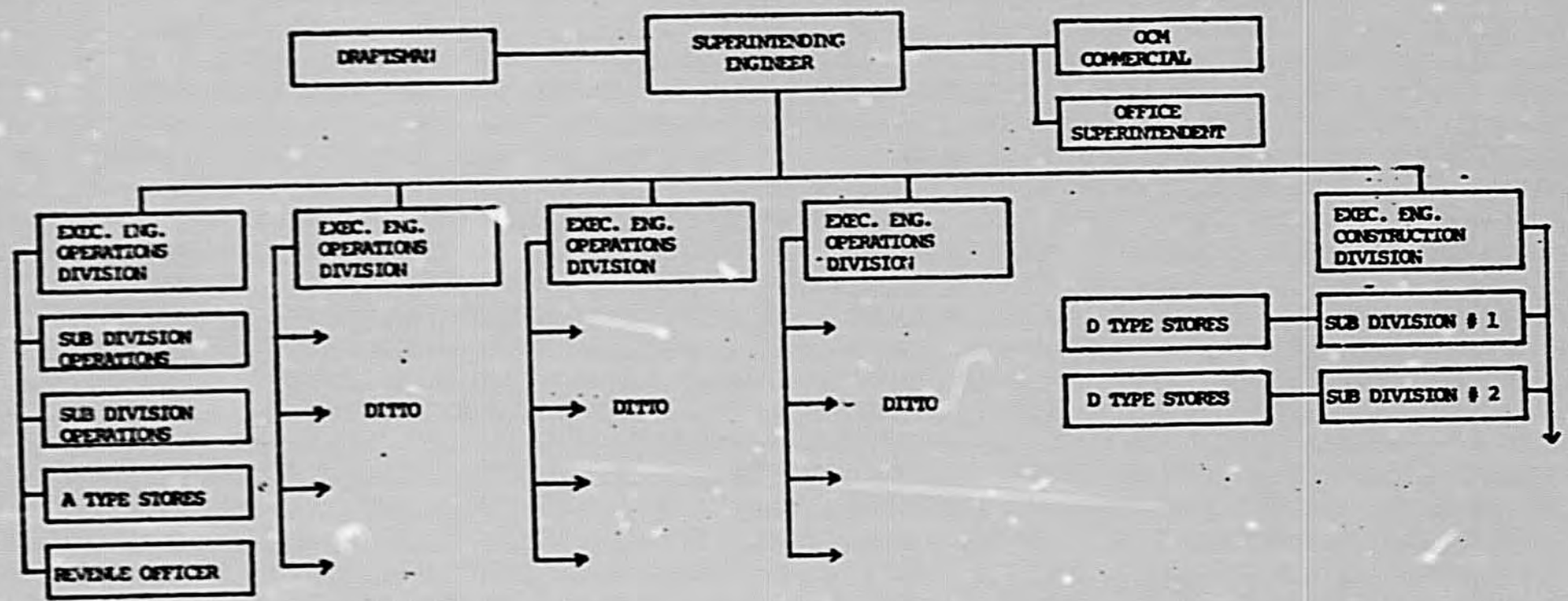


FIGURE N-2

TYPICAL ORGANIZATION OF ONE OF WAPDA'S 27 POWER DISTRIBUTION CIRCLES



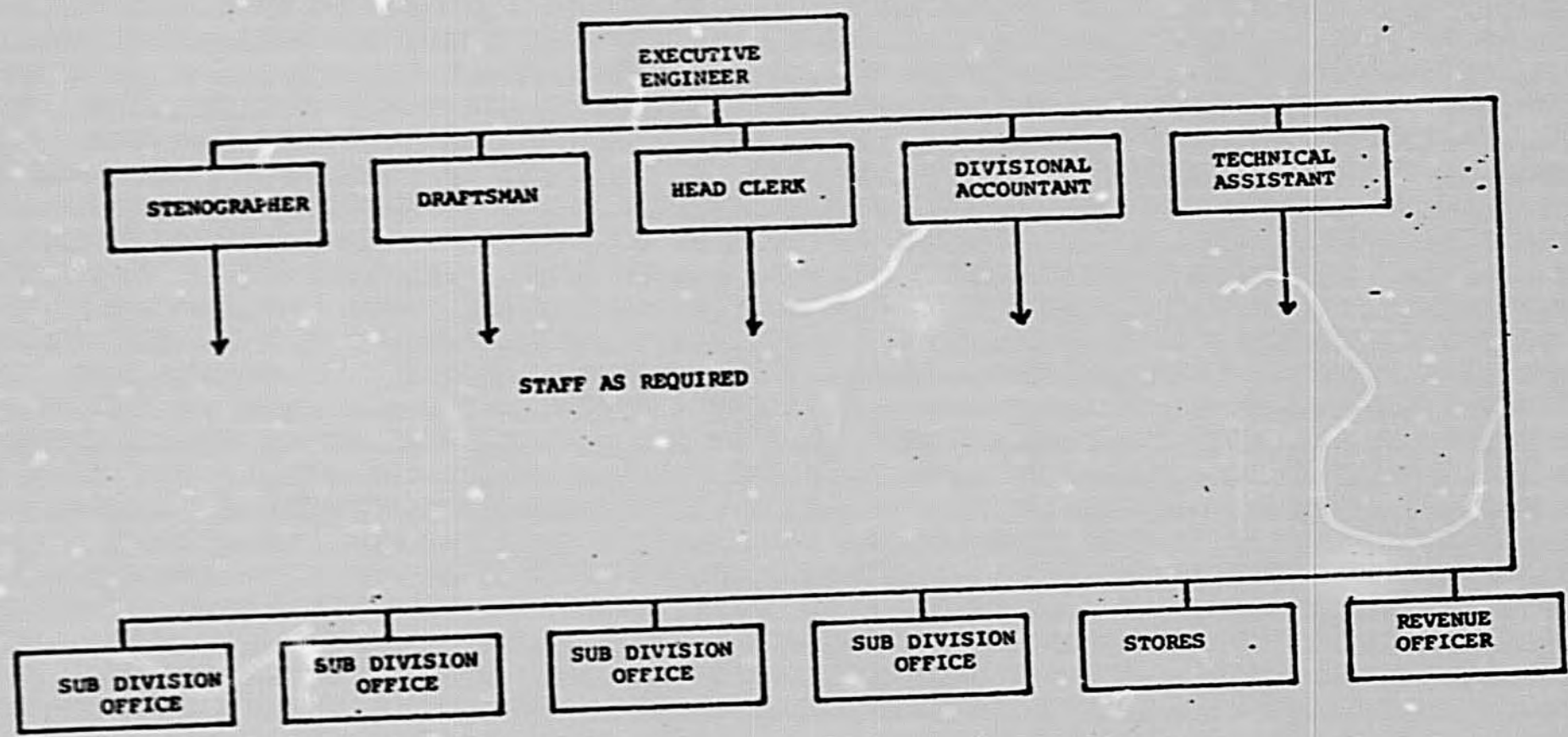
THE NUMBER OF DIVISIONS DEPENDS UPON THE NUMBER OF CUSTOMERS. IDEALLY ONE DIVISION HAS NO MORE THAN 40,000 CUSTOMERS.

A SUB DIVISION OPERATIONS IS RESPONSIBLE FOR SPECIFIC FEEDERS. THE NUMBER OF SUB DIVISIONS OPERATIONS DEPENDS UPON THE SIZE OF THE DIVISION.

THE NUMBER OF CONSTRUCTION DIVISIONS AND SUB DIVISIONS DEPENDS UPON THE LOCATIONS OF THE WORK SITES AND THE WORK LOAD.

FIGURE N-3

TYPICAL ORGANIZATION OF ONE OF WAPDA'S 104 POWER DISTRIBUTION OPERATIONS DIVISIONS

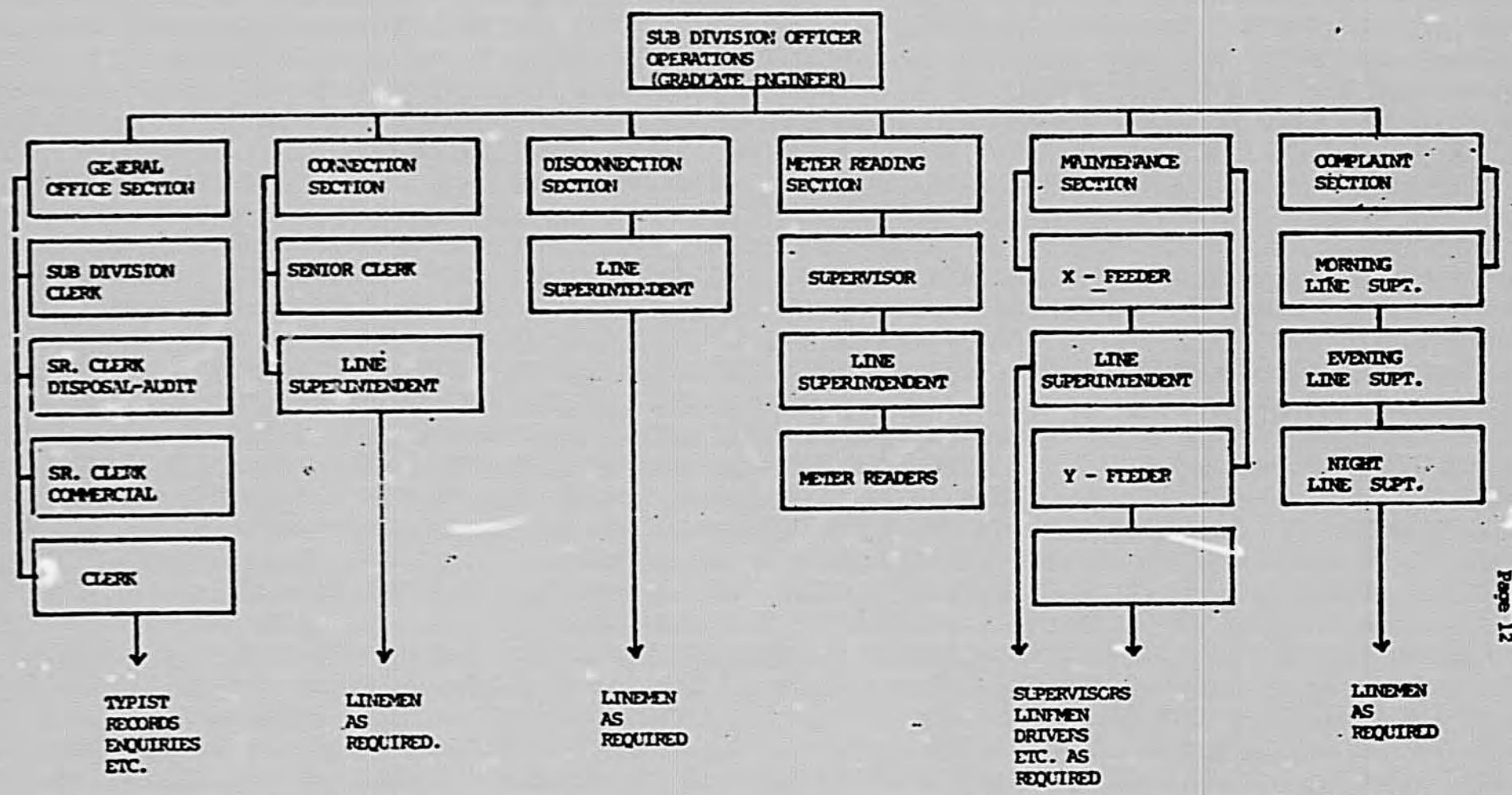


THE NUMBER OF SUB DIVISIONS DEPENDS UPON THE SIZE OF THE DIVISION

ANNEX N
Page 11

FIGURE N-4

TYPICAL ORGANIZATION CHART OF ONE OF WAPDA'S 485 POWER DISTRIBUTION OPERATIONS SUB-DIVISIONS



NUMBER OF FEEDERS DEPENDS ON SIZE OF SUB DIVISION

ANNEX N
Page 12

FIGURE N-5

TYPICAL ORGANIZATION OF A REVENUE OFFICER OFFICE

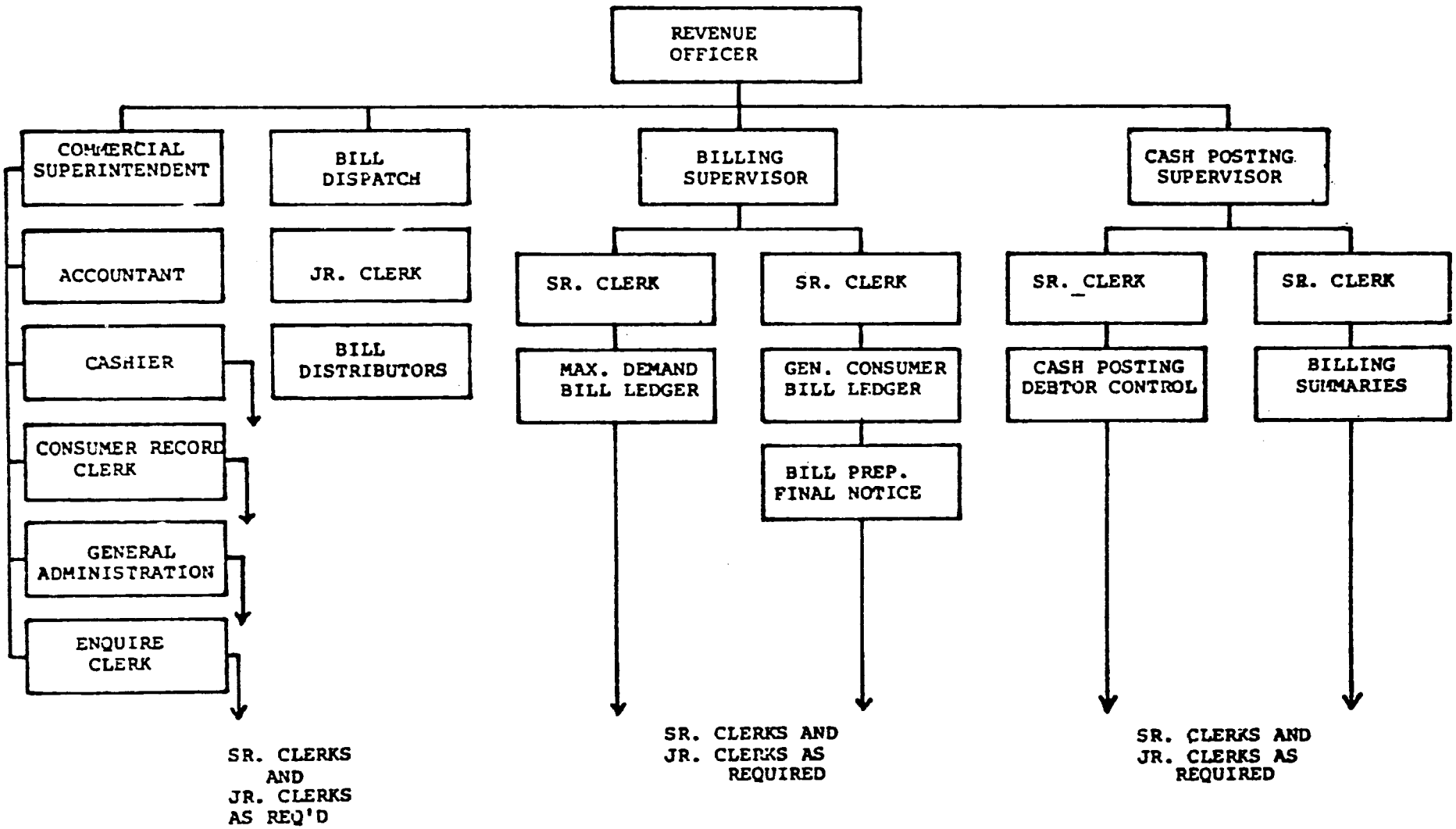
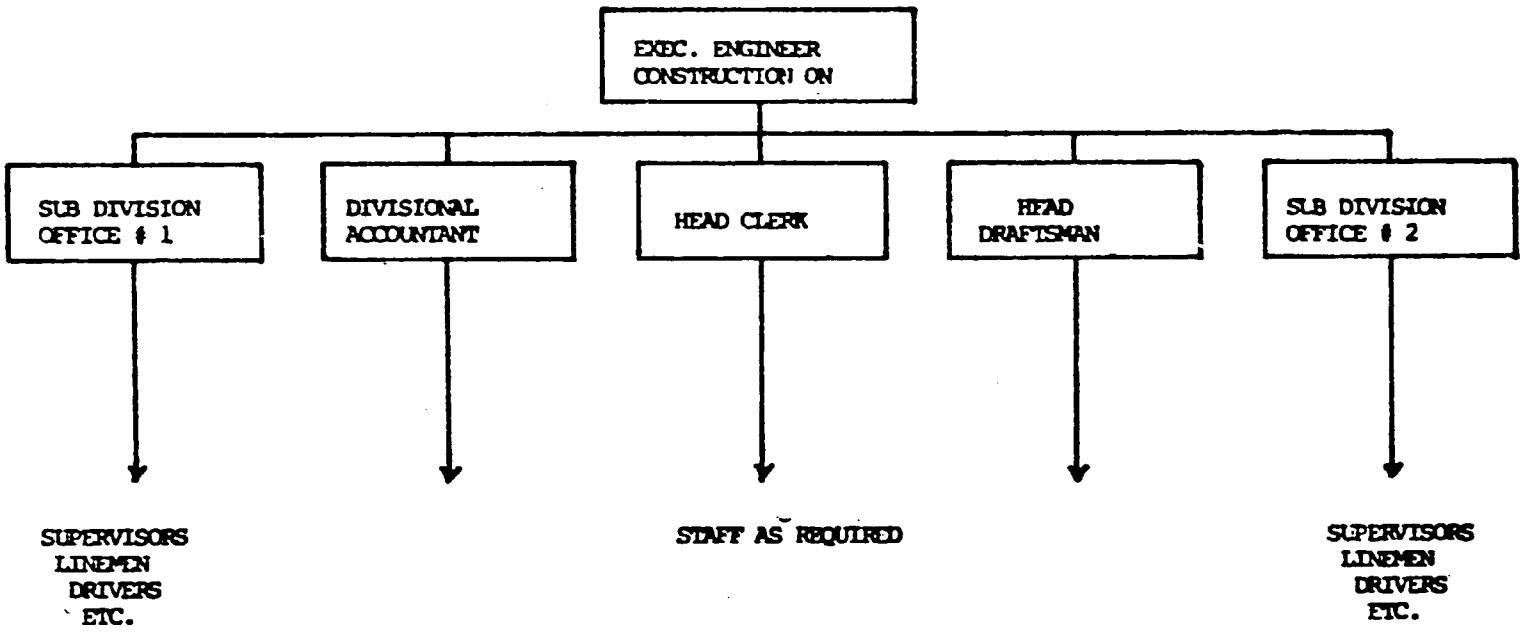


FIGURE N-6

TYPICAL ORGANIZATION CHART OF POWER DISTRIBUTION CONSTRUCTION DIVISION OF WAPDA



THE NUMBER OF CONSTRUCTION SUB DIVISIONS DEPENDS UPON THE SITE LOCATIONS AND THE WORK LOAD.

PROJECT DESIGN TEAM'S ECONOMIC ANALYSIS OF MARCH 1982

1. General Framework

The economic analysis examines the project as conceived to determine likely returns to the economy of Pakistan and compares such returns with those of other projects being financed by the GOP. The analysis treated each of the five components of the project separately and has found them economically competitive and acceptable.

Two of the project components, Institutional Improvement and Training, are " soft " projects where benefits are tangible but extremely difficult to quantify. Therefore, these two components did not undergo a traditional benefit-cost analysis nor a cost-effectiveness analysis. The necessity for these components and their benefits will be discussed in narrative form where in one example, increased staff efficiency and smaller numbers of new employees, resulted in an annual savings of Rs 36 million.

The net benefits of the three remaining components, System Energy Loss Reduction, Gas Turbine Generation, and Rural Electrification Network Expansion, lend themselves to quantification. Each component was subjected to a benefit-cost analysis and for each, the internal economic rate of return (IERR) was calculated. The results of these benefit-cost calculations were subjected to sensitivity analysis to test the vulnerability of assumptions made in carrying out the benefit-cost analysis to possible variations which may develop during project implementation.

2. Methodology

For the Institutional Improvement and Training components, the two components not subjected to benefit quantification, a cost-effectiveness analysis was not made due to resource constraints. Carrying out such an analysis would have entailed: (a) the identification and costing-out of alternative strategies that would achieve the same results; (b) the selection of the least-cost alternative from among strategies considered; and, (c) comparing the economic cost of the least-cost alternative with the cost of these components as now envisioned. Although conceivably such comparisons are possible, given enough time and resources, the variations in results would not have been clear-cut enough to justify the extensive exercises involved. Moreover given the acknowledged WAPDA organizational need plus its on-going operational requirements, scheduling of institutional

modifications and training activities will in actuality yield to the requirements of providing uninterrupted utility services to its consumers.

For the three components subjected to benefit-cost analysis, the traditional methodology of comparing the present values of streams of economic benefits and economic costs, with and without the project, was employed. It was necessary to develop an energy sales forecast and to make a series of assumptions for each component dealing with load and rate of load growth, pricing, etc., in arriving at the stream of economic benefits. These assumptions, including notes explaining the rationale on which they were based, are included in the Economic Analysis Assumptions, Attachment A of this Annex.

A 30-year period was selected for quantifying costs and benefits. No salvage value was assigned to project capital investments at the end of the analysis period. Although the physical plant financed under the project will probably have a value after 30 years, the net present worth would render such remaining value insignificant. However, the salvage value of copper wire recovered from renovated power lines was built into the analysis in the year renovation is expected to occur.

Project economic costs were based on the financial costs of the different project components adjusted (decreased) for duties and taxes. Added to adjusted financial costs were the operational costs of fuel, electric energy, manpower and maintenance. A discussion of these adjustments and their magnitude is included in the Economic Analysis Assumptions (Attachment A). To the extent that the project makes electricity available to the general rural population, there occurs a very large "social soundness" factor. The average standard of living in rural areas will be improved. However, quantification of such benefits in terms of a social discount rate for Pakistan is not attempted. To be as factual as possible, quantifiable benefits were subjected to one primary test of value: the internal economic rate of return (IERR). No benefit-cost ratios or present values of benefits were computed.

The results of the IERR computations were then subjected to sensitivity analysis in order to measure the effect of possible changes in conditions on the results of the analysis. In each case, IERRs were computed under the following three assumptions: (a) overall costs increase by 20 percent over the life of the project without any change

in benefits; (b) benefits decrease by 20 percent over the life of the project without any change in costs; and (c) costs increase by 10 percent with a concurrent decrease of 10 percent in benefits over the life of the project.

3. Shadow Pricing

It was determined that shadow pricing of foreign exchange and local labor cost was not necessary. The foreign exchange rate of the rupee is being adjusted on a continuous basis as directed by market conditions and no other adjustments are deemed necessary. WAPDA will utilize qualified construction contractors to the extent that they receive reasonable competitive prices and meet construction schedule requirements. Due to the limited availability of qualified contractors, it is expected that much distribution line rehabilitation and expansion work will not be undertaken by WAPDA Power Wing Distribution Office crews. The competition for work and utilization of going labor rates should avoid the need for shadow pricing labor costs.

In the Power Generation component, the price of natural gas that will fuel the gas turbines was shadow priced to reflect the international market price. This shadow price was approximately seven times the price being paid for gas at present. Discussions with the ADB staff indicate that the Government of Pakistan is considering raising the cost of gas to approximately U.S. $ 0.75 per million BTU. When this occurs, shadow pricing needs on fuel calculations will be lessened.

4. Project Benefits

a. Institutional Improvement and Training

The benefits that will accrue to the Distribution Organization (DO) of WAPDA and to the economy of Pakistan, as a result of the Institutional Improvement and Training components are tangible but very difficult to quantify. The benefits will be demonstrated by increases in the operating efficiency of the DO, increases in employee productivity and improvements in the quality of employee outputs. However, traditional analysis was not appropriate because these benefits are not marketed and thus do not have a price tag. Furthermore, the benefits which accrue gradually over time are difficult to schedule.

Similarly, rigorous cost-effectiveness analysis was not possible, given time and resource constraints. Nevertheless, it is possible to illustrate the nature and probable magnitude of these benefits as shown in the following illustrative examples.

The first example deals with reducing the large number of employees on the DO's payroll. The DO's workforce has been growing by an average of 4,000 persons per year over the past several years. Streamlining the present workforce, upgrading the skills of employees now on the payroll, and tightening hiring practices so that the increase in new employees is reduced from 4,000 to 2,000 per year would result in substantial savings in the form of reduced salaries and benefits. Such savings are estimated at Rs 36 million ($ 3.3 million) per year and they will continue after the life of the project. Streamlining the workforce further so that the employee to customers served ratio is increased from 1:40 to 1:80 (which would still be about one-fourth comparable ratios in other LDCs) would save Rs 70 million per year.

The second example deals with improvements in administrative practices. At present, the DO's energy losses are in part due to loose administrative controls. Those losses are estimated to be a minimum of 6 percent of all energy sold, giving an annual loss of Rs 36 million. The administrative or non-technical losses are attributed to meter tampering, pilferage, lack of follow-up of outstanding accounts and simply failure to bill consumers for energy used. The improvement in administrative control could cut these losses by half with a savings of Rs 18 million per year. The elimination of all pilferage would result in a savings of Rs 36 million per year.

These are two of many examples. There are numerous other scenarios and combinations of possible improvements. There is no doubt that the Training and Institutional Improvement components will result in substantial time savings in carrying out the power distribution functions, that resources will be better utilized and that additional cost savings will be realized which will far exceed the cost of these two components.

More importantly, the implementation of the Institutional Improvement and Training components will assist in bringing about basic changes of attitude of the DO's management and employees over the long-term. A change of management attitude and policy to insist on new employees being literate and to the extent possible basically qualified, is crucial to the DO becoming an efficient and responsive electric utility organization. Perhaps the

best conceptual measure of the benefits that will result from these two components is the implication of not undertaking them; the energy losses will grow instead of diminish.

b. Distribution System Energy Loss Reduction

The benefits of this component derive from the value of the energy saved by decreasing the magnitude of energy lost between the generating plant and the end user. This project component will address only the energy loss reduction in the distribution part of the power system. For the WAPDA projected 3 percent energy loss reduction (from 18 percent to 15 percent over a three year period), the annual energy saving is estimated at about 500,000,000 kilowatt-hours by the time the project is completed. The energy thus recovered is equivalent to the production from a 170 MW unit operating 8 hours a day, 365 days a year.

Thus, the return on investment for this component is high. The IERR was computed at 70 percent. The returns remained high under sensitivity analysis assumptions. A reduction in project benefits of 20 percent left an IERR of over 50 percent. This is partly due to the relatively small investments required to reduce losses a few percentage points. Because of the great magnitude of power involved, a small increase in power system efficiency yields high returns.

Additional benefits of this component may lie in changing WAPDA's attitude toward distribution system maintenance and rehabilitation. Once WAPDA recognizes the value of energy loss reduction, it should not only maintain the rehabilitated system in order to continue realizing these savings, but also work to further reduce losses and recover more of the currently wasted energy. This component is a good example of what appropriate technology transfer and institutional development can bring in the form of large savings.

c. Gas Turbine Generation

The analysis of this component is not possible with proposed A.I.D. inputs alone. The A.I.D. financed gas turbine and associated equipment will be incorporated into a combined cycle gas turbine generation plant. This plant will include a 60 kilometer gas supply pipeline, 4 gas turbine driven generators plus 4 exhaust gas heat

recovery boilers and 2 steam turbine generators and supporting switchyard equipment. While it is anticipated that A.I.D. financing will cover only a portion of the equipment listed above, an integrated analysis is made considering the plant as a whole. Inputs by others (WAPDA, Japan, Asian Development Bank) were introduced into the cost side of the analysis in the years they are scheduled to occur without respect to source. The only direct benefits considered for this component are those revenues collected from the sale of energy generated by the overall combined cycle plant. Those benefits alone proved substantial, yielding an IERR of 16 percent using conservative assumptions. This return proved sensitive to decreases in project benefits. A reduction in benefits of 20 percent reduced the IERR to 10 percent . An increase in project costs of 20 percent reduced the IERR to about 11 percent.

However, the combined cycle plant benefits exceed those computed when the current generation shortfall in Pakistan is considered. As stated earlier, this generation shortfall amounts to about 15 percent of all power demand during peak load hours. The shortfall is the result of low water levels in the reservoirs supporting the hydro power plants from February through June of each year and the reduced hydro generation capacity plus necessary derating of older thermal power units and a slow generation installation program due to financial constraints. The combined cycle plant, using the poorer quality indigenous natural gas as fuel, will help meet the generation shortfall in the most expeditious way possible. Thus, it will help mitigate the need for load-shedding and black-outs during peak load hours. There is little question that the value of electric power is very high for those consumers who reside or who have businesses in areas frequently blacked-out. Given a choice, these consumers are willing to pay a much higher price for power during peak load hours to avoid "black-outs". The price these consumers would be willing to pay exceeds that which they would have to pay for substitute power if it were available. The cost of substitute power (either kerosene for lighting or diesel fuel for electricity and/or motive power) is three to five times the price of WAPDA electric power. Therefore, the benefit that will result from this component is substantially understated. (In World Bank terms, this understatement of benefits is the "Surplus Economic Benefits" which can be credited to a project.)

d. Rural Electrification Network Expansion

This component will yield substantial benefits to rural inhabitants in project areas. These benefits include an improved standard of living, increased irrigation and agricultural productivity, additional commercial activities, and expanded agro -based industries.

The most immediate benefit is improved lighting. It is estimated that over 230,000 rural families and community centers (mosques, schools, etc.) and about 25,000 commercial establishments will switch from kerosene lanterns to electric power for lighting as a result of the project. The rural residential or commercial consumer making the change to electricity will realize sizeable savings in fuel costs. The cost of the equivalent of one kilowatt-hour of lighting by kerosene lanterns is estimated at Rs 4.45 as compared with Rs. 0.80 for one kilowatt-hour of lighting with electricity. For the average rural electric connection, the kerosene costs avoided represent a savings of about Rs 560 per year. For the average commercial establishment, this savings will be about Rs 1000 per year. The switch to electricity will result in an improved quality of life due to a more versatile form of lighting and a much safer environment with a marked reduction of fires in buildings and homes.

Another benefit gained from changing to electricity will be increased productivity from motive power installations. At present, the most prevalent source of energy for motive power in project areas, aside from draft animals, is diesel-powered engines. Diesel engines are used in all types of commercial and industrial activities and for irrigation where electricity is not available. Diesel engines require a relatively high initial investment and are costly to maintain and expensive to operate due to the high cost of diesel fuel. On the other hand, electric motors cost about 20 percent of the price of diesel engines of the same capacity, are relatively maintenance-free, and cost much less to operate. It is estimated that consumers switching from diesel driven equipment to electric motors will cut their plant investment and their operation and maintenance costs by two-thirds. Therefore, it is projected that during the first five years of the project, approximately 2,200 industrial concerns and 4,200 irrigation tubewell owners will install electric motors. Such installations, whether being conversions from diesel engine driven pumps or new electric

powered pumps, will each contribute to the improvement of Pakistan's economy by reduction of kerosene imports and the accompanying savings of foreign exchange. Rural electrification will bring about the large savings in fuel, equipment and operation and maintenance costs for residential, commercial, industrial and irrigation energy users. These savings account for about 70 percent of the direct benefits realized from this component. The benefits to the economy of Pakistan are reflected in the amounts of money thus saved by the rural population, by the country's reduced dependence on imports(kerosene, diesel and lube oil) and by utilization of indigenous forms of energy such as hydropower, natural gas and coal. The change to indigenous fuels brings a large indirect benefit through creation of many industries and employment opportunities. The profit that WAPDA realizes from the increased sales are considered direct benefits to the economy. It is estimated that this direct benefit accounts for about 30 percent of all the benefits which will accrue to the economy of Pakistan as a result of this component of the project.

The benefit-cost analysis for this component yielded an IERR of 23 percent. World Bank literature correctly suggests that due to the large but unquantifiable social benefits of rural electrification, projects with yields somewhat below the opportunity cost of capital may still be worth undertaking. This, however, is not the case here since the direct economic benefits provide yields equal to or greater than the opportunity cost of capital.

When subjected to sensitivity analysis, the economic yields proved relatively firm. An increase in project costs by 20 percent lowered the IERR to 19 percent whereas a decrease in benefits by 20 percent lowered it to 17 percent. A third sensitivity assumption, where costs were increased by 10 percent and benefits decreased by 10 percent, reduced the IERR to 18 percent. Thus, the sensitivity analysis suggests that the economic returns of this component are slightly more sensitive to decreases in benefits than to increases in costs. More importantly, the sensitivity analysis suggests that this project will yield acceptable economic returns even if unforeseen events cause sizeable changes in the benefits, costs or both.

In addition to the quantifiable benefits mentioned above, electric energy consumers will be provided access to new products and conveniences. The most important of these will be access to electric fans which are locally

manufactured and widely used to ease the summer heat where electricity is available. Refrigeration, television and other conveniences will also be accessible for the first time to many rural inhabitants once the electric service is installed.

For the commercial, industrial and irrigation consumers, availability of reliable electric power will provide an impetus for change from traditional methods and techniques in areas where the high cost of diesel has heretofore inhibited investments in tubewells, commerce and industries. With the introduction of electricity, it is expected that many new commercial activities will spring up and existing ones will improve and expand.

5. Conclusions

Based on the above analyses, the project appears economically feasible and should be undertaken. In fact, additional benefits, not reflected in this analysis, will accrue to the economy of Pakistan due to complementarity of the five components to each other and because of their synergistic effects on all aspects of rural life.

The analysis demonstrates that the Institutional Improvement and Training components, which were not subjected to benefit-cost nor cost-effectiveness analyses, will yield relatively high levels of tangible economic benefits. Accordingly, these two components should be undertaken. They are sound and timely, and as noted, they are complementary to the other A.I.D. assisted components. In the complementary role, they are absolutely essential due to the importance of creating an organizational environment conducive to new attitudes and business practices so necessary for the success of the other three components.

Components 3, 4 and 5 were subjected to benefit-cost analyses and yielded relatively high economic rates of return. The results of each analysis, including changes in economic returns when subjected to sensitivity analysis, are summarized in the following table:

Internal Economic Rate of Return

Component Condition	Energy Loss Reduction	Power Generation	Rural Distribution Network Expansion
Base Analysis	70%	16%	23%
Costs Increase 20%	58%	11%	19%
Benefits Decrease 20%	55%	10%	17%
Costs Increase and Benefits Decrease 10%	57%	11%	18%

A review of recent IBRD and ADB financed energy-related projects in Pakistan shows that IERR's of 12-15 percent were considered acceptable. The IERR's of components 3, 4 and 5, when considered together, was 22 percent. Thus, these three components, considered individually or together, provide economic returns that compare very favorably with other recent investments in this sector.

The sensitivity analysis indicates that the economic returns which will derive from this project are relatively firm even if assumptions made in carrying out the basic analysis were optimistic. Although the IERR's proved sensitive to increases in cost, and more sensitive to decreases in benefits than to cost increases, the level of benefits remained high and compares favorably with IERRs of other investments.

In sum, the economic analysis indicated that this project as envisioned is a sound investment and that it should be undertaken.

PROJECT DESIGN TEAM'S ECONOMIC ANALYSIS ASSUMPTIONS OF MARCH 1982

A. Energy Loss Reduction Component

1. Economic Costs

WAPDA has indicated that the taxes and duties shown below are imposed on equipment used in expanding the rural distribution network. For the purpose of this analysis, only the principal imported items are considered, namely, transformers, conductors and meters. A weighted average for the taxes and duties that will be charged these materials is as follows:

Type of Equipment	Taxes/Duties	Percent of Material Cost	Weighted Total
	%	%	
Transformers	18	5	90
Conductors(all types)	35	21	735
Meters	37	27	999
Non-Taxed Materials	0	47	0
Totals:		100	1,824

Thus, the weighted average of taxes and duties in relation to projects costs is approximately 20 percent. This percentage was adjusted to 16.28 percent after making an allowance for some of the contingency factor which has been included in the financial costs.

The economic cost of materials used in components 3 and 5 was derived by taking 83.72 percent of the financial costs.

2. Annual Distribution of Costs

For the purpose of all economic analyses, it was assumed that project costs will be incurred as follows: 5 percent during the first project year, 20 percent for the second, and 25 percent for each of the last three years. Benefits that derive from these costs were assumed to lag by one year. In other words, it was assumed that it takes one year on average for benefits to begin to accrue from the time costs are incurred. Tables for component 3 as well as other component costs, reflect this 5-20-25-25-25 ratio and a lag of one year in benefit accrual.

3. Projected Load Growth

The consumption growth of WAPDA's different classes of consumers is as follows:

Type Consumer	Total Consumption PFY 1979/80 MWH	Growth Trend
Residential	1,819	13%
Commercial	389	8%
Industrial	3,154	5%
Tubewells	2,356	7%
Total:	7,718	7.6%

Weighted Average=(8% rounded off

Total consumption was assumed to grow at 8 percent per year starting in PFY 1979/80.

4. Revenues from Recovered Energy

There were two possible approaches for forecasting the monetary value of recovered energy. One approach was to calculate the cost incurred by WAPDA in producing the energy (Rs 0.334/KWh), and the second approach was to calculate the amount of revenue that WAPDA now foregoes due to incurring these losses. It was decided to adopt the latter approach since WAPDA suffers a generation shortfall and can sell all the energy it produces.

5. Life of the Rehabilitated System

It is reasonable to assume that once loss reduction capability is demonstrated and WAPDA recognizes the value of such loss reduction, that it will not only maintain the rehabilitated system in order to continue realizing these savings, but will also work to further reduce losses. In order to present a conservative analysis, it was assumed that loss reduction would be maintained at 3 percent for four years following completion. After that, it was assumed that the loss reduction would begin to decrease from year to year at a compounded rate of 5 percent.

B. Power Generation Component

1. Analysis of Entire Combined Cycle Plant

It was not practical to conduct a cost-benefit analysis of the four gas turbines alone. Therefore, the combined cycle plant was considered as a whole integrated unit. Cost estimates were obtained from the feasibility study conducted by NESPAK in January 1982, titled "450 MW Combined Cycle Plant at Guddu"

2. Economic Costs

Economic costs were derived primarily from the NESPAK study. In that study, NESPAK developed detailed cost estimates

of all project costs, including separate line items for import duties, taxes and interest during construction. Approximately 32 percent of all costs were considered transfer payments. Thus, the economic costs of the combined cycle plant were developed by reducing NESPAK financial estimates of costs by 32 percent.

3. Distribution of Funds over Project Years

Capital investments were applied as indicated in the estimated costs of D.J. Christofersen's report. The approximate attribution was 32,33,18,15 and 2 percent over the five-year life of the project.

4. Shadow Pricing of Natural Gas

The current price of natural gas to fuel the combined cycle plant was estimated by NESPAK at Rs 1.85/Million BTU. This natural gas is supposed to be supplied from the Mari gas field with the gas having a heat value of 723 BTU per cubic feet. The price of Mari gas was estimated by NESPAK at Rs 1.33 per 1000 cubic feet. This price is considered unrealistically low. In conversations with GOP and gas company officials, the team concluded that the price will be adjusted upwards in the near future to conserve Pakistan's natural gas resources. The price of 11 Rs/M BTU was mentioned, which the team thought was still low by international standards. Thus the team recommended and this evaluation uses a fuel cost of Rs 13.2 per million BTUs or a price approximately seven times what is now being charged. (WAPDA in a communication of July 1, 1982, advised that it expects to pay Rs 7.72 per 1000 cubic feet, equivalent to Rs 10.67/million BTU, in 1985, the first year of plant operation plus an annual escalation of 10 percent).

The price of natural gas is normally tied to the heat energy a particular gas releases and not to its volume. For example, the Mari gas field has a high nitrogen content (19.5 percent) and its heat value is estimated at 723 BTU/ft^3. The Sui gas by contrast has a heat value of 933 BTU/ft^3, or 29 percent more energy per cubic foot than the Mari field gas. All other things being equal, the price of Sui gas should be at least 29 percent higher than Mari gas.

5. Benefits

Direct benefits only were considered, i.e. net income from sale of generated energy. In computing these benefits, it was assumed that: (a) the gas turbine will begin to yield revenues in two years or during year one in the analysis; (b) annual operation and maintenance costs were assumed at 1 percent of the economic costs; (c) system energy losses between the power plant and the end-user will be as at present, 31.5 percent; (d) all WAPDA consumers will share in energy use

consistent with their historic utilization; and, (e) energy was assumed to be sold at an average of Rs 0.54 per KWh. These assumptions are on the conservative side. It is likely that a 3 percent reduction in current losses will be realized by the time the combined cycle plant is completed. Thus, energy losses in PFY 1985/86 may be reduced to 28.5 percent.

C. Rural Distribution System Expansion Component

1. Economic Costs

Materials to be used in this component as in component 3, include conductors, transformers, meters, capacitors, connectors and voltage regulators and accessories. No data were available on taxes and duties on capacitors and voltage regulators. In computing the economic costs of this component, a discount of 16.28 percent was assumed to cover average import duties, taxes, etc. Therefore, a factor of 83.72 percent was applied to financial costs to arrive at economic costs.

2. Distribution of Costs

The economic costs were assumed to be disbursed over the five year life of the project as follows: 10, 25, 25, 20, and 20 percent.

3. Description of Energy Use

There are several general consumer groups to whom WAPDA currently provides service. These include domestic, commercial, industrial and tubewell, community (including street lights), government entities and bulk service to a few very large users. For the purpose of this analysis, all of the above were placed into five groups: domestic, community, commercial, tubewells and industrial. It was assumed that the number of community connections (schools, mosques etc.) will comprise less than 5 percent of all connections and will be quite similar in their consumption patterns to domestic consumers. Therefore, these two consumer groups, domestic and community, are combined for the purpose of this analysis.

The per service energy use quantities assumed at the beginning of the project were based on actual consumption data for the different provinces as obtained from WAPDA's records for PFY 1979/80. Such data were straightforward for commercial, industrial and tubewell consumers, but were not so clear for domestic consumers because urban and rural consumption figures were not separated.

The degree of variation in annual energy consumption from province to province for the domestic/community category is as follows:

	PFY 1979/80 KWh per Service Connections
Punjab	755
Sind	920
NWFP	700
Baluchistan	674

From this, a weighted annual average energy use of 762 KWh was determined for PFY 1979/80. For use in the economic evaluation, a conservative figure (approximately 50 percent of the 762 KWh) of 330 KWh per year per service was used for the rural services to be connected. This is the equivalent of each domestic and community service using daily 5 light bulbs of 60 watts for three hours -- neglecting any hot plates, fans, refrigerators, etc.

For commercial consumers, the weighted average of annual energy use for PFY 1979/80 was found to be 817 KWh/Year. Again, to adjust for the rural setting, 600 KWh/year was used for PFY 1979/80 (approximately 75 percent of the national average). For industrial consumers, the PFY 1979/80 weighted average energy use was 31,000 KWh/year. However, an annual consumption of 22,000 KWh/connection was adopted. This value is equivalent to one 10 HP motor (7.5 KW) running 8 hours per day, 365 days a year. Finally, for tubewell consumers, the PFY 1979/80 weighted average was 24,300 KWh/consumer. A value of 20,000 KWh/consumer, or a 10 HP motor (7.5 KW) running 8 hours a day for 11 months (335 days) a year was adopted. It is recognized that many tubewells may be larger in capacity and operate 16 to 20 hours per day during seasons of peak water demand, but for purposes of this analysis, the 20,000 KWh per year per service was used.

4. Growth of Energy Use Per Connection

Growth trends in power consumption by the different groups were based on a study of WAPDA's records over the last five-year period. The data were not consistent, showing annual growth rates of over 50 percent at times and showing a minor decrease in average consumption from year to year at other times. Nevertheless, a weighted average annual growth was computed per consumer group. The results were

13 percent, 8 percent, 5 percent, and 7 percent compounded annual growth rates for domestic, commercial, industrial and tubewell consumers, respectively. The following growth rates were adopted based on these values and adjusting for the rural setting:

Domestic/Community	: 11 percent compounded years 1-6; 7 percent compounded thereafter
Commercial	: 8 percent compounded annually
Industrial	: 5 percent compounded annually
Tubewells	: 4 percent compounded annually

These growth rates are believed to be very conservative. The World Bank estimates that rural energy consumption is growing at between 10-20 percent per year. For comparison, India has a growth rate of 15 percent according to the World Bank.

5. Electric Rates

Electric service rates were based on WAPDA's average rates charged consumers during the month of December 1981. These rates per kilowatt-hour were: 40 paisa for domestic, 104.21 paisas for commercial, 64.25 paisas for industrial and 35.86 paisas for private tubewells. (The average cost of WAPDA's electric power was calculated and checked by WAPDA's economic division to be 33.4 paisas per kilowatt-hour for the month of December 1981.) These rates were used in the analysis to compute revenues. It should be noted that at the urging of the World Bank and the Asian Development Bank, electric rates have been increased by WAPDA at a higher rate (33 percent in 1980 and 53 percent in 1981) than production cost increases. Recently, the Asian Development Bank assumed a compounded 10 percent growth in electric rates in analyzing its Rural Electrification project. However, in this analysis, no differential growth was assumed of rates (revenues) over costs i.e. the team assumed that WAPDA's costs of delivering electricity to consumers and the rates charged consumers would grow at the same rate.

6. Household Economic Benefits

It was assumed that all residential consumers connected during the life of the project will switch from kerosene to electric power for lighting. The 14 feasibility

studies conducted by local consultants for WAPDA between 1977-1980 with A.I.D. financing indicated that kerosene lanterns were used almost exclusively to provide light in non-electrified villages in all provinces. These studies also indicated that, on average, each rural household owned and operated 1.5 locally manufactured lanterns of varying sizes and that these lanterns were used for about 3.5 hours a day during the evening hours. Data included in these feasibility studies also indicated that one liter of kerosene would be enough to fuel a lantern for about six hours.

For the purpose of analysis, it was assumed that each household will use one lantern only for lighting for 3.5 hours each night. It was also estimated that the lantern would be large enough to provide lighting of a quality equivalent to two 60-watt light-bulbs. Economic benefits for household consumers were based on the annual costs as shown on the next page.

7. Economic Benefits of Commercial Consumers

The economic benefits that will accrue to the consumer group derive from switching from kerosene to electric lighting and from diesel-operated engines for refrigeration and commercial loads to electric-powered motors. Because of the relatively small number of commercial consumers in the case of lighting and the small electric load to service motive power requirements, it is anticipated that such services will not consume more than 5 percent of the power sold in rural areas.

8. Economic Benefits of Tubewell and Industrial Consumers

Of the total number of tubewells and industries under the project, it was assumed that 50 percent of existing diesel engines will switch to electric power when it becomes available. It was also assumed that the remaining 50 percent will switch during the life of the project. Thus, the benefits will be derived from reduced fuel and maintenance costs by switching to electric motors and from the possible eventual sale of used diesel engines replaced by electric motors. For new tubewell installations, the economic benefits will derive from lower investment costs in purchasing an electric motor instead of diesel engine in the first place, as well as reduced running costs over the life of the tubewell.

WITHOUT PROJECT
USING KEROSENE LANTERN

Lantern

Cost : Rs 35
Life : 4 years
Annual cost : Rs 8.75

Glass Chimney

Cost : Rs 3.50
Life : 2 months
Annual cost : Rs 21.0

Wick

Life : one month
Annual cost : Rs 3.6

Other

Travel, matches, etc.
Annual cost : Rs 10.0

SUB-TOTALS : Rs 43.35

Fuel

Use 3.5 hrs/day, 365 days/year
Consumption 213 liters/year
Economic cost/Liter Rs 3.00
Annual fuel cost: Rs 539

TOTAL ANNUAL COST: Rs 682.35

WITH PROJECT
USING TWO 60 WATT LIGHT BULBS

Two 60-Watt Light Bulbs

Cost per bulb Rs 7.00
Life : 5 months (540 hours)
Annual cost : Rs 33.6

Meter Rent

Rent per year :Rs.18.0
75% assigned to lighting
Annual cost : Rs 13.5

Housewiring

Total cost : Rs 400
Life : 20 years
75% assigned to lighting
Annual cost : Rs 15.0

Rs 62.1

Electricity

Use 3.5 hrs/day, 365 days/year
Consumption : 153 KWh/year
Unit cost : Rs 0.40
Annual electricity cost Rs 61.32

TOTAL ANNUAL COST Rs 123.42

For 1 lantern per household

Savings= 682.35 - 123.42 = 558.93 Rs /household/year

For 1.5 lanterns per household

Savings= 1,023.525 - 123.42= 900.105 (Use Rs 900)

The current distribution of diesel motors by size as shown in "Agriculture of Pakistan, 1980" statistics throughout Pakistan is thus: 85 percent 10-12 HP; 12 percent 15 HP; and 2 percent 25 HP. Project tubewells were assumed to consist of 12 HP diesel motors only to simplify computations. The following data were collected on these three types of motors, all low-speed diesel engines:

		10-12 HP	15 HP	25 HP
Cost (in Rs)	:	18,000	22,000	37,000
Average Use Per Day	:	8 hours	8 hours	8 hours
Consumption Per Hour	:			
Diesel	:	2.4 liters	3.0 liters	5.0 liters
Motor Oil	:	0.19 "	0.25 "	0.38 "
Maintenance Cost Per Hour Operation	:	Rs 0.92	Rs 1.61	Rs 1.90

Additionally, data were collected on the prices of diesel and motor oil which these engines consume. Without exception, the diesel engines in rural areas use low-speed diesel (LSD). LSD sells at the distributor for Rs 2.75/liter, which includes Rs 0.04 in excise taxes. The economic price of LSD is then Rs 2.71. A 5 percent surcharge was added to reflect delivery to the point of use. (No profit was added because, unlike kerosene, diesel is used by relatively larger operations that preclude a middleman at the village level). Thus, the economic price of LSD was considered Rs 2.85 per liter. The price of motor oil was quoted at Rs 10.45/liter, free of taxes.

Data were also collected on the price of electric motors. A market survey considered four different sizes from four different manufacturers. Based on this survey 10 HP, 15 HP, and 25 HP were found to cost Rs 3,600, 4,600 and 7,500, respectively. Finally, because of the demand for diesel motors in non-electrified areas, the average price of used diesel engines was estimated at 45 percent of its original values. Based on these data, the following computations were derived:

Tubewells

Without Project	With Project
Diesel - 12 HP	Electric - 10 HP
Investment Costs	Investment Costs
Cost: Rs 18,000	Cost : Rs 3,600
Life: 30 years	Life : 30 years
Annual cost : 600 Rs	Annual cost Rs 120
Operator/Maintenance costs	Maintenance Costs
Cost per hour operation Rs 0.92	50% of cost over 30 year life
per year (8 hrs x 335 days) (11 months) = Rs 2,466	Annual cost Rs 60
Energy	Energy
Use 8 hrs/day	Use 8 hrs/day
Consumption 2.4 liter/hr of diesel or 6432 liters diesel/year	10 HP uses 7.5 KW
Consumption 0.19 liter/hr of oil or 509 liters motor oil/year	Total use (8 hrs, 335 days or 11 months) 20,100 KWh
Costs : diesel Rs 2.85/liter, Oil Rs 10.45	Costs : 0.359 Rupees/KWh
Annual fuel cost = Rs 23,650	Annual cost Rs 7,216
Total Investment, Maintenance and operation costs per year Rs 26,716	Total investment, Maintenance and Operation costs/year Rs 7,396

Savings = Rs 26,716 - 7,396 = Rs 19,320/Unit/Year

Industrial Consumers

Diesel 12 HP - Without Project		Electric 10 HP- With Project	
Investment cost			
Same as tubewells	Rs 600		Rs 120
Maintenance Cost			
8 hrs/day, 365 days/year: 92 x 8 x 365 =	Rs 2686	Same as tubewells	Rs 60
Energy		Energy	
8 hours/day, 365 days/year:		8 x 365 x 7.5KW= 21,900 KWH	
Diesel: 2.4 x 8 x 365= 7008 liters		Cost 0.643 Rs /KWH	
Oil : 0.19x8x365 =555 Liters			
Annual fuel cost : 2.85 (7008)		Annual cost:0.643x21,000=Rs 14,082	
10.45 (555) = Rs 29,056			
TOTALS:	Rs 32,342		Rs 14,262

Savings : 32,342 - 14,262 = Rs 18,080/per unit/year

Industrial and Tubewell Consumers:

Salvage value of diesel motors: .45 x 18,000 = Rs 8,100/unit

Tubewells : Number to be connected 4,218 ≅ 4220

Old, with diesel engines = 2,110

New using electric motors = 2,110

Industrial: Total 2259 ≅ 2260

Old 1130

New 1130

PROJECT DESIGN TEAM'S RURAL DISTRIBUTION SYSTEM EXPANSION SUB-PROJECT MODEL

1. General

Approximately 250 sub-projects costing an average of about $ 400,000 each will be implemented under the Rural Distribution System Expansion component of the project. Each sub-project will cover the electrification of several new villages plus additional connections in nearby already electrified villages. Sub-projects will be selected on the basis of screening criteria that identify the potential load and also take into account the accessibility of the sub-project area or areas to the national electric grid. Also built in the screening criteria will be other factors such as the availability of infrastructure, social considerations and economic return. The screening criteria will rule out sub-projects in areas where narcotics activities, i.e., growing of poppies or processing of opium poppies into heroin, are occurring. These sub-project areas may already be partly electrified with varying degrees of saturation (the percentage of consumers receiving service within an area) or may be without electric service. The screening criteria will be used to determine the most likely candidate areas and identify them for further study.

2. Screening Criteria

The screening criteria are based on several easily visible, objectively identifiable indicators. These indicators are given different weight points, the sum of which gives a relatively accurate picture of the overall standing of the particular sub-project vis-a-vis other areas to be electrified. These screening criteria are outlined below:

AID-Assisted Electrification Project - Pakistan

Illustrative Sub-Project Screening Criteria

A. First Stage Screening

a. Narcotics activity within sub-project area? (If yes, project does not qualify) — YES/NO

b. Distance from 11KV feeder within limits? (Limits: Punjab no more than 2 miles/village, Sind and NWFP no more than 3.4 miles/village, Baluchistan no more than 6 miles/village) — YES/NO

(If no, area is questionable, careful second stage screening required).

B. Second Stage Screening

Classification	(Maximum point Sample Calculation based on the Model Sub-Project Areas)				
Consumers	Point Count	Punjab	Sind	NWFP	Baluchistan
Domestic Community Services (per 1000 Potential)	30	196	124	55	43
Commercial (per 100 Potential)	50	165	51	20	13
Industrial (each)	15	405	195	90	60
Tubewells (each)	5	345	150	55	15
Infrastructure					
Paved Road within area	50				
Access road	50	100	100	100	100
Irrigation Canal	50				
Bus Service	50				
Social Service					
Union Councils (per unit)	50				
Health Centers (per unit)	10	100	100	100	100
Schools (per unit)	5				
Maximum Total Point Counts :	N.A.	1311	720	420	331
Illustrative Minimum Point Count for Cut-Off.		.900	500	330	250

NOTE:- Points assigned to various classifications may be adjusted but the relationship between classifications should remain constant.

3. General Description of Average Sub-Project

There are considerable data available on rural areas in Pakistan. Some of these data are available from census and other sources, and much are rural electrification-specific. WAPDA's records, particularly its rural electrification action plan, contain considerable data on the composition of rural areas in the four provinces of Pakistan, the size of villages, population distribution by village size, percentage of electrified villages in each area and so on. In addition, WAPDA and A.I.D. collaborated on conducting rural electrification feasibility studies in 14 different areas in all four provinces of Pakistan. The studies, completed between 1977 and 1980, contain detailed information on approximately 2,000 villages based on random samples in the four provinces of Pakistan which are considered prime candidates for electrification.

Using this information, an average model sub-project was developed to be used as the basic unit of the A.I.D.-assisted project. Due to the great diversity of Pakistan's rural sector and the marked differences between the four provinces, four versions of the model were developed. These composite models represent conceptual averages and are neither typical nor intended to serve as criteria to be followed in actual implementation.

The model sub-project contains an average of 10 to 11 villages of varying sizes. The sub-project area or areas would have some infrastructure, irrigation and commercial activity. The geographic dimensions vary. Typically, sub-project area(s) would have to be within 30 miles of a grid station, preferably within 2 to 6 miles of an 11 KV feeder. It is assumed that approximately 50 percent of the villages in the model sub-project areas have been electrified and that these electrified villages comprise 60 percent of all sub-project households. (This assumption is supported by data showing that the larger villages, with larger proportions of the population, have been electrified first). The remaining 50 percent of the villages in the sub-project area are assumed to have no electric service available at the start of the project. It is further assumed that the electrified villages have saturation rates of 15 percent for domestic/community consumers and 50 percent for commercial, industrial and tubewell consumers. The four versions of the composite model are shown below in tabular form:

Model Sub-Project*

	Punjab	Sind	NWFP	Baluchistan
Number of Villages	10	10	10	11
Households	6,400	4,000	1,800	1,400
Persons/Household	6.05	7.70	6.49	5.98
Population	38,720	30,800	11,682	8,372
Commercial	330	102	40	27
Community Building	141	133	36	37
Industrial	27	13	6	4
Tubewells	50	30	11	3
Households already electrified(15% of 60%)	576	360	162	126
Commercial already electrified(50% of 60%)	99	31	12	8
Community already electrified(15% of 60%)	13	12	3	3
Industrial already electrified(50% of 60%)	8	4	2	1
Tubewells already electrified(50% of 60%)	15	9	3	1

* Based on data from 1978 Rural Electrification Feasibility Studies Prepared for WAPDA by Local Engineering Consultants and financed by A.I.D.

4. Extension of Service Under the A.I.D. Project

For the purpose of project analysis, it is assumed that electric service will be extended to all villages within the sub-project area within the life of the A.I.D. project. For villages that have been electrified, it is assumed that the saturation rate will increase from 15 percent to 30 percent for the domestic and community consumers and from 50 percent to 90 percent for commercial, industrial and tubewell consumers. For villages that will receive electricity for the first time, it is assumed that saturation rates will be 30 percent and 90 percent for domestic/

community and the production consumer groups respectively during the life of the project.

5. Analysis Methodology

The above described model, or multiples of the model, will be used as the basic unit in project analysis. Cost estimates have been developed for each province's sub-project model, which are shown in the following tables. Load forecasts will be developed for these models and an economic analysis will be conducted on the basis of the costs and figures and load forecasts.

6. Implementation Implications

It is anticipated that actual sub-project areas selected for electrification under the A.I.D. project will vary greatly from the model in many respects.: number of villages, geographic dimensions, number of inhabitants, saturation rates, number of potential consumers, etc. Each such area will be examined in accordance with the screening criteria and plans for its electrification will be developed in a conventional manner consistent with the Implementation Plan described in the project paper. Because of the tremendous backlog of customers with facilities already wired and waiting for services, no provision is being made for house wiring under the project. The following table illustrates one option for the breakdown of project funds among the provinces. Based on this breakdown and the cost estimates shown on the previous tables, it is estimated that 250 sub-projects will be constructed under the A.I.D. project.

ILLUSTRATIVE COST ESTIMATES FOR SUB-PROJECT MODEL PROVINCE: PUNJAB

- Five new villages, each with 400-500 households.

				Extended Cost:
1. High Tension Lines:				
Single-Phase: 2.2	M	$3,938	/M	8,664
Three-Phase : 4.3	M	$7,249	/M	31,171
2. Low Tension Lines:				
Single-Phase: 3.1	M	$7,427	/M	23,024
Three-Phase : 0.4	M	$8,348	/M	3,339
3. Transformers:				
Single-Phase: 50 KVA		No. 14	$ 970 /ea.....	13,580
Three-Phase : 50 KVA		No. 3	$2,185 /ea.....	6,555
4. Service Connections:				
Single-Phase:				
No. of Residential		768	$71 /ea.....	54,528
No. of Commercial		119	$71 /ea.....	8,449
No. of Community		51	$71 /ea.....	3,621
Three-Phase:				
No. of Industrial		10	$425 /ea.....	4,250
5. Tubewell Installations:		18	$3,722 /ea.....	66,996
			Sub-Total: $	224,177

- Fill-ins over Life of Project for Five Electrified Villages.

6. Service Connections:			
Single-Phase:			
No. of Residential	576	$ 71 /ea.....	40,896
No. of Commercial	93	$ 71 /ea.....	6,603
No. of Community	13	$ 71 /ea.....	923
Three-Phase:			
No. of Industrial	6	$ 425 /ea.....	2,550
7. Tubewell Installations:	12	$3,722 /ea.....	44,664
		Sub-Total: $	95,636
		Total Material Cost: $	319,813
8. Commodities (12%), labour and handling (10%), transport (6%), engineering and supervision (7%), contingency (10%) Total (45%)			143,916
		GRAND TOTAL: $	463,729

ILLUSTRATIVE COST ESTIMATES FOR SUB-PROJECT MODEL PROVINCE: SIND

- Five new villages, each with 250-350 households.

				Extended Cost:
1. High Tension Lines:				
Single-Phase: 3.0	M	$ 3,938	/M	11,814
Three-Phase : 7.0	M	$ 7,249	/M	50,743
2. Low Tension Lines:				
Single-Phase: 1.5	M	$ 7,427	/M	11,141
Three-Phase : 0.2	M	$ 8,348	/M	1,670
3. Transformers:				
Single-Phase: 50	KVA	No. 8	$ [illegible] /ea.....	7,760
Three-Phase : 50	KVA	No. 2	$ 2,185 /ea.....	4,370
4. Service Connections:				
Single-Phase:				
No. of Residential		480	$ 71 /ea.....	34,080
No. of Commercial		36	$ 71 /ea.....	2,556
No. of Community		48	$ 71 /ea.....	3,408
Three-Phase:				
No. of Industrial		5	$ 425 /ea.....	2,125
5. Tubewell Installations:		11	$ 3,722 /ea.....	40,942
			Sub-Total: $	170,609

- Fill-ins over Life of Project for Five Electrified Villages.

6. Service Connections:				
Single-Phase:				
No. of Residential		360	$ 71 /ea.....	25,560
No. of Commercial		25	$ 71 /ea.....	1,775
No. of Community		12	$ 71 /ea.....	852
Three-Phase:				
No. of Industrial		3	$ 425 /ea.....	1,275
7. Tubewell Installations:		7	$ 3,722 /ea.....	26,054
			Sub-Total: $	55,516

Total Material Cost: $ 226,125

8. Commodities (12%), labour and handling (10%), transport (6%), engineering and supervision (7%), contingency (10%) Total (45%) 101,756

GRAND TOTAL: $ 327,881

ILLUSTRATIVE COST ESTIMATES FOR SUB-PROJECT MODEL PROVINCE: N.W.F.P.

- Five new villages, each with 75-125 households.

				Extended Cost:
1. High Tension Lines:				
Single-Phase: 3.0	M	$ 3,938 /M	.....	11,814
Three-Phase : 7.0	M	$ 7,249 /M	.....	50,743
2. Low Tension Lines:				
Single-Phase: 1.3	M	$ 7,427 /M	.....	9,655
Three-Phase : 0.1	M	$ 8,348 /M	.....	835
3. Transformers:				
Single-Phase: 25 KVA	No. 7	$ 668 /ea	.....	4,676
Three-Phase : 25 KVA	No. 1	$1,485 /ea	.....	1,485
4. Service Connections:				
Single-Phase:				
No. of Residential	216	$71 /ea	.....	15,336
No. of Commercial	14	$71 /ea	.....	994
No. of Community	13	$71 /ea	.....	923
Three-Phase:				
No. of Industrial	2	$425 /ea	.....	850
5. Tubewell Installations:	4	$3,722 /ea	.....	14,888
			Sub-Total: $	112,199

- Fill-ins over life of Project for Five Electrified Villages.

6. Service Connections:				
Single-Phase:				
No. of Residential	324	$ 71 /ea	.....	23,004
No. of Commercial	6	$ 71 /ea	.....	426
No. of Community	6	$ 71 /ea	.....	426
Three-Phase:				
No. of Industrial	2	$ 425 /ea	.....	850
7. Tubewell Installations:	2	$3,722 /ea	.....	7,444
			Sub-Total: $	32,150

Total Material Cost: $ 144,349

8. Commodities (12%), labour and handling (10%), transport (6%), engineering and supervision (7%), contingency (10%) Total (45%)	64,957

GRAND TOTAL: $ 209,306

ILLUSTRATIVE COST ESTIMATES FOR SUB-PROJECT MODEL PROVINCE: BALUCHISTAN

- Five new villages, each with 75-125 households.

				Extended Cost:
1. High Tension Lines:				
Single-Phase:	6.5 M	$ 3,938	/M	25,597
Three-Phase :	12.0 M	$ 7,249	/M	86,988
2. Low Tension Lines:				
Single-Phase:	1.3 M	$ 7,427	/M	9,655
Three-Phase :	0.1 M	$ 8,348	/M	835
3. Transformers:				
Single-Phase:	25 KVA	No. 7	$ 668 /ea.....	4,676
Three-Phase :	25 KVA	No. 1	$ 1,485 /ea.....	1,485
4. Service Connections:				
Single-Phase:				
No. of Residential		168	$ 71 /ea.....	11,928
No. of Commercial		10	$ 71 /ea.....	710
No. of Community		13	$ 71 /ea.....	923
Three-Phase:				
No. of Industrial		2	$ 425 /ea.....	850
5. Tubewell Installations:		1	$ 3,722 /ea.....	3,722
			Sub-Total: $	147,369

- Fill-ins over Life of Project for Five Electrified Villages.

6. Service Connections:				
Single-Phase:				
No. of Residential		252	$ 71 /ea.....	17,892
No. of Commercial		6	$ 71 /ea.....	426
No. of Community		7	$ 71 /ea.....	497
Three-Phase:				
No. of Industrial		1	$ 425 /ea.....	425
7. Tubewell Installations:		1	$ 3,722 /ea.....	3,722
			Sub-Total: $	22,962
			Total Material Cost: $	170,331
8. Commodities (12%), labour and handling (10%), transport (6%), engineering and supervision (7%), contingency (10%) Total (45%)				76,649
			GRAND TOTAL: $	246,980

Illustrative Breakdown of Project Allocations for Provinces

	Punjab	Sind	NWFP	Baluchistan
Area Electricity Boards	5	1	1	1
Approximate (Thousands) Populations (1982)	48,700	18,500	13,400	3,400
No. of villages	26,000	6,200	6,900	5,900
No. of electrified villages	5,339	2,384	3,315	304
No. of unelectrified villages	20,661	3,816	3,585	5,596
Allocation	50%	24%	20%	6%
No. of sub-projects	90	61	78	21
Sub-projects/Capita	1/541,000	1/303,000	1/172,000	1/162,000
Capital Cost/Connection	344	413	449	639
Cost per inhabitant	57	53	69	107

RURAL DISTRIBUTION EXPANSION COMPONENT
MODEL SUB-PROJECT AND CONSUMERS PER PROVINCE

NO. SUB-PROJECTS	PUNJAB	SIND	NWFP	BAL.	TOTAL
	90	61	78	21	250
No. Domestic Per-Subproject	1,344	840	520	420	
Total	120,960	51,240	40,560	8,820	221,140
No. Commercial Per-Subproject	212	61	20	16	
Total	19,080	3,721	1,560	336	24,697
No.Community Per-Subproject	64	60	19	20	
Total	5,760	3,660	1,482	420	11,322
No. Industrial Per-Subproject	16	8	4	3	
Total	1,440	488	312	63	2,303
No. Tubewells Per-Subproject	30	18	6	2	
Total	2,700	1,098	468	42	4,308
Total Consumers Per Province	149,940	60,207	44,382	9,681	264,210
% Consumers Per Province	56.75%	22,79%	16.8%	3.7%	100%

RURAL DISTRIBUTION EXPANSION COMPONENT
FUNDING ALLOCATION PER PROVINCE AND CORRESPONDING
NUMBER OF MODEL SUB-PROJECT FY 1983-1987

	Life of Project Funding														
	FY - 1983			FY - 1984			FY - 1985			FY - 1986			FY - 1987		
Province (% Allocations of Total (Funds)	Funds Obligated ($000)	Cost/ SubP. ($000)	No. SubP.	Funds Obligated ($000)	Cost/ SubP. ($000)	No. SubP.	Funds Obligated ($000)	Cost/ SubP. ($000)	No. SubP.	Funds Obligated ($000)	Cost/ SubP. ($000)	No. SubP.	Funds Obligated ($000)	Cost/ SubP. ($000)	No. SubP.
PUNJAB (50%)	2,580	464	6	10,317	510	20	12,897	561	23	12,897	617	21	12,897	679	20
SIND (24%)	1,238	328	4	4,952	361	14	6,190	397	16	6,190	437	14	6,190	480	13
NWFP (20%)	1,032	209	5	4,127	230	18	5,159	253	20	5,159	278	18	5,159	306	17
BALUCHISTAN (6%)	309	247	1	1,238	272	6	1,547	299	5	1,548	329	5	1,548	362	4
Annual Funding	5,159		16	20,634		58	25,793		64	25,793		58	25,793		54
(% Funding)	(5%)			(20%)			(25%)			(25%)			(25%)		

	No. of Sub-Projects	Fund Allocations
PUNJAB	90	51,588,000
SIND	61	24,760,000
NWFP	78	20,636,000
BALUCHISTAN	21	6,190,000
Total:	250	$. 103,174,000

Note: A 10% inflation factor compounded annually was included.

ANNEX O
Attachment B
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COST ESTIMATE OF DISTRIBUTION ENERGY LOSS REDUCTION COMPONENT

	Item	Unit (1) Price $	Quantity	Extended Prices ($000)	Sub-Total ($ 000)
1.	H.T.Line Renovation				
	DOG (# 4/0 ACSR)	4,967	460M	2,285	
	RABBIT (# 1/0 ACSR)	2,748	560M	1,592	3,977
2.	L.T.Line Renovation				
	WASP (# 3/0 AAC)	5,268	400M	2,107	
	ANT (# 1/0 AAC)	3.098	600M	1,859	3,964
3.	Augmentation				
	50 KVA Transformers	1,993	1,500	2,990	
	100 KVA Transformers	2,672	500	1,336	4,326
4.	Meter Replacement				
	Single Phase	24	100,000	2,400	
	Three Phase	165	10,000	1,650	4,050
5.	Capacitors				
	Feeder Capacitors	1,936	800 banks	1,549	
	Tubewell Capacitors	73	40,000	2,920	4,467
6.	Voltage Regulators				
	Autoboosters	13,500	100 sets	1,350	1,350
7.	Tools & Instruments				
	Max-I-Meters & Others	132	4,000	528	528
8.	Sub-Total	Items 1-8			22,034
9.	Labor and Handling	10.0% of item 8			2,203
10.	Transportation	5.0% of item 8			1,102
11.	Engineering and Supervision	6.3% of item 8			1,388
12.	Sub-Total	Items 8-11			26,727
13.	Contingency	10.0% of item 12			2,673
14.	U.S. Consultancy	4.5% of items 12			1,203
15.	Capitalized Cost	Items 12 - 14			30,603
16.	Technical Assistance	8.0% of item 15			2,448
17.	Grand-Total	Items 15-16			33,051

(1) An inflation factor of 10 percent per annum has been built into these unit costs.

COST ESTIMATE OF RURAL ELECTRIFICATION COMPONENT

No.of Sub-Projects:250

Item Description	Unit Cost ($)	Quantity	Extended Costs ($000)	Sub-total ($ 000)
1. Primary Lines				
Single Phase	4,726	756M	3,573	
Three Phase	8,699	1,612M	14,023	17,596
2. Secondary Lines				
Single Phase	8,912	313M	2,789	
Three Phase	10,018	58M	581	3,370
3. Transformers				
Single Phase	1,028	2,441	2,509	
Three Phase	2,370	491	1,164	3,673
4. Service Connections				
Single Phase	85	259,159	22,028	
Three Phase	510	2,303	1,174	23,202
5. Tubewell Connections	4,466	3,867	17,270	17,270
6. Transport Equipment	8.0% of items	1-5(65,111)		5,209
7. Radio Communications	2.0% of items	1-5		1,302
8. Tools & Instruments	0.7% of items	1-5		456
9. Work Equipment	0.5% of items	1-5		325
10. Sectionalizing	1.0% of items	1-5		655
11. Sub-total	Items 1 to 10			73,058
12. Labor & Handling	10.0%of items	11		7,306
13. Transportation	6.0% of items	11		4,383
14. Engineering and Supervision	3.3% of items	11		2,410
15. Sub-total	Items 11 to 14			87,157
16. Contingency	10%of items	15		8,716
17. Local Consultancy	1.0% of items	15		872
18. U.S. Consultancy	3.5% of items	15		3,050
19. Capitalized Cost	Items 16 to 18			99,795
20. Technical Assistance	3.5% of items	18		3,523
21. Grand Total				103,318

An inflation factor of 10 percent per annum has been built into these unit costs.

Distribution System Energy Loss Reduction

Cost-Benefit Analysis

Year	Costs (Rs 000)	% Loss Reduction	Annual KW-hr. Loss Reduction (000)	Rs/KW-hr. Sold	Benefit of Loss Reduction Rs (000)	Net Benefit Rs (000)
0	30,686	0	-	0.594	-	-30,686
1	76,715	0.0030	32,916	0.594	19,552	-57,163
2	76,715	0.0090	106,641	0.594	63,344	-13,371
3	61,372	0.0150	191,955	0.594	114,021	52,649
4	61,372	0.0210	290,241	0.594	172,403	111,031
5	3,330	0.0270	403,002	0.594	239,383	236,053
6	3,630	0.0300	483,600	0.594	287,258	283,628
7	3.990	0.0300	522,300	0.594	310,246	306,256
8	4,390	0.0300	564,090	0.594	335,069	330,679
9	4,830	0.0300	609,210	0.594	361,870	357,040
10	5,310	0.0285	625,062	0.594	372,287	366,977
11	5,840	0.0271	641,891	0.594	381,283	375,443
12	6,430	0.0258	659,989	0.594	392,033	385,603
13	7,070	0.0245	676,861	0.594	402,055	394,985
14	7,780	0.0233	695,225	0.594	412,964	405,184
15	8,560	0.0221	712,150	0.594	423,017	414,457
16	9,410	0.0210	730,842	0.594	434,120	424,710
17	10,360	0.0200	751,740	0.594	446,533	436,173
18	11,390	0.0190	771,286	0.594	458,144	446,754
19	12,530	0.0181	793,522	0.594	471,352	458,822
20	13,780	0.0172	814,403	0.594	483,755	469,975
21	15,160	0.0164	838,630	0.594	497,950	482,790
22	16,668	0.0156	861,541	0.594	511,755	495,087
23	18,340	0.0148	882,746	0.594	524,351	506,011
24	20,180	0.0141	908,279	0.594	539,518	519,338
25	22,298	0.0134	932,238	0.594	553,749	531,551
26	24,418	0.0127	954,227	0.594	566,810	542,392
27	26,859	0.0121	981,867	0.594	583,229	556,370
28	29,545	0.0115	1,007,837	0.594	598,655	569,110
29	32,500	0.0109	1,031,674	0.594	612,814	580,314
30	35,750	0.0104	1,063,098	0.594	631,480	595,730

EIRR = 73%

Gas Turbine - Combined Cycle Plant
Direct Benefits (Revenues)

Cost-Benefit Analysis

Year	Capital Investment Economic Cost 000 Rs	Operation & Maintenance Costs	Fuel	Total Costs (000 Rs)	Gen.Power Less 31.5% (1000 KWH)	Revenue (x.54 Rs/ KWH) (000 Rs)	Net Benefit Revenues-Costs (000 Rs)
0	952204	0	0	952204	0	0	-952240
1	1003816	11550	27720	1043086	102859	55544	-987542
2	543048	12100	29150	584299	102859	55544	-528755
3	448800	34760	411510	895070	1851000	999540	104470
4	62084	34760	411510	508354	1851000	999540	491186
5	-	34760	411510	446270	1851000	999540	553270
6	-	34760	411510	446270	1851000	999540	553270
7	-	34760	411510	446270	1851000	999540	553270
8	-						
9	-						
10	-						
11	-						
12	-						
13	-						
14	-						
15	-						
16	-						
17	-						
18	-						
19	-						
20	-						
21	-						
22	-						
23	-						
24	-						
25	-						
26	-						
27	-						
28	-						
29	-						
30	-						

EIRR=16%

Rural System Expansion
Domestic & Community Consumers
Direct Benefits (Revenues)

Year	No. of Consumers Connected	Cumulative No. of Connections	Consumption KWH/ Consumer (000)	Total Consumption (000)	Energy Cost Rs 0.334/ Unit	Total Revenue Rs 040/ Unit	Net Revenue Rs 000
0	0	0	-	0	0	0	0
1	11708	11708	330	3863	1290	1545	255
2	46833	58541	366	21443	7162	8577	1415
3	58541	117082	407	47605	15900	19042	3142
4	58541	175623	451	79258	26472	31703	5231
5	58541	234164	501	117316	39183	46926	7742
6	-	234164	556	130218	43493	52087	8594
7	-	234164	595	139327	46535	55731	9195
8	-	234164	637	149042	49780	59616	9836
9	-	234164	681	159535	53285	63814	10529
10	-	234164	729	170682	57007	68272	11265
11	-	234164	780	182647	61004	73059	12054
12	-	234164	835	195433	65274	78193	12898
13	-	234164	893	209108	69842	83643	13801
14	-	234164	956	223743	74730	89497	14767
15	-	234164	1022	239409	79926	95763	15801
16	-	234164	1094	256152	85554	102460	16906
17	-	234164	1170	274089	91545	109635	18089
18	-	234164	1252	293267	97951	117306	19355
19	-	234164	1340	313803	104810	125521	20711
20	-	234164	1434	335767	112146	134307	22160
21	-	234164	1534	359277	119998	143711	23712
22	-	234164	1642	384427	128398	153770	25372
23	-	234164	1757	411332	137385	164533	27147
24	-	234164	1880	440134	147005	176053	29048
25	-	234164	2011	470950	157297	188380	31082
26	-	234164	2152	503897	168301	201559	33257
27	-	234164	2307	539186	180088	215674	35586
28	-	234164	2464	576933	192695	230773	38077
29	-	234164	2636	617303	206179	246921	40742
30	-	234164	2821	660506	220609	264202	43593

Rural System Expansion
Commercial Consumers

Net Benefits (Revenues)

Year	No. of Consumers Connected	Cumulative Total	Consumption KWH/Hrs.	Total Consumption (in 000)	Energy Cost Rs .334 KWH(in000)	Energy Revenue Rs 1.04 KWH(in000)	Net Revenue (in000)
0	0	0	-	0	0	0	0
1	1235	1235	600	741	247	771	524
2	4940	6175	648	4001	1336	4161	2825
3	6175	12350	700	8645	2887	8991	6104
4	6175	18525	756	14005	4678	14565	9887
5	6175	24700	816	20155	6732	20961	14229
6	0	24700	881	21761	7268	22631	15363
7			951	23490	7846	24430	16584
8			1027	25367	8472	26382	17910
9			1110	27417	9157	28514	19357
10			1198	29591	9883	30775	20892
11			1294	31962	10675	33240	22565
12			1398	34531	11533	35912	24379
13			1510	37297	12457	38789	26332
14			1630	40261	13447	41871	28424
15			1761	43497	14528	45237	30709
16			1902	46979	15691	48858	33167
17			2054	50734	16945	52763	35818
18			2218	54785	18298	56976	38678
19			2396	59181	19766	61548	41782
20			2588	63924	21351	66481	45130
21			2795	69036	23058	71797	48739
22			3018	74545	24898	77527	52629
23			3260	80522	26894	83743	56849
24			3520	86944	29039	90422	61383
25			3802	93909	31366	97665	66299
26			4106	101418	33874	105475	71601
27			4435	109544	36588	113926	77338
28			4790	118313	39516	123045	83529
29			5173	127773	42676	132884	90208
30			5587	137999	46092	143519	97427

Rural System Expansion
Industrial Consumers
Direct Benefits (Revenues)

Year	No. of Consumers Connected	Cumulative No. of Connections	Consumption KWH/Consumer	Total Consumption (1000xKWH)	Energy Cost 0.334 x KWH (Rs x 1000)	Energy Revenues (Rs 0.643xKWH) (Rs x 1000)	Net Revenue (Rs x 1000)
0	0	0	0	0	0	0	0
1	113	113	22000	2486	830	1598	7[illegible]
2	452	565	23100	13051	4359	8392	[illegible]
3	565	1130	24255	27408	9154	17623	8469
4	565	1695	25468	43507	14531	27975	13443
5	565	2260	26741	60434	20185	38859	18674
6	0	2260	28078	63456	21194	40802	19607
7	0	2260	29482	66629	22254	42842	20588
8	0	2260	30956	69960	23366	44984	21617
9	0	2260	32504	73459	24535	47234	22696
10	0	2260	34129	77131	25761	49595	23833
11	0	2260	35835	80987	[illegible]	52070	25025
12	0	2260	[illegible]	85027	28402	54678	26276
13	0	2260	39609	89290	29822	57413	27590
14	0	2260	41484	93753	31313	60283	28970
15	0	2260	43558	98441	32879	63297	30418
16	0	2260	45736	103363	34523	66452	31939
17	0	2260	48023	108531	36249	69785	33536
18	0	2260	50424	113958	38061	73274	35213
19	0	2260	52946	119657	39965	76939	36974
20	0	2260	55593	125640	41963	80786	38822
21	0	2260	58373	131922	44061	84825	40763
22	0	2260	61291	138517	46264	89006	42801
23	0	2260	64356	145444	48578	93520	44942
24	0	2260	67574	152717	51007	98197	47189
25	0	2260	70952	160351	53557	103105	49548
26	0	2260	74500	168370	56235	108261	52026
27	0	2260	78225	176788	59047	113674	54627
28	0	2260	82136	185627	61999	119358	57359
29	0	2260	86243	194909	65099	125326	60226
30	0	2260	90555	204654	68354	131592	63238

BEST AVAILABLE DOCUMENT

Rural System Expansion
Tubewell Consumers
Direct Benefits (Revenues)

Year	No. of Consumers Connected	Cumulative No. of Connections	Consumption KWH/ Consumer	Total Consumption (KWHx1000)	Energy Cost Rs 0.334xKWH (Rsx1000)	Energy Revenue Rs 0.359xKWH (Rsx1000)	Net Revenue (Rs x 1000)
0	0	0	0	0	0	0	0
1	211	211	20000	4220	1409	1514	105
2	844	1055	20800	21944	7329	7877	548
3	1055	2110	21632	45643	15244	16386	1141
4	1055	3165	22497	71203	23782	25562	1780
5	1055	4220	23397	98736	32977	35446	2468
6	0	4220	24333	102268	34157	36714	2556
7	0	4220	25306	106792	35668	38338	2669
8	0	4220	26318	111064	37095	39871	2776
9	0	4220	27371	115507	38579	41467	2887
10	0	4220	28466	120127	40122	43125	3003
11	0	4220	29406	124097	41448	44550	3102
12	0	4220	30789	129929	43396	46644	3248
13	0	4220	32020	135137	45135	48514	3378
14	0	4220	33301	140532	46937	50450	3513
15	0	4220	34633	146153	48815	52468	3653
16	0	4220	36018	151999	50767	54567	3799
17	0	4220	37459	158079	52798	56750	3951
18	0	4220	38958	164402	54910	59020	4110
19	0	4220	40516	170978	57106	61381	4274
20	0	4220	42438	179092	59816	64294	4477
21	0	4220	43822	184930	61766	66389	4623
22	0	4220	45575	192328	64237	69045	4808
23	0	4220	47398	200021	66807	71807	5000
24	0	4220	49291	208009	69475	74675	5200
25	0	4220	51266	216342	72358	77666	5308
26	0	4220	53316	224996	75148	80773	5624
27	0	4220	55449	233996	78154	84004	5849
28	0	4220	57667	243356	81280	87364	6083
29	0	4220	59974	253090	84532	90859	6327
30	0	4220	62273	262792	87772	94342	6569

Rural System Expansion
Summary Direct Benefits (Revenues)
All Consumers

YEAR	INDUSTRIAL (Rs x 1000)	T/WELLS (Rs x 1000)	DOMESTIC & COMMUNITY (Rs x 1000)	COMMERCIAL (Rs x 1000)	TOTAL REVENUE (Rs x 1000)
0	0	0	0	0	0
1	768	105	255	524	1652
2	4032	548	1415	2825	8821
3	8469	1141	3142	6104	18856
4	13443	1780	5231	9887	31341
5	18674	2468	7742	14229	43114
6	19607	2556	8594	15363	46122
7	20588	2669	9195	16584	49037
8	21617	2776	9836	17910	52141
9	22698	2887	10529	19357	55472
10	23833	3003	11265	20892	58993
11	25025	3102	12054	22565	62747
12	26276	3248	12898	24379	66802
13	27590	3378	13801	26332	71102
14	28969	3513	14767	28424	75674
15	30418	3653	15801	30709	80582
16	31939	3799	16906	33167	85812
17	33536	3951	18089	35818	91395
18	35213	4110	19355	38678	97356
19	36974	4274	20711	41782	103741
20	38822	4477	22160	45130	110590
21	40763	4623	23712	48739	117838
22	42801	4808	25372	52629	125611
23	44942	5000	27147	56849	133939
24	47189	5200	29048	61383	142821
25	49548	5308	31082	66299	152238
26	52026	5624	33257	71601	162509
27	54627	5849	35586	77338	173401
28	57358	6083	38077	83529	185049
29	60226	6327	40742	90208	197504
30	63238	6569	43593	97427	210828

Rural System Expansion
Domestic/Community Surplus Benefits
(Switching from Kerosene Lighting to Electricity)

Year	No. of Consumers Connected	Cummulative No. of Connections	Annual Savings x 558.93 (in Rs 000)
0	0	0	0
1	11708	11708	6544
2	46833	58541	32720
3	58541	117082	65441
4	58541	175627	98161
5	58541	234164	130881
6		234164	130881
7		234164	130881
8		234164	130881
9		234164	130881
10		234164	130881
11		234164	130881
12		234164	130881
13		234161	130881
14		234164	130881
15		234164	130881
16		231464	130881
17		234164	130881
18		234164	130881
19		234164	130881
20		234164	130881
21		234164	130881
22		234164	130881
23		234164	130881
24		234164	130881
25		234164	130881
26		234164	130881
27		234164	130881
28		234164	130881
29		234164	130881
30		234164	130881

Rural System Expansion
Surplus Benefits-Tubewell Consumers
(Switching from Diesel to Electric Motors)

Year	No. of Connections	Cumulative No. of Connections	Salvage Old Engines x8,100 (Rs 000)	Investment Maintenance + Operation Savings x 19,320 (Rs000)	TOTAL (Rs 000)
0	0	0	0	0	0
1	211	211	855	4077	4932
2	844	1055	3418	20383	23801
3	1055	2110	4273	40765	45038
4	1055	3165	4273	61148	65421
5	1055	4220	4273	81530	85803
6	0	4220	0	81530	81530
7	0	4220	0	81530	81530
8	0	4220	0	81530	81530
9	0	4220	0	81530	81530
10	0	4220	0	81530	81530
11	0	4220	0	81530	81530
12	0	4220	0	81530	81530
13	0	4220	0	81530	81530
14	0	4220	0	81530	81530
15	0	4220	0	81530	81530
16	0	4220	0	81530	81530
17	0	4220	0	81530	81530
18	0	4220	0	81530	81530
19	0	4220	0	81530	81530
20	0	4220	0	81530	81530
21	0	4220	0	81530	81530
22	0	4220	0	81530	81530
23	0	4220	0	81530	81530
24	0	4220	0	81530	81530
25	0	4220	0	81530	81530
26	0	4220	0	81530	81530
27	0	4220	0	81530	81530
28	0	4220	0	81530	81530
29	0	4220	0	81530	18530
30	0	4220	0	81530	81530

Rural System Expansion
Surplus Benefits - Industrial Consumers
(Switching from Diesel to Electric Motors)

Year	Number	Cumulative	Salvage x 8,100 (000 Rs)	Investment Maintenance & Operation x 18,080 (Rs 000)	TOTAL (Rs 000)
0	0	0	0	0	0
1	113	113	458	2043	2501
2	452	565	1831	10215	12046
3	565	1130	2288	20430	22718
4	565	1695	2288	30646	32934
5	565	2260	2288	40861	43149
6	0	2260	0	40861	40861
7	0	2260	0	40861	40861
8	0	2260	0	40861	40861
9	0	2260	0	40861	40861
10	0	2260	0	40861	40861
11	0	2260	0	40861	40861
12	0	2260	0	40861	40861
13	0	2260	0	40861	40861
14	0	1160	0	40861	40861
15	0	2260	0	40861	40861
16	0	2260	0	40861	40861
17	0	2260	0	40861	40861
18	0	2260	0	40861	40861
19	0	2260	0	40861	40861
20	0	2260	0	40861	40861
21	0	2260	0	40861	40861
22	0	2260	0	40861	40861
23	0	2260	0	40861	40861
24	0	2260	0	40861	40861
25	0	2260	0	40861	40861
26	0	2260	0	40861	40861
27	0	2260	0	40861	40861
28	0	2260	0	40861	40861
29	0	2260	0	40861	40861
30	0	2260	0	40861	40861

Rural System Expansion
Summary Surplus Benefits
All Consumers

Year	Households (000 Rs)	Industrial (000 Rs)	Tubewells (000 Rs)	TOTAL (000 Rs)
0	0	0	0	0
1	6544	2501	4932	13977
2	32720	12046	23801	68567
3	65441	22718	45038	133197
4	98161	32934	65421	196516
5	130881	43149	85803	259833
6	130881	40861	81530	253272
7	130881	40861	81530	253272
8	130881	40861	81530	253272
9	130881	40861	81530	253272
10	130881	40861	81530	253272
11	130881	40861	81530	253272
12	130881	40861	81530	253272
13	130881	40861	81530	253272
14	130881	40861	81530	253272
15	130881	40861	81530	253272
16	130881	40861	81530	253272
17	130881	40861	81530	253272
18	130881	40861	81530	253272
19	130881	40861	81530	253272
20	130881	40861	81530	253272
21	130881	40861	81530	253272
22	130881	40861	81530	253272
23	130881	40861	81530	253272
24	130881	40861	81530	253272
25	130881	40861	81530	253272
26	130881	40861	81530	253272
27	130881	40861	81530	253272
28	130881	40861	81530	253272
29	130881	40861	81530	253272
30	130881	40861	81530	253272

Rural System Expansion
Summary Direct and Surplus Benefits -All Consumers
Cost Benefit Analysis

Year	Investment Costs (000 Rs)	Direct Benefits (000 Rs)	Surplus Benefits (000 Rs)	Total Benefits (000 Rs)	Net Benefits
0	65925	0	0	0	- 65926
1	263704	1653	13977	15630	-248074
2	329630	8822	68567	77389	-252241
3	329630	18856.	133197	152053	-177577
4	329630	30342	196516	226858	-102772
5	13200	43115	259833	302948	289748
6	13200	46122	253272	309394	296194
7	13200	49037	253272	302309	289109
8	13200	52141		305413	292213
9	13200	55472		308744	295544
10	13200	58994		312266	299066
11	13200	62748		316020	302820
12	13200	66802		320074	306874
13	13200	71102		324374	311174
14	13200	75674		328946	315746
15	13200	80582		333854	320654
16	13200	85812		339084	325884
17	13200	91395		344667	331467
18	13200	97356		350628	336828
19	13200	103741		357013	343813
20	13200	110591		363863	350663
21	13200	117838		371110	357910
22	13200	125611		378883	365683
23	13200	133940		387212	374012
24	13200	142822		396094	382894
25	13200	152239		405511	392311
26	13200	162509		415781	402581
27	13200	173402		426674	413474
28	13200	185049		438321	425121
29	13200	197504		450776	437576
30	13200	210828	253272	464100	450900

EIRR=23%

System Energy Loss Reduction
Sensitivity Analysis

Year	Costs Base Case (000 Rs)	Benefits Base Case (000 Rs)	Costs Increase 30%		Benefits Decrease 30%		Costs Increase 15%	Benefits Decrease 15%	Net Benefit (000Rs)
			Costs (1.3) (000 Rs)	Net Ben. (000 Rs)	Benefit (.7) (000 Rs)	Net Bene. (000 Rs)	Costs (1.15) (000 Rs)	Bene. (.85) (000 Rs)	
0	30686	0	39892	-39892	0	-30686	35289	0	-35289
1	76715	19552	99730	-80178	13686	-63029	88222	16619	-71603
2	76715	63344	99730	-36086	44341	-32374	88222	53842	-34380
3	61372	114021	79784	+34237	79815	18443	70578	96918	26340
4	61372	172403	79784	+92619	120682	59310	70578	146543	75965
5	3330	239383	4329	+235054	167568	223548	3829	203476	199647
6	3630	287252	4719	+282533	201076	197446	4174	244164	239990
7	3990	310246	5187	+305059	217172	213182	4588	263709	259121
8	4390	335069	5707	+329362	234548	230158	5048	284809	279761
9	4830	361870	6279	+355591	253309	248479	5554	307589	302035
10	5310	372287	6903	+365384	260601	255291	6106	316444	310338
11	5840	381283	7592	+373691	266898	261058	6716	324091	317375
12	6430	392033	8359	+383674	274423	267993	7394	333228	325834
13	7070	402055	9191	+392864	281438	274368	8130	341747	333617
14	7780	412964	10114	+402850	289075	281295	8947	351019	342062
15	8560	423017	11128	+411889	296112	287552	9844	359564	349720
16	9410	434120	12233	+421887	303884	294474	10821	369002	358181
17	10360	446533	13468	+433065	312573	302213	11914	379553	367639
18	11390	458144	14807	+443337	320701	309311	13098	389422	376324
19	12530	471352	16289	+455063	329946	317416	14409	400649	386240
20	13780	483755	17914	+465841	338623	324348	15847	411192	395345
21	15160	497950	19708	+478242	348565	333405	17434	423257	405823
22	16668	511755	21668	+490087	358228	341560	19168	434992	415824
23	18340	524351	23842	+500509	367046	348706	21091	445698	424607
24	20180	539518	26234	+513284	377663	357483	23207	458590	435383
25	22198	553749	28857	+524892	387624	365426	25528	470687	445159
26	24418	566810	31743	+535067	396767	372349	28081	481788	453707
27	26859	583229	34917	+548312	408260	381401	30888	495745	464857
28	29545	598655	38409	+560246	419058	389513	33877	508857	474880
29	32500	612814	42250	+570564	428970	396470	37375	520892	483517
30	35750	631480	46475	+585005	442036	406286	41112	536758	495646
				EIRR=57.4%		EIRR=55.4%			EIRR=55.6%

Gas Turbines - Combined Cycle Plant
Sensitivity Analysis

Year	Base Costs (000 Rs)	Base Benefits (000 Rs)	Costs Up 30% New Costs (000 Rs)	Costs Up 30% Net Benefits (000 Rs)	Benefits Down 30% New Benefits (000 Rs)	Benefits Down 30% Net Benefits (000 Rs)	Costs Up 15%, Benefits Down 15% New Costs (Rs 000)	Costs Up 15%, Benefits Down 15% New Benefits	Costs Up 15%, Benefits Down 15% Net Benefits
0	952204	0	1237865	-1237865	0	- 952204	1095035	0	-1095035
1	1043086	55544	1356011	-1300467	38881	-1004205	1199549	47212	-1152337
2	584299	55544	759588	- 704044	38881	- 545418	671244	47212	- 624032
3	895070	999540	1163591	- 164051	699678	- 195432	1029331	849609	- 179722
4	508354	999540	660860	+ 338680	699678	+ 191284	584607	849609	+ 265002
5	446270	999540	580151	+ 419389	699678	+ 253368	513210	849609	+ 336399
6									
7									
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Rural System Expansion
Sensitivity Analysis

Year	Base Investment Costs (000 Rs)	Base Benefits (000 Rs)	Costs increase by 30% New Costs (1.30 Base) (000 Rs)	Costs increase by 30% New Net Benefits (000 Rs)	Benefits dec.by 30% New Bene. (.7 Base) (000 Rs)	Benefits dec.by 30% New Net Benefits (000 Rs)	Cost Increase by 15%,Bene.Dec.by 15% New Cost (1.15 Base) (000 Rs)	Cost Increase by 15%,Bene.Dec.by 15% New Bene. (.85 Base) (000 Rs)	Cost Increase by 15%,Bene.Dec.by 15% New Net Benefits (000 Rs)
0	65925	0	85703	- 85703	0	- 65925	75814	0	- 75814
1	263704	15630	342815	-327185	10941	-252763	303260	13286	-289974
2	329630	77389	428510	-351121	54172	-275458	379075	65781	-313294
3	329630	152053	428510	-276457	106437	-223193	379075	129245	-249830
4	329630	226858	428510	-201652	158801	-170823	379075	192829	-186245
5	13200	302948	17160	285788	212064	198864	15180	257506	242325
6	13200	309394	17160	292234	216576	203376	15180	262985	247806
7	13200	302309	17160	285149	211616	198416	15180	256963	241783
8	13200	305413	17160	288253	213789	200589	15180	259601	244421
9	13200	308744	17160	291580	216121	202921	15180	262432	247252
10	13200	312266	17160	295105	218586	205386	15180	265426	250246
11	13200	316020	17160	298860	221214	208014	15180	268617	253437
12	13200	320074	17160	302914	224052	210852	15180	272063	256883
13	13200	324374	17160	307214	227062	213862	15180	275718	260536
14	13200	328946	17160	311785	230262	217062	15180	279604	264424
15	13200	333854	17160	316694	233698	220498	15180	283776	268596
16	13200	339084	17160	321924	237359	224159	15180	288221	273041
17	13200	344667	17160	327507	241267	228067	15180	292967	277787
18	13200	350628	17160	333468	245230	232230	15180	298033	282853
19	13200	357013	17160	339853	249900	236700	15180	303461	288281
20	13200	363863	17160	346703	254704	241504	15180	309284	294104
21	13200	371110	17160	353950	259777	246577	15180	315443	300263
22	13200	378883	17160	361723	265218	252018	15180	322051	306871
23	13200	387212	17160	370052	271048	257848	15180	329130	313950
24	13200	396094	17160	378934	277266	264066	15180	336680	321500
25	13200	405511	17160	388351	283858	270658	15180	344684	329504
26	13200	415781	17160	398621	291047	277847	15180	353414	338234
27	13200	426674	17160	409514	298672	285472	15180	362672	338234
28	13200	438321	17160	421161	306825	293625	15180	372573	357393
29	13200	450776	17160	433161	315543	302343	15180	383160	367980
30	13200	464100	17160	446940	324870	311670	15180	394485	379305

System Energy Loss Reduction, Gas Turbines-Combine Cycle Plant
and Rural System Expansion (Three Components)
Cost-Benefit Analysis

Year	Total Costs (Rs 000s)	Total Benefits (Rs 000s)	Net Benefit (Rs 000s)
0	1048815	0	-1048815
1	1383505	90726	-1292779
2	990644	196277	- 794367
3	1286072	1265614	- 20458
4	899356	1398801	499445
5	462800	1581871	1079071
6	463100	1596192	1133092
7	463460	1612095	1148635
8	463860	1640022	1176162
9	464300	1670154	1205854
10	464780	1684093	1219313
11	465310	1696843	1231533
12	465900	1711647	1245747
13	466540	1725969	1259429
14	467250	1741450	1274200
15	468030	1756411	1288381
16	468880	1772744	1303864
17	469830	1790740	1320910
18	470860	1808312	1337452
19	472000	1827905	1355905
20	473250	1847158	1373900
21	474630	1868600	1392462
22	476138	1890178	1414040
23	477810	1911103	1433293
24	479650	1935152	1455502
25	481668	1958800	1477132
26	483888	1982131	1495802
27	486329	2009443	1523114
28	489015	2030516	1547501
29	491970	2063130	1571160
30	495220	2095120	1599900
			EIRR:22%

TABLE IV

COMBINED CYCLE PLANT

ESTIMATED REVENUE

(US $ Million)

Year	Rate (2) ¢/KWH	Rate (3) ¢/KWH	Revenue	Discount Revenue	Discount (1) Accumulative Total
1	0	0	0	0	0
2	3.15	4.20	4.73	3.57	3.57
3	3.31	4.41	4.96	3.26	6.83
4	3.47	4.63	93.77	53.61	60.45
5	3.65	4.86	98.46	48.95	109.40
6	3.83	5.10	103.38	44.69	154.09
7	4.02	5.36	108.55	40.81	194.90
8	4.22	5.63	113.98	37.26	232.16
9	4.43	5.91	119.67	34.02	266.17
10	4.65	6.20	125.65	31.06	297.24
11	4.89	6.52	131.94	28.36	325.60
12	5.13	6.84	138.54	25.89	351.49
13	5.39	7.18	145.46	23.64	375.13
14	5.66	7.54	152.74	21.59	396.72
15	5.94	7.92	160.37	19.71	416.43
16	6.24	8.32	168.39	18.00	434.42
17	6.55	8.73	176.81	16.43	450.85
18	6.88	9.17	185.65	15.00	465.85
19	7.22	9.63	194.94	13.70	479.55
20	7.58	10.11	204.68	12.51	492.06
21	7.95	10.62	214.92	11.42	503.48
22	8.36	11.14	225.66	10.43	513.90
23	8.78	11.70	236.95	9.52	523.42
24	9.21	12.29	248.79	8.69	532.11
25	9.68	12.90	261.23	7.94	540.05

1. Discount rate is 15%

2. Power cost at generator terminals.

3. Power cost at load assumes 25% losses.

TERMS OF REFERENCE OF WAPDA CONTRACTS WITH LOCAL A/E FIRMS THAT ARE ASSISTING WITH THE PREPARATION OF A NATIONAL RURAL ELECTRIFICATION MASTER PLAN.

1. To make maps of all those villages of Pakistan on reproducible paper using a scale of 1:50,000 which have population more than 1,000 in Punjab and Sind and more than 300 in NWFP and Baluchistan.

2. To identify the villages by provinces, divisions, districts and tehsil and to computerize 1961 and 1972 Census data according to WAPDA formats.

3. To conduct socio-economic and technical surveys covering

   a) 500 household interviews,

   b) 50 village surveys,

   c) 60 case studies of small industry and tubewells.

   d) Consumption data of about 500 consumers of different categories.

   e) Consumers and network data from subdivisions.

   f) Data on existing electric and diesel operated tubewells, and to computerize all the above data according to WAPDA formats.

4. To forecast the population and numbers of households for the project periods of ten years on annual basis for the first 10 years and for the 20th and 30th year.

5. To develop energy consumption, peak demand, bulk supply and revenue forecasts per district for the first 10 years on annual basis and for the 20th and 30th year.

6. To update the maps of the existing 11 KV system and grid stations, indicating conductor sizes, transformer capacities in respect of 11 KV system, along with supplying technical data of concerned grid stations.

7. To plan and mark the proposed network of Distribution System to be constructed for the purpose of electrifying the villages along with extension and augmentation of allied existing 11 KV system including proposals for re-routing/bifurcation of the existing distribution

lines wherever necessary. The plans for SCARP electrification will also be incorporated.

8. To determine year-wise load demand of grid stations, secondary transmission lines and generating station for the project period.

9. To identify the following areas in the plan:

   i) Sweet sub-soil water and agricultural potential

   ii) Under developed areas.

10. To prepare village-wise cost estimate for electrification along with schedules for materials and cost estimates per district.

11. To conduct financial, economic, socio-economic and environmental analyses, similar to those conducted under feasibility studies under US AID, per district.

12. Computerization of final results of each master plan report according to WAPDA formats.

13. The Consultant will prepare and provide to WAPDA base maps to scale 1:50,000 so that WAPDA may prepare SEPIA copies within fifteen days. After the existing system has been worked out and checked, the reproducible maps to scale 1:50,000 will be submitted to WAPDA so that WAPDA may prepare SEPIA copies within fifteen days and return the maps to the Consultant for preparation of Master Plan.

FINANCIAL ANALYSIS ANNEX

TABLE 1

PROPOSED FINANCIAL PLAN
INSTITUTIONAL IMPROVEMENT COMPONENT
(In $ 000)

	A.I.D. Dollars			Rupees[a/]	
	Loan	Grant	Total	U.S.	GOP
1. Technical Assistance					
a. L/T Salaried Expatriates	-	4,955	4,955	1,940	-
b. S/T Salaried Expatriates	-	876	876	270	-
c. S/T Volunteer Expatriates	-	16	16	319	-
d. L/T Pakistani Professionals	-	-	-	919	-
Sub-Total :	-	5,847	5,847	3,448	-
2. U.S. Short-Term Training					
a. Pakistani T.A. Team Members	-	131	131	40	-
b. WAPDA Project Staff	-	318	318	99	-
Sub-Total :	-	449	449	139	-
3. Commodities					
a. ADP Computer Component	-	1,136	1,136	-	-
b. Other Office Equipment	-	909	909	-	-
c. Tools and Instruments	-	682	682	-	-
d. Vehicles for T.A. Team	-	88	88	-	-
e. Other T.A. Support	-	-	-	22	-
Sub-Total :	-	2,815	2,815	22	-
4. Design and Construction of Warehouses & Customer Service Centers					
a. Design (Local A/E)	-	-	-	197	-
b. Construction	-	-	-	-	1,964
c. Land	-	-	-	-	432
Sub-Total :	-	-	-	197	2,396
5. Other (Salaries, Office Space, Supplies, Utilities)	-	-	-	-	1,477
Sub-Total :	-	-	-	-	1,477
TOTAL(1 - 5)	-	9,111	9,111	3,806	3,873
10% Contingency	-	911	911	358	387
GRAND TOTAL :	-	10,022	10,022	4,164	4,260

a/ Expressed as dollar equivalents at the exchange rate of $ 1.00 = Rs 12.16 as of July 19, 1982

FINANCIAL ANALYSIS ANNEX

TABLE 2

PROPOSED FINANCIAL PLAN

A DISTRIBUTION FUNCTION TRAINING COMPONENT

(in $ 000)

	A.I.D. Dollars			Rupees a/	
	Loan	Grant	Total	U.S.	GOP
1. Technical Assistance					
a. L/T Salaried Expatriates	-	5,013	5,013	2,210	-
b. S/T Salaried Expatriates	-	33	33	11	-
c. S/T Volunteer Expatriates	-	29	29	353	-
d. L/T Pakistani Professionals	-	-	-	540	-
Sub-Total :	-	5,075	5,075	3,114	-
2. Training					
a. U.S. Short-Term Implementation					
Training of Pakistan T.A. Team Members	-	58	58	18	-
b. New Comprehensive Program					
i. U.S. Short-Term					
(a) Short Courses	-	1,124	1,124	667	-
(b) Sister Utility Exchange	-	1,537	1,537	578	-
ii. U.S. Long-Term Academic	-	821	821	58	35
iii. In-country Short-Term	-	-	-	-	5,840
Sub-Total :	-	3,540	3,540	1,321	5,875
3. Commodities					
a. Office Equipment, Furniture	-	-	-	-	389
b. Training Aid/Supplies	-	1,136	1,136	-	-
c. Vehicles for T.A. Team	-	36	36	-	-
d. Other T.A. Support	-	-	-	22	-
Sub-Total :	-	1,172	1,172	22	389
4. Design and Construction of Training Institute					
a) Design (Local A/E)	-	-	-	119	-
b) Construction	-	-	-	2,855	-
c) Land	-	-	-	-	645
Sub-Total :	-	-	-	2,974	645
5. Other (Salaries, Office Space; Supplies, Utilities)	-	-	-	-	2,251
Sub-Total :	-	-	-	-	2,251
TOTAL:	-	9,787	9,787	7,431	9,160
Contingency 10%		978	978	743	916
GRAND TOTAL :	-	10,765	10,765	8,174	10,076

a/ Expressed as dollar equivalent at the exchange rate of $ 1.00 = Rs 12.16 as of July 19, 1982

FINANCIAL ANALYSIS ANNEX

TABLE 3

PROPOSED FINANCIAL PLAN

ENERGY LOSS REDUCTION COMPONENT
(In $ 000)

	A.I.D. Dollars			Rupees[a/]	
	Loan	Grant	Total	U.S.	GOP
1. Technical Assistance					
a. L/T Salaried Expatriates	-	1,240	1,240	479	-
b. L/T Pakistani Professionals	-	-	-	371	-
Sub-Total:	-	1,240	1,240	850	-
2. Training					
U.S. Short-Term					
a. Pakistani T.A. Team	-	40	40	9	-
b. WAPDA Project Staff	-	82	82	18	-
Sub-Total:	-	122	122	27	-
3. Commodities					
a. Tools and Instruments	-	500	500	-	-
b. Vehicles for T.A. Team	-	45	45	-	-
c. Other T.A. Team Support	-	-	-	22	-
d. Energy Loss Reduction Equipment and Materials	1,289	7,378	8,667	-	1,287
Sub-Total	1,289	7,923	9,212	22	1,287
4. FAR for Energy Loss Reduction Work	13,333	-	13,333	-	-
Sub-Total	13,333	-	13,333	-	-
5. Other (Labor, Warehousing, Transport, Utilities)	-	-	-	-	5,848
Sub-Total	-	-	-	-	5,848
Total:	14,622	9,285	23,907	899	7,135
10% Contingency	1,463	928	2,391	90	714
Grand Total	16,085	10,213	26,298	989	7,849

a/ Expressed as dollar equivalents at the exchange rate of $1.00=Rs 12.16 as of July 19, 1982.

FINANCIAL ANALYSIS ANNEX

TABLE 4

PROPOSED FINANCIAL PLAN

POWER GENERATION COMPONENT

Phase I - Guddu Gas Turbine Combined Cycle Power Generation Plant

	Foreign Exchange Costs	Local[a/] Currency Costs
	(In $ 000)	
A.I.D. : Grant	2,000	-
Loan	50,000	-
ADB[b/]	60,500	-
WAPDA/GOP	-	86,522
Total Phase I:	112,500	86,522

Phase[c/] II - Guddu Gas Turbine Combined Cycle Power Generation Plant

Islamic Development Bank and Kuwait Fund b/	84,170	-
WAPDA/GOP	-	90,471
Total Phase II:	84,170	90,471
Total Phases I and II:	196,670	176,993
Grand Total Phases I and II:	373,663	

a/ Expressed as dollar equivalents at the exchange rate of $ 1.00 = Rs. 12.15 as of July 19, 1982 and includes 10 percent contingency factor.
b/ Anticipated funding levels.
c/ Not considered part of this Rural Electrification Project.

TABLE 5

PROPOSED FINANCIAL PLAN
RURAL SYSTEM EXPANSION COMPONENT
(In $ 000)

	A.I.D. Dollars			Rupee a/	
	Loan	Grant	Total	U.S.	GOP
1. Technical Assistance					
a. L/T Salaried Expatriates	-	1,017	1,017	400	-
b. L/T Pakistani Professionals	-	-	-	522	-
Sub-Total :	-	1,017	1,017	922	-
2. U.S. Short-Term Training					
a. Pakistani T.A. Team Members	-	127	127	30	-
b. WAPDA Project Staff	-	254	254	59	-
Sub-Total :	-	381	381	89	-
3. Commodities					
a. Vehicles for T.A. Team	-	99	99	-	-
b. Other T.A. Team Support	-	-	-	32	-
c. Rural System Expansion Equipment and Materials	8,581	7,594	16,175 b/		15,183
Sub-Total :	8,581	7,693	16,274	32	15,183
4. FAR for Rural Distribution System Expansion	33,160	-	33,160	-	-
Sub-Total :	33,160	-	33,160	-	-
5. Other (Labor, Warehousing, Transport, Utilities)	-	-	-	-	9,687
Sub-Total :	-	-	-	-	9,687
TOTAL :	41,741	9,091	50,832	1,043	24,870
10% Contingency	4,174	909	5,083	104	2,487
GRAND TOTAL :	45,915	10,000	55,915	1,147	27,357

a/ Expressed as dollar equivalent @ the exchange rate of $ 1.00 = Rs 12.16 as of July 19, 1982

b/ Does not include $ 15 million that will be provided in FY-84 under the Agricultural Commodity & Equipment Project 391 - 0468, to import transformers, capacitors, meters and other equipment to connect irrigation tubewell pumps and other rural customers under this project.

FINANCIAL ANALYSIS ANNEX

TABLE 6

ILLUSTRATIVE ALLOCATION OF FUNDS FOR ENERGY LOSS REDUCTION WORK

Item	AID	GOP a/ (In $ 000)	Total
1. Compression Conductor Connectors Program.	500	-	500
2. Change of Conductor of economically overloaded lines.	10,500	1,158	11,658
3. Installation of new lines to relieve economically overloaded lines.	1,000	129	1,129
4. Installation of Capacitors.			
a) 11,000 volt, 600 KVAR Banks.	1,500	-	1,500
b) 230/400 volt on tubewells.	2,000	-	2,000
5. Change of Transformers.	2,500	-	2,500
6. Installation of voltage regulators.	1,000	-	1,000
7. Direct Load Control Program.	3,000	-	3,000
8. Tools and instruments.	500	-	500
9. Sub-Total	22,500	1,287	23,787
10. Labor, Warehouse Charge, Transportation, Engineering and Supervision (25% of the AID-GOP total of line 9).	-	5,848	5,146
11. Total	22,500	7,135	29,635
12. Contingency (10% of line 1)	2,250	714	2,964
13. Grand Total	24,750	7,849	32,599

a/At the exchange rate of $ 1.00 = Rs 12.16 as of July 19, 1982.

REGIONAL LEGAL ADVISOR'S ANALYSIS OF THE GUDDU PROJECT

July 27, 1982

Mr. Eugene Staples,
AA/Asia
Room 6212, NS
Agency for International Development
Washington D.C. 20523

Dear Rocky,

RURAL ELECTRIFICATION PROJECT - COMMINGLING

The provisions of A.I.D. HB 1 - Supp. B - Chapter 9 require that the Assistant Administrator/Asia (in consultation with G.C))consider problematic "commingling" situations and determine whether there is, indeed "commingling". Although the Mission does not see the history of the Guddu plant as constituting "commingling", as contemplated by the FAA, the situation may be sufficiently complex to warrant referral to A.A./Asia.

I have enclosed the RLA Briefing Memorandum and Executive Summary to assist you in your arriving at a determination as to whether or not there is a "commingling" situation.

If it is your determination that there is "commingling" requiring Administrator action, please advise as soon as possible so that the necessary Embassy action can be pursued. We need to move promptly on this so that the project can be assured of an FY 82 obligation.

Sincerely,

Original Signed By,

Enclosures: as stated.

Donor M. Lion

OPTIONAL FORM NO. 10
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

Memorandum

TO : Dr. Donor M. Lion, Director

DATE: June 15, 1982

FROM : Stephen J. Spielman, RLA

SUBJECT: EXECUTIVE SUMMARY

ISSUE:

Whether the Proposed Rural Electrification Project/ Guddu constitutes assistance to a bloc project or in support of a bloc project within the meaning of Section 620 (h) of the Foreign Assistance Act of 1961, as amended. (Commingling).

SUMMARY DISCUSSION:

The provisions of FAA 620 (h), as implemented by A.I.D., require that a determination be made as to whether a proposed project will result in "commingling", i.e. promote or assist foreign aid projects of bloc countries. In "clear" cases, this is to be a Mission determination. In ambiguous cases, this is to be an AA/Asia determination, in consultation with General Counsel. Authority to proceed with a proposed project may be granted by the Administrator even after a determination of commingling upon the recommendation of the Embassy and Mission to the effect that the proposed project is in "... the best interests of the United States".

The Guddu power station/worker colony, initiated in 1969 and now entering its third of four phases, originally received funding from both Czechoslovakia and the USSR. This funding, however, represents a relatively small percentage of the total project cost and, in the instance of Czechoslovakia, was provided on commercial rather than "assistance" terms. By far the largest contribution to project costs has been borne by the GOP with international donors and non-bloc countries having some, albeit relatively minor, participation.

Pakistani contractors and labor predominated in Phase 1 and 2 construction. Non-bloc private firms have participated in upgrading and maintaining Phase 1 and 2 equipment.

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Bloc technicians were required on site during construction of Thermal Station Phases 1 and 2. At the present time, there are still twenty-seven Russians at work at Guddu but after the overhaul and inspection team from the USSR finishes its assignment in November 1982, all bloc personnel will be required to leave Guddu.

Operation of Phase 1 of the Plant has been under total Pakistani control since 1980. Phase 2 will, similarly, be totally operated by Pakistanis by the end of 1982.

The publicity for the Guddu plant/colony, although acknowledging Czech and USSR assistance, has been directed by WAPDA and the media primarily to emphasizing the Pakistan achievement with "international" assistance. With increasing actual and potential non-bloc participation, there appears to be a further disassociation of the Guddu plant/colony from its already attenuated bloc linkage.

RECOMMENDATIONS:

i) A determination by the GOP to award the contract for the phase 3 generation equipment to the Japanese would further support an "international" rather than bloc characterization of the Guddu plant/colony. If the contract is awarded to Japan, I recommend the Mission present the issue of commingling to the AA/Asia for decision. The AA/Asia should also be provided with the substance of the factual analysis I have prepared and, to the extent appropriate, the A.I.D. Mission assessment (citing the RLA research) that the factual analysis of the Guddu project strongly suggests that, in the context of legislative intent, there is no commingling, i.e. the use of A.I.D. assistance will not promote or assist the foreign aid projects or activities of Communist-bloc countries.

ii) In the event that the GOP awards the contract for the phase 3 generation equipment to the People's Republic of China, there is a clear risk that A.I.D. assistance can produce the negative consequences of commingling addressed by FAA 620(h). I recommend that the Mission, therefore, make a determination as to whether, even assuming commingling, the "best interests of the United States" are served by going forward with this proposed project.

Assuming an affirmative determination is made, the Ambassador should be requested to review the factual analysis and join the Mission in its conclusion. The Mission and Embassy should, then, submit this joint determination as a recommendation to the Administrator to consider in his approval or disapproval of the project.

OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

Memorandum

TO :Dr. Donor M. Lion, Director

DATE: June 13, 1982

FROM :Stephen J. Spielman, RLA

SUBJECT:BRIEFING MEMORANDUM FOR GUDDU COMMINGLING DISCUSSIONS

ISSUE:

Whether the Proposed Rural Electrification Project/Guddu constitutes assistance to a bloc project or in support of a bloc project within the meaning of Section 620 (h) of the Foreign Assistance Act of 1961, as amended. (Commingling).

Sub Issue 1: What are the procedural mechanisms for addressing the commingling issues ?

Sub Issue 2: What are the criteria for determining whether a proposed project will result in commingling ?

1. LEGISLATIVE/REGULATORY CONTEXT:

Section 620 (h) of the Foreign Assistance Act of 1961, as amended, provides as follows:

> " The President shall adopt regulations and establish procedures to insure that United States foreign aid is not used in a manner which, contrary to the best interests of the United States, promotes or assists the foreign aid projects or activities of the Communist-bloc countries."

This legislative requirement is implemented by A.I.D. HB 1 - Supp.B - Chapter 9 (Commingling). The context of passage of FAA 620 (h) was Congressional concern that U.S. assistance funds were being expended in Cambodia in a manner which resulted in aiding Russian and Chinese communist assistance projects, without the United States obtaining appropriate credit. In offering the amendment, Congressman Hardy stated:

> " ... in a recent study my sub-committee made into certain aspects of our aid program in Cambodia, it developed that

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our aid funds were being expended in various ways which resulted in aiding Russian and Chinese Communist aid projects... The amendment which I have offered is designed to prevent the commingling of United States and Sino-Soviet bloc aid in any manner which is inconsistent with the best interests of the United States." (Congressional Record, July 12, 1962. P 12512)

This legislative context is reflected in the A.I.D. Handbook implementation which, while concerned with the negative effects of commingling, does not mandate an absolute prohibition against commingling. To the contrary, the Handbook implementation guidelines provide that, even should it be determined that commingling exists, the "best interest of the United States" may, nonetheless, warrant a specific affirmative determination by the Administrator, acting on the recommendation of the A.I.D. Mission and the American Embassy in the cooperating country, to go forward with the project.

II. PROCEDURAL MECHANISMS FOR CONSIDERING COMMINGLING:

The alternative factual situations which may arise in determining whether there is potential commingling and procedure to be followed in considering each such situation are as follows:

A) The Mission determines that there is "clear cut" absence of A.I.D. assistance which will promote or assist bloc project or activities: No further action required.

B) The Mission determines that the issue of commingling is not "clear cut": The facts are to be referred to AID/W where a determination is to be made by the AA/Asia, acting in consultation with General Counsel, as to whether the project will result in commingling. If it is determined that there is no commingling, no further action is required.

C) The Mission or AA/Asia determines that the A.I.D. project or program will promote or assist bloc projects or activities but is not contrary to the best interests of the United States : The A.I.D. Mission and Embassy are to prepare a recommendation to this effect and submit that recommendation to Administrator for his decision.

III CRITERIA FOR DETERMINING WHETHER A PROPOSED PROJECT WILL RESULT IN COMMINGLING:

The only "formal" definition of "commingling" is to be found in HB 1-supp.B, Chapter 9 which simply repeats the language of FAA 620 (h).

> "Commingling, as used in this Chapter means the use of AID assistance in a manner which, contrary to the best interests of the United States, promotes or assists the foreign aid projects or activities of Communist-bloc countries."

"Communist bloc countries" is further defined as any country not included in A.I.D. Geographic Code 935 (USSR, CSSR and People's Republic of China are all excluded from Code 935).

To assist the Mission in evaluating the unique factual circumstances presented in each case, the Mission may obtain some further guidance from the body of General Counsel Opinions which has been generated by the commingling issue as well as from Manual Order 1018.9 (effective May 8, 1964, but superseded by HB 1 B, Chapter 9). It should be noted, at the start, that the criteria for determining whether there is commingling and the criteria for an Administrator to determine that a project should proceed even if there is commingling are not mutually exclusive, i.e. many of the reasons which may impel an Administrator to determine that a project should go forward are also reasons which may suggest that there is an absence of commingling or, perhaps, minimal commingling. It is also important to recognize that no absolute line has been drawn as to what facts dictate a conclusion of commingling, but, rather, that the concept of commingling is both relative and fluid.

The following is intended to provide some suggestions as to facts to be considered in determining whether a given project will result in commingling:

a) Is the project receiving bloc country assistance ? To the extent that the funds provided by bloc sources to the project are provided on an armslength, commercial basis, and not through grants or concessional loans, the funds so provided need not be considered "assistance" within the meaning of FAA 620 (h). To the extent that the funds are provided by a private company or an organization which is not an official agency of a bloc government, the

contribution need not be considered a contribution to a "bloc project" (Mission Order 1018.9, superseded).

b) Are the U.S. Government funds being provided to construct a facility, even an annex, which is physically separable from the bloc project ? (Memorandum from Bruce S. Mencher to Robert S. Smith, March 12, 1969).

c) What are the relative contributions of the bloc governments, host country, and non-bloc countries ? Is the Communist bloc government a "primary" contributor ? (Mission Order 1018.9 superseded).

d) What efforts have been made to promote the identity of the project as a bloc project, non-bloc project, international project or host country project ? In this context, the following should be considered:

i) Is the project highly visible ?

ii) Are there flags, insignies, decal's or other designations which foster the perception of the project as a bloc effort ?

e) What is the Mission's knowledge as to future funding of the project and the effect this future funding would have on commingling ? Will it dilute the perception of the project as a bloc effort ?

f) What is the Mission's opinion as to the effect the proposed A.I.D. assistance will have on the project being perceived as a bloc project, non-bloc project, international project or host country project.

IV FACTUAL ANALYSIS

a) General Background

In 1969, WAPDA initiated construction of phase 1 of the four phase Guddu Power Station, situated on the right bank of the River Indus in a small remote village of Upper Sind. It is anticipated that this Power Station, once all phases are completed, will be the biggest power station in Pakistan with a final project capacity of 1,099 megawatts. This capacity exceeds that of the Mangla Hydro Power Station (600 megawatts) and the Multan Natural Gas Power Station (265 megawatts). The Guddu Power Station, in

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addition to adding stability to the National Grid, has been and will be responsive to the increase in power demand in Sind and Baluchistan.

The Guddu project, located in a sparsely populated desert area, consists of both the power generation plant and a workers' colony housing 6,000 persons, complete with residential accommodations, water, electricity, secondary and primary schools, hospital and recreational facilities. In analysing the issues presented by bloc contributions to the project, it is appropriate to recognize that the power generation plant and worker colony are integrated efforts and, accordingly, both should probably be considered as a single undertaking.

The Guddu thermal power station consists of four phases:

1. Phase 1 - Initiated in 1969 and completed in 1970, consists of two thermal generating units and one gas turbine yielding a total capacity of 220 megawatts. During the course of Phase 1, some work was undertaken on developing the infra-structure of the worker colony . Czechoslovakian generation units are in use.

2. Phase 2 - Commenced in 1978 and commissioned in 1980, resulted in installation of one 210 megawatt unit. It was during Phase 2 that the greatest expenditures were made for the infra-structure, accommodations, and amenities of the worker colony. Soviet generation units are in use.

3. Phase 3 - Currently in preparation and scheduled to provide an additional capacity of 210 megawatts. Japanese or People's Republic of China generation units are being considered.

4) Phase 4 - Scheduled to provide an additional capacity of 450 megawatts. U.S. participation is proposed for this phase.

b) Physical Layout of Guddu

Each of the proposed four phases of the power station are located in or to be located in separate buildings. The buildings housing phase 1, 2 and 3 are or will be connected. The phase 4 building, we are informed, will not be connected and, in fact, will be accessible only through a separate gate entrance servicing exclusively the phase 4

facility. It is my general impression, however, that the four phases of the facility, abutting each other, integrated into one distribution network and relying on a single worker colony, are properly viewed as one plant. Historically, phase 1 and 2 have been referred to as the Guddu Thermal Power Station plant, and to now separate out this fourth phase and identify it as a "separate project" is inconsistent. It could also be noted that the physical isolation of the Guddu area makes it difficult to view the four phases as other than one growing project.

c) Financial Analysis of Monetary Contributions to Guddu Thermal Power Station/Colony 1/

In analysing contributions, I consider it appropriate, for reasons given above, to define the project as including both the power station and the worker colony.

1. Phase 1 - The first phase of the project was developed around the provision by Skoda Export (Czechoslovakia) of two thermal generated units having a capacity of 220 megawatts. This equipment, however, was not provided to WAPDA on grant or concessional loan terms, but, rather, was supplied on a cash-cum-barter basis, 40% cash/60% barter.

The total cost for phase 1 of the project was Rs 698 million, of which the Czechoslovakian cash-cum-barter contribution was approximately 20.5%. The Pakistani contribution was 74% with the remaining funding being provided through Italian credit, World Bank loan and Canadian private sources.

Even isolating the power plant as a separate project, the bloc participation in phase 1 was less than one-third of its total cost.

2. Phase 2 - The second phase of the project was developed around the provision by Technopromexport (USSR) of a 210 megawatt generator. The equipment was provided through USSR credit although, according to Mr. Husain Ali (Guddu Project Director), the credit was not on particularly "soft" terms. The total cost of phase 2 of the project was Rs 1905 million, of which the USSR credit represented approximately 16%. The Pakistani contributions was 82% with the remaining funding being provided through Japanese credit and World Bank loans.

1/ See tables 1 and 2 attached.

isolating the power plant as a separate project, the bloc participation in phase 2 was, perhaps, one-third of its total cost.

3. Phase 3 - Still not implemented, WAPDA is considering the People's Republic of China and Japan as the source of the 210 megawatt generating unit.

d) Manpower Analysis of Construction and Operation of Guddu Thermal Power Station/Colony

Analysis of relative man-power contributions and the identity of the various executing agencies suggests that WAPDA has attempted and continues to attempt to minimize the presence of bloc personnel. In discussions with WAPDA representatives, it was made clear that bloc personnel are being replaced as rapidly as possible and, by the end of 1982, there will be no bloc personnel at site. This is consistent with the oft-expressed concern of the WAPDA leadership that Guddu be perceived as a Pakistani achievement with international assistance rather than the achievement of any single country or bloc.

1. Phase 1 - Phase 1 was constructed with assistance from 110 Czechs, 5 Italian consultants and 7,000 Pakistanis (skilled and non-skilled workers). Skoda supplied the plant equipment and erected the plant. The construction of the worker colony was contracted to a Pakistani firm as were most of the Phase I civil works.

At the present time, no foreigners are involved in the operation of Phase 1 or worker colony.

2. Phase 2 - Phase 2 required the presence of 290 Russians (maximum) and 90 Poles (maximum). Pakistan contributed 5,000 laborers (skilled and non-skilled). USSR executing agencies supplied the power plant equipment and installed the turbo generators. The boiler installation, mechanical equipment, civil works, electrical works, lighting systems, cooling systems, circulating water systems, cranes and hydro-technical works were all contracted to and executed by Pakistani firms.

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At present there are approximately 27 Russians at the site, assisting in operation of the power station - Phase 2. 60 additional Russian technicians are scheduled to arrive during summer 1982 for the first over-haul and inspection of Phase 2 but all are scheduled to leave by November 1982. There are also two British technical trainers at site.

e) Analysis of Ancillary Contributions to Project

In addition to the financial and man-power contributions listed earlier, there have been a significant number of additional international donors and businesses participating in the Guddu Thermal Power Station/Colony. The result of this is that, although major equipment of phase 1 is still visibly "Skoda", there is considerable evidence of modifications and additions through use of equipment from non-bloc countries, e.g. Japan, USA and West Germany. A summary of the actual and contracted for additional contributions follows:

1) Construction of Grid Station - Contract with Japan for US $ 20 million.

2) 500 KV Transmission system - Financed by Kuwaiti fund (this transmission system is not, however, properly a part of the Guddu project).

3) Training Institute for Pakistani Engineers and Technicians - Financed by ADB Loans for 36 million sterling pounds and Rs 1.8 million.

4) Modifications of Power Plant:

a) Switzerland - US$ 79,310
b) Japanese - US$ 600,000 +
c) United States - US$ 100,000 ±
(Honeywell and Rockwell)
d) West Germany - DM 175,214 + US$ 20,781

f) Publicity/Propaganda and Perceptions of Guddu Project

Although the GOP has consistently acknowledged the Communist bloc contributions to the Guddu Thermal Power Station, the direction of the Pakistan publicity effort has been to maximize public perception of the plant/colony as a Pakistani undertaking. A number of examples are cited to illustrate this point:

1) Absence of bloc identifying signs at Thermal Power Station or colony: Other than standard machinery name plates identifying the source of manufacture of the largest pieces of power equipment, there are no decals, signs or other indicee of bloc participation in the power plant or colony. In the entrance hall to Phase 1 there is, however, one plaque in Urdu on which are listed the names of the eight prime contractors for that phase including Technopromexport (USSR).

2) Pakistan Economist, November 22, 1980: A series of articles in the Pakistan Economist, while acknowledging significant Czechoslovakian and USSR contributions, emphasized that "Guddu is an international project" and, further, that WAPDA is attempting to minimize dependence on maintenance/repair supplies from foreign countries. The report also stressed the Pakistani control of current operations:

> Ever since the commissioning of these units, the entire thermal power station is being operated and maintained exclusively by Pakistani staff, rather more efficiently than such units in Czechslovakia. This fact is duly recognized and appreciated by the Czechs themselves, who speak highly of the craftmanship and proficiency of Pakistani engineers and technicians.

The absence of heavy industry in the country - one of the conditions of survival in the present age - is having a serious impact upon the efforts for rapid industrialization of our economy. We have to depend upon other countries for the import of necessary spare parts and accessories. This precarious situation is a dangerous impediment in the way of smooth functioning of the project. The acute shortages of the spare parts of the present installed Czechoslovakian Units have impelled our Engineers to find ways and means to produce spares at home.

The Power Station Workshop is at present manufacturing 40% of the spare parts required for the maintenance of the Auxiliary equipment including the big parts required at the intake circulating Water System, thus decreasing dependance on the supply of spare parts from abroad. Several modifications have been carried out in the plant at later stages to obtain more stability in the operation by Pakistani engineers.

WAPDA Brochure(1980): A WAPDA brochure describing the Power Station emphasized that"... since its commissioning in 1974, [Phase 1] has been operated and maintained exclusively by Pakistani engineers and technicians."

Indus,October/December 1980: An article by Mr. Mirza Ali, (Project Director, Guddu) emphasized the Pakistani achievement at Guddu in the context of acknowledging an earlier dependence on bloc technology;

Eversince the commissioning of these units, the entire Thermal Power Station is being operated and maintained exclusively by Pakistani Staff, rather more efficiently than such units in Czechoslovakia. This fact is duly recognized and appreciated by the Czechs themselves, speaks highly of undoubted

ability craftmanship and proficiency of Pakistani engineers and technicians.

***

WAPDA Engineers... had no experience... Training of the technical hands, therefore, became imperative. 30 Engineers were sent to USSR for training on similar plants in operation in Russia and about 400 technicians were given a comprehensive training at Training Institute Guddu. These people, who laboured hard for the early completion of this Project are now waiting anxiously for taking over the operation of this so far biggest Unit in the country.

5) Pakistan Economist, January 23, 1982 - In an article entitled "Red Star Over Guddu", there was considerable discussion as to criteria to be applied in contracting for the third phase of the Guddu Thermal Power Station. This article, despite its somewhat misleading title, emphasized the need to make a non-political decision and suggested that the past Soviet experience has been discouraging, e.g. "time consuming formalities", high cost of servicing and maintenance, high cost of Russian workers, etc.

V. RECOMMENDATIONS:

i) A determination by the GOP to award the contract for the phase 3 generation equipment to the Japanese would further support an "international" rather than bloc characterization of the Guddu plant/colony. If the contract is awarded to Japan, I recommend the Mission present the issue of commingling to the AA/Asia for resolution. The AA/Asia should also be provided with the substance of the factual analysis I have prepared and, to the extent appropriate, the A.I.D. Mission assessment (citing the RLA research) that the factual analysis of the Guddu project strongly suggests that, in the context of legislative intent, there is no commingling, i.e. the use of A.I.D. assistance will not promote or assist the foreign aid projects or activities of Communist-bloc countries.

ii) In the event that the GOP awards the contract for the phase 3 generation equipment to the People's Republic of China, there is a clear risk that A.I.D. assistance can produce the negative consequences of commingling addressed by FAA 620 (h). I recommend that the Mission,

therefore, make a determination as to whether, even assuming commingling, the "best interests of the United States" are served by going forward with this proposed project.

Assuming an affirmative determination is made, the Ambassador should be requested to review the factual analysis and join the Mission in its conclusion. The Mission and Embassy should, then, submit this joint determination as a recommendation to the Administrator to consider in his approval or disapproval of the project.

GUDDU THERMAL POWER STATION STAGE 1

(includes Worker Colony)

(Rs in Millions)

	Local	Foreign	Total
A. Cost of the Project			
i) Power Plant (Supply and Erection)	348.78	143.13	491.91
ii) Colony	16.23		16.23
iii) Consultants	6.37	9.66	16.03
iv) Civil Works	174.82		174.82
Total	546.20	152.79	698.99

B. Financing	(Rs in Millions)	%
i) World Bank loan	30.00	4.292%
ii) Canadian(Stadler Hurter)	2.24	0.321%
iii) Czechoslovakian cash-cum-barter credit (40% cash + 60% barter)	143.13	20.477%
iv) Italian Credit	7.38	1.057%
v) Local (Pakistani)	516.24	73.953%
	698.99	100%

GUDDU THERMAL POWER STATION STAGE II

(Rs in Millions)

	Local	Foreign	Total
A. Cost of Project			
i) Supply of Power Plant	215.192	298.686	513.878
ii) Erection works	429.818	-	429.818
iii) Colony	44.580	-	44.580
iv) Consultants	10.853	10.650	21.503
v) Civil and other works	895.221		895.221
	1595.664	309.336	1905.00

B. Financing	(Rs in Millions)	
i) World Bank loan	30.00	1.575%
ii) Japanese Credit	4.00	0.210%
iii) USSR Credit	309.336	16.237%
iv) Local (Pakistani)	1561.664	81.978%
	1905.00	100%

ILLUSTRATIVE TRAINING PROGRAM

for

Officers and Employees of WAPDA Assigned to

POWER DISTRIBUTION
and
RURAL ELECTRIFICATION FUNCTIONS

From a Comprehensive Report Prepared by:

Mr. Edward E. Gaither
National Rural Electric Cooperative Association

and

Dr. Rudi Klauss
National Association of Schools of Public Affairs and Administration

ILLUSTRATIVE TRAINING PROGRAM

Component II - Distribution Function Training

I. Short-Term U.S. Training

A. Short Courses

	Course	Duration	Annual Average Participants	Frequency	Audience
1.	Organization & Operation of Rural Electrification System	6 weeks	10	Annually	Senior Management to Chief Engineer
2.	Management Concepts Applied to Utility Operations & System Planning for Electricity Distribution	4 weeks	30	3 times per year	Engineers

B. Sister Utility On-the-JOB TRAINING Exchanges From WAPDA to U.S. Electric Utilities

Exchange Category	Average Length of Exchange	Average Number of Exchanges per Year	Number of Years	Total Number of Exchanges
General Management and Administration	4 months	4	4	16
Commercial	4 months	8	4	32
Financial	4 months	8	4	32
Technical	4 months	20	4	80
Total:		40		160

II. Long-Term U.S. Academic Training

Subject	Degree	Participants	Audience
a. Vocational/Technical Education	Masters	2	Training Staff
b. Instructional Technology	"	2	"
c. Finance	MBA	2	Finance Staff
d. Inventory Procurement and Management	MBA	2	Stores Staff
e. Marketing	MBA	2	Commercial Staff
f. General Management	MBA	2	Senior Management
g. Computers Management Information System	MBA	2	A.D.P. Staff

III. In-Country Training

A. Electric Utility Management

	Course	Duration	Annual Average Participants	Frequency	Audience
1.	Management - Its Nature & Scope.	1 week	60	3 times per year	Senior & Mid.level Management
2.	Principals of Organization	1 week	60	"	"
3.	Planning & Organiing for Operations	1 week	60	"	"
4.	Interpretation of Financial Reports	1 week	60	"	"
5.	Commercial (Customer) Services	1 week	60	"	"
6.	Human Relations Skills	1 week	60	"	"
7.	Organizational Planning	1 week	60	"	"
8.	Career Awareness	1 week	60	"	"
9.	Use of Accounting Data for Utility Management	1 week	60	"	"
10.	Use of Financial Data for Planning & Control	1 week	60	"	"
11.	Cash Management for Managers	1 week	60	"	"
12.	Organizational Dynamics	1 week	60	"	"
13.	Organizational Evaluation	1 week	60	"	"
14.	Human Resources Management	1 week	60	"	"
15.	Utility Economics for Management	1 week	60	"	"

B. COMMERCIAL MANAGEMENT & CUSTOMER SERVICE

Course	Duration	Annual Average Participants	Frequency	Audience
1. Customer Service Program	4 weeks	120	Bimonthly	Sr. Mgmt. & Com.Mgrs.
2. Handling Customer Complaints	1 week	40	Semi Annual	Complaint Supv.&Clerks
3. Productive Uses Programs	2 weeks	40	Semi Annual	Com.Mgrs.
4. Productive Uses Application	2 weeks	40	Semi Annual	Com.Mgrs.
5. Customer Communications	1 week	40	Semi Annual	Com.Mgrs.
6. Customer Involvement	1 week	40	Semi Annual	Com.Mgrs.
7. Community Service Program	week	40	Semi Annual	Com.Mgrs.
8. Corporate Image (Public Relations)	1 week	40	Semi Annual	Sr. Mgmt. & Com.Mgrs.

C. FINANCIAL MANAGEMENT & ACCOUNTING

Course	Duration	Annual Average Participants	Frequency	Audience
1. Uniform System of Accounts for Electric Utilities	12-4 weeks courses	220	Monthly	All Accountants
2. Accounting Procedures	4 weeks	20	Annually	Accounting Supv.
3. Billing and Collections	4 weeks	20	"	Rev. Officers
4. Customer Records	2 weeks	20	"	" "
5. Accounts Receivables	4 weeks	20	"	" "
6. Accounts Payable	1 week	20	"	Accounting Supv.
7. Internal Audit Procedures	4 weeks	20	"	Sr. Mgmt.
8. Work Order Inventories	4 weeks	20	"	Plant Accountants
9. Continuing Property Record	4 weeks	20	"	"
10. Cash Management	1 week	20	"	Sr. Mgmt.
11. Financial Forecasting	4 weeks	20	"	" "
12. Financial Managment	4 weeks	20	"	" "

D. Technical Management and Distribution Engineering

	Course	Duration	Annual Average Participants	Frequency	Audience
1.	Design & Staking	4 weeks	40	Semi Annual	Design Engineers
2.	Secondary (Low Tension) Design	2 weeks	40	"	"
3.	Economic Sizing of Conductor	2 weeks	20	Annually	"
4.	Voltage Drop Studies	2 weeks	20	"	"
5.	Sectionalizing Studies	2 weeks	20	"	"
6.	Load Forecasting	4 weeks	20	"	Planning Engineers
7.	Planning Feasibility Studies	4 weeks	20	"	"
8.	Technical Operations	4 weeks	20	"	Operating Engineers
9.	Cost of Service Studies	4 weeks	20	"	Rate Engineers
10.	Retail Rate Design	4 weeks	20	"	"
11.	Construction Supervision	2 weeks	40	Semi Annually	Construction Engineers
12.	Construction Completion (close out)	1 week	40	"	"
13.	Load Management	4 weeks	20	Annually	Operating & Planning Engineers
14.	Loss Management	4 weeks	20	"	"
15.	Electric Utility Economics for Engineers	2 weeks	20	"	Engineers

E. AUTOMATIC DATA PROCESSING

Course	Duration	Annual Average Participants	Frequency	Audience
1. Management Information Systems	1 week	40	Semi Annual	Sr. & Mid. Mgmt.
2. Utilizing Management Information Systems for Improved Results	1 week	40	Semi Annual	Sr. & Mid. Mgmt.

F. PROCUREMENT & INVENTORY MANAGEMENT

1. Procurement Procedures	2 weeks	20	Annually	Dir.Procurement & Sr. Staff
2. Inventory Management	2 weeks	160	8 times per Year	Sr. Mgmt.& Store Keepers
3. Stores Control-Electric Plant	4 weeks	160	8 times per Year	Sr. Mgmt. & Store Keepers
4. Stores Control-General Plant	2 weeks	20	Annually	Sr. Mgmt.
5. Perpetual Inventory	1 week	20	Annually	Sr. Mgt. & Store Keepers

G. SUPERVISORY MANAGEMENT

Course	Duration	Annual Average Participants	Frequency	Audience
1. Supervisory Management	2 weeks	120	Bimonthly	Supervisors Sr.Clerks Line Suptds. & Foremen
2. Planning & Organizing for Supervisors	1 week	120	"	"
3. Controlling Work Activities	1 week	120	"	"
4. The Human Side of Supervision	1 week	120	"	"
5. The Communications Process	1 week	120	"	"

H. TECHNICAL SUPERVISION

Course	Duration	Annual Average Participants	Frequency	Audience
1. Distribution System Operation and Maintenance	2 weeks	80	Quarterly	Line Supts. & Foremen
2. Substation Operation & Maintenance	1 week	80	"	"
3. Transformers	1 week	80	"	"
4. Regulators	1 week	80	"	"
5. Automatic Circuit Reclosures	1 week	80	"	"
6. Capacitors	1 week	80	"	"
7. Meters	1 week	80	"	"
8. Relays	1 week	80	"	"

I. TRAINING OF TRAINERS

1. Training Methodology	6 weeks	20	Semi Annual	All Instructors
2. Training Materials Development/ Production	3 weeks	20	"	"
			"	"
3. Curriculum Development	4 weeks	20		
4. Management of Training	2 weeks	20	"	"
5. Classroom Communication Skills	3 weeks	20	"	"
6. Annual Refresher Course	2 weeks	20	"	"
7. Lineman Trainers Training	10 weeks	30	3 times per year	"

J. CONSTRUCTION MANAGEMENT

Course	Duration	Annual Average Participants	Frequency	Audience
1. Assembly Line Distribution Construction	2 weeks	40	Semi Annually	XEN Const. & Supervisors
2. Construction Planning & Organizing	1 week	40	"	"
3. Inspection	2 weeks	20	Annually	"
4. Supervision	1 week	20	"	"
5. Construction Materials Management	1 week	40	Semi Annually	"
6. Construction Completion (close out)	1 week	20	Annauuly	"

K. VOCATIONAL TECHNICAL TRAINING

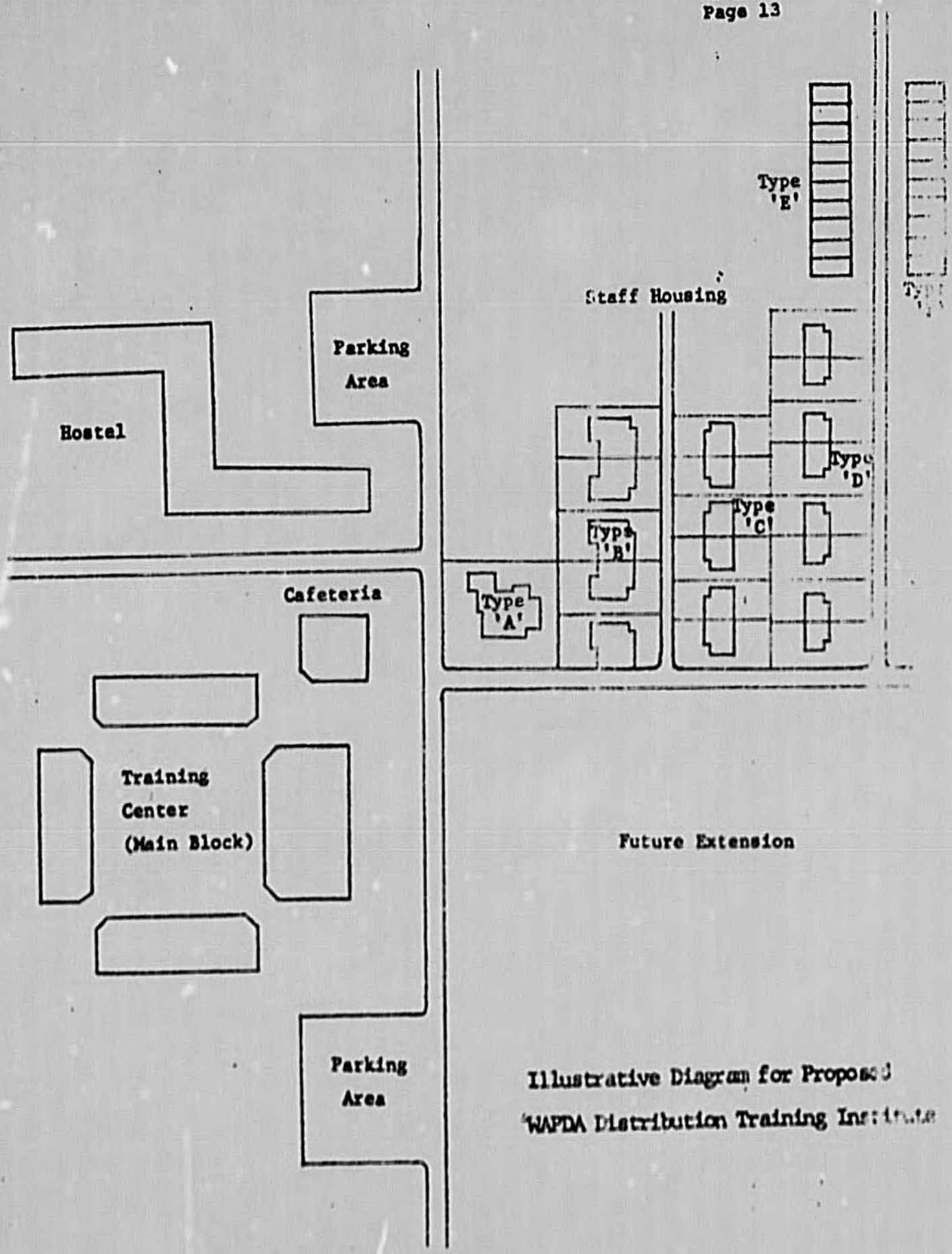
1. Linemans Training	8-4 weeks Courses	2,500	Monthly	Linemen Asst. Linemen
2. Transformer Repair	4 weeks	30	Semi Annual	Technicians
3. Meter Testing & Repair	4 weeks	30	"	"
4. Automatic Circuit Reclosure Repair	2 weeks	30	"	"
5. Relay Application & Maintenance	4 weeks	30	"	"
6. Linemans Apprentice Program	4 years	100		Apprentice Linemen
7. VHF Communications Operators Training	1 week	100	10 months per year	Communication Technicians
8. VHF Communications Maintenance	3-4 week courses	30	Semi Annual	"

ILLUSTRATIVE BUDGET FOR PROPOSED WAPDA DISTRIBUTION ORGANIZATION TRAINING INSTITUTE

Component II - Distribution Organization Training

Cost Item		Estimated Cost (in thousands of Rupees) FY 84*
1.	Training Center (20,000 sq.ft. @ Rs. 300/sq.ft.)	Rs. 8,640
2.	Cafeteria (3,000 sq.ft. @ Rs. 280/sq.ft.)	1,210
3.	Hostel (22,000 sq.ft. @ Rs. 250/sq.ft.)	7,920
	Staff Accommodation	
4.	Type "A" (2,000 sq.ft. @ Rs. 250/sq.ft.)	720
5.	Type "B" (7,500 sq.ft. @ Rs. 200/sq.ft.)	2,160
6.	Type "C" (12,000 sq.ft. @ Rs. 180/sq.ft.)	3,110
7.	Type "D" (12,800 sq.ft. @ Rs. 180/sq.ft.)	3,318
8.	Type "E" (12,000 sq.ft. @ Rs. 150/sq.ft.)	2,592
9.	Type "F" (10,000 sq.ft. @ Rs. 150/sq.ft.)	2,160
10.	Sub-total:	31,830
11.	Utilities (10% of Line 10)	3,183
12.	Roads and Grounds (10% of Line 10)	3,183
13.	Design and Construction Supervision(5% of Line 10)	1,591
14.	Cost of Land	8,640
15.	Sub-total:	48,427
16.	Contingency (10%)	4,843
17.	Estimated Total Cost	53,270

* Projected FY-82 cost assuming 20% inflation per annum



Illustrative Diagram for Proposed
WAPDA Distribution Training Institute

Excerpted from

Recurrent Cost Analyses of Three Proposed USAID Projects

by

Harold W. Wisdom & William J. Nagle

II. RURAL ELECTRIFICATION

Implications and Problems: The recurrent costs of the rural electrification project consist of all operating, maintenance, replacement and additional administrative costs incurred in the supply of electricity to customers served by the project. The rural electrification project does not appear to have potential recurrent cost problems; WAPDA merely needs to ensure that rates are set high enough to cover the operating costs of the project. However, because of the institutional framework in which the rural electrific ation project will operate and because of the practice of WAPDA of underestimating certain operating costs, there are several troublesome points which we feel need to be examined in greater detail during the project implementation phase.

1. The control by GOP over WAPDA's budget on both the expenditure and revenue sides severs the direct linkage between operating expenditure and revenues. While this provides the GOP with flexibility to use the utility as an instrument for social change, it also removes the management discipline self-financing imposes up on a utility. Among other things, for example, it encourages spending any current operating surpluses on urgent social programs rather than on easily-postponed maintenance and replacement items.

2. WAPDA's depreciation charges are based upon the original purchase cost (book value). This practice substant ially under-estimates the actual replacement cost, which is set on the world market and is subject to inflation. WAPDA has taken a physical inventory of its plant and equipment and is preparing a current replacement cost estimate. We were told that full implementation of a current replacement cost depreciation accounting system would be difficult. Peat, Marwick and Mitchell are assisting WAPDA on this problem. The issue is a key one for recurrent cost analyses, since

replacement cost depreciation would increase annual operating costs WAPDA should be encouraged to adopt the replacement cost procedure.

3. Natural gas prices charged WAPDA are regulated prices and reportedly are set substantially below world prices. Setting aside the broader question of whether subsidized gas prices are in the national interest, we were told by several persons interviewed that it was likely that gas prices will rise substantially in the future, probably more rapidly than the general rate of inflation, although not to their free market level. Since gas purchases are a significant part of WAPDA's operating costs, any upward movement in natural gas will be reflected in increases in recurrent costs.

4. Equipment and parts replacement cost are subject to world price increases. WAPDA estimates that these costs have been increasing at about 12 - 15 percent annually, on a unit cost basis in proportion to the importance of equipment and parts in total recurrent costs

5. The proposed USAID project is only one of several electric power expansion projects in Pakistan. The Asian Development Bank, World Bank and other donor countries have electric power projects in various stages of planning and implementation Concern was expressed by WAPDA that the implementation of all of these projects could severely strain WAPDA's administrative system. If this occurs, efficiency losses could significantly increase recurrent costs.

6. The rate structure appears to subsidize some users at the expense of others. Both GOP Economic Affairs and WAPDA finance officials agreed that industrial and commercial users were subsidizing agricultural and residential users. The policy of charging the same rate for the entire country for each user category suggests that urban users also are subsidizing rural users, since it is likely that the long-run average cost of providing a kilowatt hour of electricity is greater for the more remote rural areas

The desire to stimulate agricultural development and improve the standard of living in the rural areas by providing electricity at less than cost is understandable However, it is not at all clear that it is in the long run economic interest of Pakistan to make the commercial and industrial sectors pick up the burden of this subsidy The higher electricity rates increase the operating costs of industrial and commercial users and these higher costs are passed along to consumers in the form of higher costs

of goods.

The combination of nationwide rates and the higher costs of providing rural electricity suggests that the rural electrification project probably will increase electricity rates for urban and current rural customers. Because the cost of providing electricity to rural areas is higher than for urban areas, it follows that an expansion of the rural system relative to the urban system will increase total system average costs. Since electricity rates are set at the national level and reflect the need to cover the long-run average costs of the total system, it also follows that the increase in total average cost will be translated into higher electricity rates for urban and current rural customers. Thus, the subsidy burden carried by urban customers will increase even when there has been no change in service to them. We should mention that GOP officials stated that it would be politically difficult to alter the rate structure; nevertheless, we feel that the full economic implications of the subsidies need to be analyzed.

The first four points raised suggest substantial upward pressure on WAPDA's recurrent costs in the future. Increases in recurrent costs, in turn, will require either like increases in electricity rates or current account transfers from GOP or a combination of both. Increases in electricity rates not matched by like increases in rural incomes would lead to increasingly burdensome electricity bills for rural consumers. Any reaction by consumers to the higher bills in the form of reductions in consumption and/or non-payment of electricity bills would further exacerbate the situation. We stress that we do not predict that these events will, in fact, occur; we merely raise them as items that, because of their implications, warrant further study.

Recommendations

We recommend that USAID conduct an in-depth study of WAPDA's recurrent costs over the next 15-20 years. The study should focus on the four items discussed above and include detailed forecasts of recurrent costs and increases in electricity rates, by user category, necessary to cover recurrent costs. Each major cost item should be projected on the basis of price increases expected for that item rather than using a single rate of inflation for all items.

BEST AVAILABLE DOCUMENT

A thorough economic analysis also should be made of the rate structure , with the emphasis on the social benefits and costs of the current subsidization of agricultural and residential use. This could be done as a part of the recurrent cost analyses; however, we feel that it has a lower priority and could be done at a later date.

LIST OF PROJECT-RELATED DOCUMENTS ON FILE AT USAID/PAKISTAN

A. Consultant Reports

1. Pakistan Rural Electrification	Gilbert F.Moon/NRECA
2. Evaluation of Rural Electric Distribution - Technical Viewpoint	Carlos A. Molina/NRECA
3. Rural Electrification for Pakistan Management and Commercial Operations	Lucio Burgos/NRECA
4. Rural Electrification : Training Component	Edward R Gaither/NRECA Rudi Klanss
5. Distribution Inventory Management	Cauis Bisco/Peat, Marwick and Mitchell
6. Guddu Gas Turbine Project	D.J. Christoffersen/NRECA
7. Rural Electrification in Pakistan - a Socio-Economic Impact Study	Dr. Mohammad A. Rauf/ Quaid-e-Azam University
8. 450 KW Combined Cycle Plant at Guddu	National Engineering Services of Pakistan
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