PD-AAM-437

RURAL ELECTRIFICATION II

PROJECT PAPER

USAID/Bangladesh

June, 1981

AGENCY FOR INTERNATIONAL DEVELOPMENT

PROJECT DATA SHEET

1. TRANSACTION CODE: A (A = Add, C = Change, D = Delete)

Amendment Number: N.A.

DOCUMENT CODE: 3

COUNTRY/ENTITY: BANGLADESH

3. PROJECT NUMBER: 388-0054

BUREAU/OFFICE: ASIA 04

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

PROJECT ASSISTANCE COMPLETION DATE (PACD): MM 12 DD 31 YY 87

7. ESTIMATED DATE OF OBLIGATION (Under 'B.' below, enter 1, 2, 3, or 4)

A. Initial FY 81 B. Quarter 4 C. Final FY 84

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

A. FUNDING SOURCE	FIRST FY 81 B. FX	C. L/C	D. Total	LIFE OF PROJECT E. FX	F. L/C	G. Total
AID Appropriated Total	19,400	600	20,000	47,464	2,536	50,000
(Grant)	(19,400)	(600)	(20,000)	(47,464)	(2,536)	(50,000)
(Loan)	( )	( )	( )	( )	( )	( )
Other 1.						
2.						
Host Country		2,128	2,128		18,898	18,898
Other Donor(s)						
TOTALS	19,400	2,728	22,128	47,464	21,434	68,898

9. SCHEDULE OF AID FUNDING ($000)

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
FN	263	062				50,000		50,000	
TOTALS						50,000		50,000	

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

11. SECONDARY PURPOSE CODE

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

A. Code	COOP	BR					
B. Amount	50,000	50,000					

PROJECT PURPOSE (maximum 480 characters)

The project purpose is to provide electric power to rural areas for production, employment creation, rural households and community services in project areas. Emphasis will be on productive uses of electricity, notably agricultural irrigation.

SCHEDULED EVALUATIONS

Interim MM 05 YY 82 MM YY

Final MM 12 YY 87

15. SOURCE/ORIGIN OF GOODS AND SERVICES

[X] 000 [X] 941 [X] Local [ ] Other (Specify)

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

17. APPROVED BY

Signature: Frank B. Kimball

Title: Director, USAID/Dacca.

Date Signed: MM 06 DD 12 YY 1981

18. DATE DOCUMENT RECEIVED IN AID/W, OR FOR AID/W DOCUMENTS, DATE OF DISTRIBUTION

MM DD YY

AID 1330-4 (8-79)

BANGLADESH

RURAL ELECTRIFICATION II
(388-0054)

FY 1981 PROJECT PAPER

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Definititions and Terms

Geographic/Political Divisions

Thana - Approximately 440 county-sized political subdivisions of Bangladesh.

Government Agencies

BADC - Bangladesh Agricultural Development Corporation, Government Corporation responsible for supplying agricultural inputs.

BFIDC - Bangladesh Forest Industrial Development Corporation. Government Corporation under the Ministry of Agriculture responsible for wood product production.

BKB - Bangladesh Agricultural Bank. Responsible for financing farmer purchases of agricultural inputs.

BSCIC - Bangladesh Small and Cottage Industries Corporation. Government Corporation responsible for development of small industries.

IRDP - Integrated Rural Development Program. Government agency charged with rural development, principally directed through multipurpose cooperatives.

PBS - Palli Bidyut Samity, translated as Rural Electric Society, which are being established in project areas to own, operate and maintain electric distribution systems.

PDB - Bangladesh Power Development Board, responsible for all electricity generation and transmission.

REB - Bangladesh Rural Electrification Board, responsible for all rural electrification distribution.

Other Organizations

NRECA/CAI - National Rural Electric Cooperative Association and Commonwealth Associates Inc. The U.S. based rural electric cooperative association and the engineering consulting firm which are jointly providing consulting services for RE I. Also referred to as the "Consultant".

Local Consultants - Private Bangladeshi firms doing electrical system construction.

GEM - General Electric Manufacturing. EDC owned factory producing electric transmission and distribution equipment.

GEC - General Electric Corporation. Private factory producing motors, transformers and switchgear.

ISGA - Private firm which distributes and installs power pumps, engines and motors financed by BKB.

Currency

Taka - Bangladesh Taka, the assumed rate of exchange being Taka 16 = US$1.00

$ - U.S. Dollar

Terms

AAC - All Aluminum Conductor
ACSR - Aluminum Cable, Steel Reinforced
Amp - Ampere
Cusec - Cubic feet per second
DTW - Deep tubewell
FX - Foreign exchange
HP - Horsepower
Hz - Hertz (cycles per second)
kVA - Kilovolt ampere
kV - Kilovolt
kWH - Kilowatt hour
LC - Local currency
LLP - Low lift pump
MVA - Megavolt ampere
MW - Megawatt
MWH - Megawatt hour
NESC - National Electric Safety Code (USA)
O&M - Operations and Maintenance
ROW - Right of Way
STW - Shallow tubewell
V - Volt

BANGLADESH - RURAL ELECTRIFICATION II
(388-0054)

A. Recommendation and Summary

It is recommended that AID approve $50 million grant funding to the Government of Bangladesh (BDG) for the rural electrification project described in this Project Paper.

B. Project Funds

Project funding totals $68.898 million, $50 million AID financed and $18.898 million BDG financed.

AID obligations will be in three tranches: FY 1981, $20 million; FY 1983, $23 million and FY 1984, $7 million. AID funds would finance $47.464 million in foreign exchange costs mainly for technical services procured in the U.S. and commodities procured from U.S. and Code 941 source/origin, and $2.536 million in local currency costs.

This project is part of Phase II of the national rural electrification program. The total Phase II Program (FY 1981-87) has an estimated cost of $188.831 million funded by AID $50 million; Kuwait $30 million; and the World Bank $50 million (scheduled for fourth quarter CY 1981), and the BDG $58.831 million.

C. Summary Description of the Project

The project will construct electric distribution systems in selected rural areas and develop the institutions to own and operate them. Approximately 3,590 miles of line and 14 substations will be constructed under RE II. Four new rural electric cooperatives will be developed. AID will fund technical assistance for the entire Phase II Program.

D. Grantee

The Grantee will be the Government of the People's Republic of Bangladesh (BDG). Responsibility for implementing the project has been assigned by the BDG to the Rural Electrification Board, an independent agency under the Ministry of Power, Water Resources and Flood Control.

PART I - BACKGROUND, PROJECT JUSTIFICATION AND DETAILED DESCRIPTION

A. BACKGROUND

In FY 1978, AID approved a grant and loan of $50 million, (Rural Electrification Project 388-0021) to finance development of electrical distribution systems in selected rural areas. Prior to that time, rural electrification was practically unknown in Bangladesh. By 1980, the demand for electrical service in the thirteen project areas was exceeding expectations. The Rural Electrification Project (RE I) was amended in late 1980 and AID funding increased to $69.3 million, mainly to permit additional connections.

RE I is demonstrating the technical, socio-economic and administrative soundness of rural electrification in Bangladesh. Experience to date with RE I serves as the basis for design of the Rural Electrification II Project (RE II). A major evaluation of RE I was conducted between February and May 1981. Evaluation findings are presented as Annex A to this PP (under separate cover). Purpose of RE I was to provide reliable electric service at reasonable rates to existing and potential sources of rural employment, community service facilities and rural households. Progress to date indicates that the purpose can be achieved essentially as planned. Preliminary indications of socio-economic impact tend to confirm the reasonableness of the project justification. The opportunities for increasing agricultural production through irrigation seem greater than expected. Institutional performance has been noteworthy. The Rural Electrification Board (REB), the thirteen rural electric societies (PBS's) and the private Bangladeshi firms are demonstrating good capability and promise in planning, managing, engineering, constructing, operating and maintaining the electrical distribution systems. There have been a few weaknesses in RE I performance and the design of RE II has been adjusted accordingly.

The RE II Project described herein comprises a portion of an on-going national rural electrification program. The first implementation stage was the RE I project, fully funded by AID and the BDG. The next implementation stage consists of the development of 20 new PBS's funded by AID ($50 million), the World Bank ($50 million tentative), Kuwait ($30 million), and the BDG ($58.8 million). This PP refers to the second implementation stage as the "Phase II Program"(1) as contrasted with the "RE II Project" which is the AID supported portion of the program. The attached map shows the thirteen original PBS areas of RE I, and the 20 PBS's of the Phase II Program. The entire Phase II Program will cover a new area of about 60 thanas with a population of about 15,200,000. Approximately 10,000 miles of line will be constructed and/or rehabilitated and 480,000 consumers connected. Connections will include most of the irrigation pumps in the 60 thanas, a large portion of the rural factories and businesses and approximately

20% of the households over the life of the program. As AID's portion, AID will finance development of four new PBS's and their electrical distribution systems, limited expansion of the original 13 PBS systems, technical assistance requirements for the entire Phase II Program, and power use commodities. The World Bank will finance eight PBS systems and Kuwait will finance another eight PBS systems.

In reexamining the energy environment in Bangladesh, USAID has strengthened the conclusion that rural electrification comprises an appropriate part of Bangladesh's medium term energy strategy--for stimulating production and employment and reducing dependence on imported fuels.

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(1) In late May 1981 the BDG revised its definitions of the rural electrification program phases. The eight Kuwait financed PBS's will be called Phase I.b. The original 13 RE I PBS's will be called Phase I.a. The twelve new PBS's to be financed by AID (4) and the World Bank (8) will be considered Phase II.a. Phase II.b. will include another 12-16 PBS's for which other donor funding is being sought.

For PP purposes, the definitions of RE I, RE II and the "Phase II Program" will remain unchanged. For implementation planning purposes, the 13 original PBS's constitute the first implementation stage, the 20 new PBS's constitute the second stage, and subsequent PBS's will constitute the third and subsequent stages.

B. PROJECT JUSTIFICATION

Success to Date

Rural electrification is one of USAID's most successful and best known projects. Its basic administrative, technical, economic and social soundness are well demonstrated. BDG commitment and support are very high. Other donors, including the World Bank, the Asia Development Bank, Kuwait and Finland have committed funds or expressed intentions to support expansion of the program.

Energy and Development

The importance of energy to economic development has been underscored in recent years. In Bangladesh, the average annual per capita energy consumption, roughly estimated at 6 x 10^6BTU's, is one of the lowest in the world, below so-called subsistence level of energy consumption and less than 1/15th of that in Western European countries. This level of energy consumption is characteristic of poverty at the margin of physical existence.

Rural electrification in Bangladesh is probably unique among similar programs elsewhere in the high proportion of electric load which can be channelled almost immediately into economically productive uses. Approximately 57% of all electric energy consumed will be for agricultural irrigation and rural industries, according to conservative estimates. If the demand for electrified irrigation grows as hoped, the energy used for productive purposes could rise to 80%.

Agricultural Development

The Second Five Year Plan (SFYP) calls for a doubling of food grain production by 1985 as the basis for national development. Increased food production is essential to feed and employ the rural population and to stimulate rural agro-based industry for a second round of production, employment and income. Food production increases are to be achieved by more intensive cultivation using HYV seed, fertilizer and irrigation. Massive irrigation by small power pumps is the key. Irrigated area is to be increased from 3.16 million acres (1978) to 7.2 million acres (1985). The number of power pumps will increase from 56,200 to 205,000 and will account for 78% of the increase in irrigated area. An assured water supply will increase cropping intensity and reduce cropping risks, thereby increasing the opportunities for HYV cultivation. This strategy is relatively energy intensive and requires a rapid increase in commercial energy, mainly for fertilizer production, and power for irrigation. Fortunately, Bangladesh is relatively well endowed with natural gas which can be used to produce fertilizer and electric power. The other main source of electric generation is hydro.

The SFYP calls for a rapid increase in the number of electrified pumps. Electricity is technically and economically suitable for powering irrigation pumps. Compared to diesel which is now used to power nearly all irrigation pumps, electricity has significant "cost-savings" and "production" benefits and saves foreign exchange (II.B. Economic Analysis).

Employment, Rural Industry and the Poor

Rural electrification is considered critical to the rural employment strategy described in the CDSS[2] which is the most important means of reaching the rural poor. With nearly one-third of the rural population unemployed/underemployed and up to 50% functionally landless, employment creation is necessary to increase national production and to distribute income to the rural poor. The strategy relies on the agricultural sector to absorb most of the rapidly increasing labor force and rural small scale industries to employ a high proportion of the rest.

Rural industry development is the necessary corollary to agricultural sector growth--to create employment, income and the demand for agricultural products and to provide the goods and services needed by a modernizing agricultural sector. Rural industries in Bangladesh provide about 12% of GDP and 11% of total rural employment. Much of the labor force is comprised of poor and landless persons, and about one-third are women. A number of development programs, including USAID's Rural Industries Project (scheduled for FY 1981 obligation) are planned to stimulate rural industries.

Expansion of rural industries requires commercial energy. Power must be supplied to rural areas if employment is not to be restricted to urban areas. Electricity is a preferred choice of energy for many rural industries because of its flexibility in providing power, light, heat and refrigeration as needed.

Besides the employment impact of irrigation and rural industry development, rural electrification directly promotes rapid growth of the electric supply and service industries, i.e. engineering and construction of electrical distribution systems; manufacture, supply and service of basic electrical distribution system commodities (poles, wire, switches, etc.); and of power use commodities (motors, pumps, capital equipment, refrigerators, sewing machines, light bulbs, etc.).

Lighting and Households

The dramatic impact of household electrification is widely acknowledged. Electricity changes the perceptions and opportunities

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(2) Ref. USAID/Bangladesh FY 1983 CDSS, pages 44-55

of rural people. Light extends the working day by about five hours. The impact may be difficult to measure but it is easy to see as small rural industries, shops, bazaars, community service facilities and homes spring to life in the evening hours. In homes, lights expand the time for off-farm production, study and entertainment.

While the bulk of the eletric load will go to productive uses, households will be hooked up in much greater numbers than other connections. Sign ups to date in the 13 PBS's have averaged about 40% of rural households. Under AID's portion of the RE II Program, about 145,000 households or 20% of total households will receive connections by 1988. As rural electrification continues beyond the six year project period, additional households will be connected as resources permit. By year 17, an estimated 300,000 households will be connected.

Import Substitution

Without rural electrification, it is highly doubtful that Bangladesh can afford the commercial energy needed for irrigation and rural industry. Bangladesh has already experienced diesel shortages in peak irrigation seasons which have forced curtailment of irrigated areas. Bangladesh's present imports of petroleum products (POL) amount to about two-thirds of total export earnings. With demand for commercial energy rising 10% to 15% per annum, the country's demand for imported POL will increase to unaffordable levels, unless natural gas is effectively substituted for POL.

Alternatives

Alternative energy sources must be developed in Bangladesh, but practical alternatives to electricity will not be available in rural areas on a meaningful scale for the medium term. USAID is presently examining the feasibility of increasing energy availability from conventional and non-conventional sources as a part of a possible alternative energy activity (Part II.A. Technical Analysis). Alternative energy options appear particularly limited in Bangladesh in view of the nation's dearth of natural resources and the extremely heavy exploitation of traditional fuels--crop residues, cow dung and

firewood.

Relation to CDSS

Rural electrification has major direct impact on two of the Mission's primary objectives in Bangladesh, i.e. "increasing food grain production" and "expanding employment opportunities among the rural poor", and an indirect but possibly significant impact on another, "reducing human fertility". A study in the Philippines[3] has shown high correlation between electrification in rural areas and acceptance of family planning. This correlation is likely in Bangladesh also were electric lines, perhaps more than any other recent development, serve as a harbinger of new ideas into village life.

The project strongly supports important CDSS themes related to the promotion of private enterprise, decentralization and local participation. Under the RE II Program, engineering and construction of the rural electrification systems will be performed by over 50 private firms under contract. These firms will receive a large amount of training, on-the-job guidance and supervision from REB and the Consultant.

The rural electric systems are owned and operated by independent PBS's. Despite initial skepticism about the capability of rural people to operate these sophisticated management and physical systems, PBS's are demonstrating good performance and outstanding potential. Creating important independent rural organizations responsive to local concerns has been a precedent setting achievement of RE I.

Relation to General AID Strategy

With respect to rural electrification programs, AID strategy[4] calls for consideration of: 1) the implications of national rural electric plans for energy supply; 2) evidence of benefits from rural electrification; and 3) cost of electricity compared to decentralized systems. To this, USAID/Bangladesh would add: 4) the availability of alternatives.

Rural electrification is a top BDG priority. The SFYP provides for rapid expansion of rural electrification to provide the energy needed for rual development. In view of the excellent economic

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(3) A.N. Herrin, "Rural Electrification and Fertility Change in the Southern Philippines". Published paper supported by grants from International Development Research Center and AID.

(4) "Energy Assistance Policy Paper" dated January 19 1981, from AA/PPC, A Shakow.

returns to rural electrification and the lack of available alternatives, AID and BDG see a vital role for rural electrification over the medium term.

C. DETAILED DESCRIPTION

1. Purpose

The project purpose is to provide electric power to rural areas for production, employment creation, rural households and community services in project areas. Emphasis will be on productive uses of electricity, notably agricultural irrigation. Power and lighting will be provided for rural industries including small scale agricultural processing and other village and cottage industries; and for shops, bazaars and community service facilities. About 20% of all rural households in the project areas will be electrified with project resources.

2. Main Features

The project will be implemented over a six year period (FY 1981 to FY 1987) under the direction of REB. Main project features include:

1) Construction of electrical distribution systems (11 kV and less) in four new PBS areas; expansion of the electrical distribution systems in the original thirteen PBS's, and connection of about 149,000 consumers.

2) Expansion and development of the REB for overall rural electrification program management and direction.

3) Establishment and development of four new PBS's to own, operate and maintain the four new electrical distribution systems.

4) Development of local private sector capacity to: a) engineer and construct electrical distribution systems; and b) manufacture and/or supply construction commodities, electrical equipment, spare parts and services.

5) Power use programs to facilitate the productive use of power for irrigation and rural industries.

6) Technical assistance and extensive training by non-local consultants in program planning and management; institutional development, construction, operation and use.

3. AID Financed Costs

AID's $50 million contribution will be used as follows: construction commodities, $29.706 million; technical assistance and training, $12.732 million; power use commodities, $4.8 million; support commodities, $1.0 million; and contingency/inflation, $1.762 million. The BDG will finance $18.898 million including construction materials, engineering/construction services, REB operations, development loans to PBS's and consumer loans.

4. Policy Context

This PP contains policy changes, some in the form of conditions precedent and covenants to be negotiated with the BDG as part of Project Agreement proceedings, notably: 1) productive versus domestic uses of electric power; 2) reliability of power supply to the PBS's; 3) power use programs and private sector supply of electric motors; 4) wholesale and retail power rates; and 5) development of adequate electric generating capacity. Other policies which have been successfully incorporated into the RE I will be reinforced, including: 6) autonomy of the PBS's; 7) development of private sector capability in the electric supply and service industries; 8) development of the REB with authority over all rural electrification; and 9) standardization of engineering design and commodity specifications.

4.1 Productive versus Domestic Use of Electricity

Policy has been evolving under the RE I project toward more emphasis on productive uses of electricity. RE II formally acknowledges and accelerates this policy change. The rationale for emphasizing more productive connections is based mainly on the rural production/employment strategy discussed above in the "Project Justification". Also, Bangladesh may not have the resources to contemplate a major shift to commercial energy for rural domestic uses.

In the RE I project design, up to 75% of rural households in the 13 PBS's were to be connected over a 17 year period, approximately 30% (460,000 households) within the six year project period. About 64% of energy use was planned for household consumption. Initial sign ups for electricity in the thirteen RE I PBS's exceeded expectations, for residential and productive uses. To date, 549,191 potential consumers have signed up as follows (11 of 13 PBS sign ups complete): residential 486,427; irrigation 18,067; small industry 12,137; commercial 20,449; education 2,449; mosque, clinic, hospital, church 718; others 8,944. Decisions were required about resource allocation, i.e. who was to be connected. Economics favor more productive connections since benefits are greater and the nature of the benefits preferable--production rather than consumption. However, each productive connection entails construction costs and electrical load which displacesa number of residential consumers.

The REB took a major step toward a productive use policy in mid 1980 when new line design criteria (staking criteria) was established for deciding where lines within the villages will be constructed. Lines were to be run to generate the most revenue. In practice, this criteria is favoring productive connections. A deep tubewell (DTW) connection, for example, costs roughly 30 times more than a household connection but yields roughly 50 times more revenue.

Under the RE II project, about 57% of total energy is targeted for productive uses. Efforts will be made over the life of RE II to promote productive use of electricity and to increase the percentage of energy used for productive uses to more than the targeted 57%. To implement this policy, RE II includes: 1) revised targets and line design (staking) criteria; 2) review of electrical system engineering design to ensure that electric distribution systems are technically suitable for the planned useages and load; 3) power use programs (ref. 4.3); and 4) a special review of actual staking practices to determine if lines are being planned and constructed as needed to reach irrigation pumps.

This policy change is a difficult one for the BDG, which looks at rural electrification in a political as well as economic context, and thus is reluctant to reduce household connections.

4.2 Power Transmission

As part of the Project Agreement negotiations, the BDG will be requested to rehabilitate the Power Development Board's (PDB) 33 kV transmission systems which service PBS substations under the rural electrification program. Power reliability is critical for productive uses. Studies by the Consultant have shown electric power reliability is a serious problem in certain areas and that many of the problems relate to inadequate maintenance and resulting poor physical condition of the 33 kV transmission systems. The Consultant has formulated short and long term recommendations for upgrading the 33 kV systems. Up to 3,000 miles of 33 kV line may be involved with costs borne by the BDG apart from the rural electrification program. The RE consultant will provide limited technical services to advise on and monitor the rehabilitation program. For negotiation with BDG, Annex D prescribes a proposed rehabilitation program with RE II disbursements dependent on adequate rehabilitation progress.

In rehabilitating its 33 kV systems, the Ministry of Power, Flood Control and Water Resources will be forced to improve PDB physical and administrative systems with significant benefits for all electric consumers. The PDB transmission system above 33 kV is to be rehabilitated under a planned 1981 ADB project.

4.3 Power Use Program

RE II will include an expanded power use program to promote the productive use of electricity, especially for agricultural irrigation. The on-going RE I power use program has not been effectively designed or implemented (RE I Evaluation Annex).

With policy emphasis shifting to productive use, a more effective power use program has become necessary. Irrigation and other productive uses of electricity are being constrained primarily by a very limited supply and extremely inadequate distribution/sales/service of electric motors and related equipment. This situation exists partly because: 1) customs barriers virtually prohibit the importation of electric motors from 2 HP to 25 HP, a barrier instituted to protect a domestic manufacturer who cannot meet the national need for these motors: 2) distribution of irrigation pumps and attached motors/engines has been handled mainly through government institutions at subsidized prices; there has been little private sector distribution.

Thus, the RE II power use program focuses on: 1) arranging an adequate supply of motors and other equipment; 2) developing private sector distribution sales/service; 3) providing loans for the purchase of motors and related equipment; and 4) appraising power use potentials and the means for promoting electrified irrigation and small industry. To help accomplish this, the PP contains a CP that the BDG will reduce customs barriers to permit importation of these motors in necessary quantities. The PP also includes arrangements for the BDG to fund a $5 million credit program for farmer purchasers of motors and related irrigation equipment, and a covenant that the BDG permit private distributors to import and distribute these motors.

4.4 Power Rates

To reflect true energy costs, thereby permitting proper allocation of energy and other resources, power must be priced near its economic cost. Also, true power rates will help the PBS's achieve financial viability. Financial viability will enable the PBS's to become autonomous rural institutions (ref. 4.6).

Determing true economic costs is difficult. USAID will negotiate a condition precedent that the BDG approve a formula for setting the wholesale power rates (which PBS's pay to the PDB) at levels which cover justifiable costs. Project covenants also call for periodic revision of PBS retail rates at levels which will permit PBS financial viability.

4.5 Generating Capacity

The "Technical Analysis" in this PP indicates that Bangladesh

is expected to have sufficient generating capacity to meet the projected demand for electric power. BDG plans for the development of generating capacity are ambitious, however, and USAID is emphasizing the need for the BDG to pursue generating programs on a priority basis. A covenant refers to this issue.

4.6 PBS Autonomy

As the owners and operators of rural electric distribution systems, PBS's are unique in Bangladesh in being non-governmental publicly owned rural organizations with multimillion dollar facilities and operations. Local control and autonomy of PBS's is central to the rural electrification strategy for providing efficient, reliable rural electric service. PBS development has been carefully planned to create local PBS's with the authority, means and incentives to be responsive to local demands for good service (ref. Project Description). Despite initial skepticism about the ability of these rural organizations to own and operate these sophisticated physical and administrative systems, progress to date with PBS development has been better than satisfactory; the potential for long run viability remains excellent.

While the concept of PBS autonomy is strongly supported by the REB, the PBS's are, in practice, financially dependent for many years and necessarily subject to a multitude of controls. The policy and practice of autonomous and responsible PBS's must be carefully nurtured. Here the experience of NRECA consultants, most of whom have managed or been working members of independent rural cooperatives in the U.S., is invaluable.

4.7 Development of Private Electric Service Industries

To achieve rapid and cost-effective design and construction of rural electric distribution systems, the project relies on private local consultant firms (local consultants) and local private construction contractors (contractors). Under RE I, a total of nine local consultants and 35 contractors have been awarded contracts totalling $4.5 million. The majority of firms have performed well and justified the use of private contractors.

Growth of the rural electrification program directly and indirectly promotes related growth of a number of electric manufacturing, supply and service industries. REB has establish specifications for rural electric housewiring needs and contracted with local manufacturers to produce them. These commodities are being sold directly through PBS's to consumers. As private sector distribution systems develop in response to the demonstrated consumer demand, the REB is refiring from direct procurement of these commodities and replacement parts.

Rural electrification has profited greatly from this decision

to expand capability of the private sector. RE II will continue this policy by awarding contracts for goods and services to private contractors, establishing standards for RE commodities, demonstrating markets (e.g. for electric motors), marketing motors through private distributors, and by providing extensive classroom and field training in technical /administrative subjects to managers and staff of local engineering consultants, construction contractors and supply/service firms.

4.8 Rural Electrification Board (REB)

The REB, responsible for planning and implementing rural electrification in Bangladesh, was newly created under RE I. The intent was to install an organization suited for rural electrification and undistracted by other objectives or outdated organizational structures, policies, systems and practices. Special effort has been taken to recruit qualified and motivated officers. The results have been very good. REB performance is exceptionally good in comparison to standards of management of other development programs.

4.9 Uniform Specifications and Standards

To construct technically superior systems at low cost which can be operated and maintained in Bangladesh, the Consultant and REB have strongly supported a policy of strict specifications and standards for engineering, construction and commodities. Uniformity and standardization is effected wherever possible. The Consultant will continue to work with the REB to maintain appropriate specifications and standards.

5. Differences between RE I and RE II

The project is a follow-on to the Rural Electrification I Project (388-0021). Besides the multidonor nature of the follow-on program and the policy changes noted in 4.1 to 4.5 above, there are a few other noteworthy project design differences between the proposed RE II and RE I with respect to AID's role in providing technical assistance; the evolving emphasis of the technical assistance effort on augmenting REB and PBS management and supervision capabilities; more attention to the operation and maintenance of the electrical distribution systems; and possible modifications of the distribution system design.

5.1 AID's Role in Funding Technical Assistance

To ensure sound technology transfer and institutional development, technical assistance is a most critical component of this RE II extension project. Except for BDG contributions, the donors and the BDG have agreed that AID will fully fund the technical assistance (TA) and most of the training for the entire Phase II program, i.e. for all 20 PBS's.

By providing the TA, AID can help assure continuity and effectiveness of overall program direction and standards. The rural electrification program embodies fundamental concepts and technologies, adapted to Bangladesh, which are providing a solid foundation for success, e.g. streamlined management and administration, uniform engineering and construction specifications and standards, maximized role of the private sector and of the independent PBS's and emphasis on human resources development. Continued success of rural electrification will depend on maintaining these features and minimizing the proliferation and redundancy of policies, systems, specifications and standards which frequently occur in large multidonor funded sectors. The danger of redundant policies and systems is amply illustrated by the serious operational difficulties of many programs in Bangladesh.

5.2 Technical Assistance and Training

The RE II project will continue the heavy RE I emphasis on human resource development and training. The REB, PBS's and other organizations have achieved remarkable progress in implementing RE I, but human resources are stretched. Staff and skills must continue to be augmented rapidly to meet the needs of RE II. Managerial expertise is weak at most levels and will require special attention (Ref. Evaluation Annex).

Technical assistance and training requirements comprise less than 10% of donor funding for the Phase II Program, compared to 17% for RE I, but the $12.7 million total for RE II TA and training is a critical project input, vital for program management and the transfer of necessary skills and technologies. To maintain the effectivess of TA as the program expands, the Consultant will provide less direct training and supervision and work more closely with REB and PBS managers on management and supervision planning, training of trainers and systematic monitoring of performance. Particularly with respect to the design and construction of electrical distribution systems, the REB will undertake with the Consultant to closely monitor local consultants' and contractors' performance.

5.3 Operation and Maintenance of Electrical Distribution Systems

Power reliability depends importantly on proper maintenance. Transmission and distribution system maintenance has been neglected in the past with predictable results. A critical period in the maintenance of PBS distribution systems is immediately after electrification when the inexperienced PBS's take over responsibility for O&M. PBS performance in this early stage will affect public perceptions about rural electrification and will tend to set a standard for future PBS performance. More technical assistance will be provided to guide PBS's in operating and maintaining the electrical distribution system.

5.4 Line Design

Engineering design of the RE I electrical distribution systems reflected load projections at the time. With policy evolving toward more productive load, engineering design of PBS distribution systems will be re-examined. Specifically, the Consultant and REB will review the revised load forecasts to determine the impact, if any, on the planned construction mix of three phase and single phase primary lines (ref. II.A. "Technical Analysis").

6. Description of Main Features

6.1 Construction of Electrical Distribution Systems(5)

The project includes construction or rehabilitation of approximately 4,300 miles of electrical distribution line, including 1,960 miles of high tension (HT)(11 kV/6.35 kV), 1,630 miles of low tension (LT)(430/230 V), 710 miles of rehabilitated HT, 14 substations (33 kV/11 kV), and connection of 62,100 meters serving about 4,495 irrigation pumps and rural industries and 145,000 households(6), commercial establishments and community facilities (schools, health clinics, etc.). AID will contribute $29.7 million for construction commodities (U.S. and 941 source/origin) for construction of four new PBS's and expansion of the 13 original RE I PBS systems.

New PBS's

AID will provide the donor financing for four new PBS's tentatively selected as follows: Chittagong I PBS; Bogra II PBS; Jamalpur I PBS and Rangpur II PBS. Approximately 600 miles of HT and LT will be constructed in each PBS. Direct construction costs average about $ 7.0 million per PBS of which AID will finance $4.95 mainly for conductors, poles, transformers, prefabricated substations and other commodities. The BDG will finance the remaining $ 2.05 million for PBS headquarters site, PBS offices, warehouses and other facilities and the related engineering and construction services.

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(5) This description pertains to the AID supported portion of the overall Phase II Program unless otherwise noted. Except for specific targets, costs, etc., the description is equally applicable to the entire Phase II Program.

(6) 62,100 meters based on an average of 2.5 household connections per meter.

Total population in the four PBS's is approximately 3,120,000 in 557,500 households. Planned connections cover the bulk of the irrigation pumps and small industries which can be economically reached and about 20% of the total households. Continued expansion of the PBS areas beyond the project period will permit additional connections at relatively low costs per connection.

PBS's have been selected on the basis of a feasibility study conducted by REB and the Consultant. Based on the study, 20 PBS areas were identified and ranked; the top 12 were earmarked for AID and World Bank funding. In selecting USAID's areas, USAID and REB chose those with high feasibility rankings, with special consideration to irrigation potential and power supply(7).

Thirteen Original PBS's

The distribution system in each of the original RE I PBS's will be expanded from about 350 miles of HT each to about 400 miles, especially to meet the demand for productive connections. An additional 20,500 metered connections are targeted, including about 1,485 irrigation pumps and rural industries. The relatively modest expansion in each PBS permits cost-effective connections because the basic physical and organizational infrastructure is already in place. AID will finance $9.9 million, or $761,500 per PBS for construction commodities.

Means of Construction

Engineering design and layout of the backbone distribution systems are done by the REB and the Consultant. These organizations also oversee the detailed design and construction.

Detailed design and layout of the village distribution systems is done by private Bangladeshi engineering firms (local consultants) and actual construction of the distribution systems, including the substations, is done by private Bangladeshi construction firms (contractors) under contract to the REB. The BDG finances these contracts. Normally, about four contractors are utilized for the construction of one PBS.

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(7) In June 1981, the World Bank appraisal mission in Dacca indicated to USAID that it would prefer to make its final selection of PBS areas later this summer when additional feasibility analysis is available. Hence, USAID proposes to retain some flexibility in final selection of AID areas, to adjust for continuing detailed feasibility analysis and to accommodate the Bank.

Detailed engineering design does not begin until the PBS's are organized and functioning. The PBS signs agreements with the REB regarding organizational and financial responsibilities. A sign up campaign must be conducted by the PBS prior to construction.

6.2 Rural Electrification Board (REB)

The REB, responsible for planning and implementing rural electrification in Bangladesh, will be expanded to manage the expanded Phase II program. Main REB duties include: planning new distribution schemes; establishing and enforcing specifications and standards; contracting for and supervising the engineering and construction of the distribution systems; organizing and developing the PBS's to manage and operate the electric systems; promoting the electric supply and service industry, procuring construction commodities, etc.

The REB has performed exceptionally well in implementing RE I, but the Phase II Program will necessitate a quantum jump in REB's work. To meet the challenges, the REB budget will be increased from approximately $710,000 annually to $1,070,000 annually. Management and staff will be increased from the present sanctioned level of 396 to about 453. The Consultant will continue to assist the REB to plan and execute its numerous functions. Emphasis will be on management and productivity--to enable the REB to handle a program more than twice as large as RE I with only about 15% more staff.

6.3 PBS Development

A new PBS organization will be established in each of the 20 new PBS areas (including the four AID supported PBS's). PBS's own and operate the rural electric distribution system in their area. PBS primary responsibilities are: to manage, operate and maintain the physical system including the 33/11 kV substations; to promote and meter new consumers; bill and collect from consumers; enforce safety and other standards; keep financial records and repay the development and other loans from the REB.

Local control and autonomy of PBS's is central to the project strategy. The PBS development program includes local election of PBS leadership; extensive management and technical training; on-the-job technical assistance; streamlined organization and procedures; and adequate budget and facilities.

Organization: Each PBS is governed by a local nine person Board of Directors. Directors are initially selected, and then elected on a rotating basis beginning 18 months after energization. The Board appoints a General Manager with broad managerial jurisdiction. PBS organization is discussed further in IV.B. "Administrative Arrangements".

Development Loans: The REB makes a capital development loan in the form of a Tk 150 million (approximately $9.4 million) line of credit to each PBS for the value of the electrical distribution system construction and the PBS headquarters construction (offices, warehouses, etc.). The development period is 35 years with a ten year grace period. Interest rate is 2%. The development loan agreement contains standard provisions whereby the PBS agrees to fulfil its responsibilities and functions in accordance with program specifications, procedures and standards. REB also makes operating loans to PBS's until PBS revenues can cover administrative costs.

Training: REB, with the Consultant, conducts an extensive training program for PBS directors, managers and staff. Training covers responsibilities and functions of Board members and managers, financial records and accounts, electrical system operations and maintenance, logistics,and member service.

Technical Assistance to PBS's: REB, with the Consultant, provides written guidance and instructions with respect to all PBS organizations, functions, standards and specifications. Following classroom training for PBS staff, the REB and the Consultant provide close on-the-job guidance to PBS's for each major phase of PBS responsibilities.

PBS Headquarters Construction: The REB contracts for andhelps supervise construction of the PBS's physical facilities. Construction includes offices; warehouses for spare parts, storage space, etc. PBS headquarters construction costs approximately $831,000 per PBS, entirely financed by the BDG.

6.4 Power Use Program

Power use programs will be developed to promote the use of electricity for rural production, especially for irrigation and rural industry. Main objectives will be to assure an adequate supply of electric motors and an effective in-country distribution and service system for motors and related equipment. The anticipated demand for electricity for productive uses is high but productive use is hampered by insufficient supply of motors; inadequate distribution and service networks for motors and related equipment; and by inadequate credit to finance consumer purchases of motors and related equipment. The RE I Evaluation (Annex A, Attachment 4) concluded that RE I power use programs were not effectively designed or implenented and that power use programs required revision in view of emerging power use issues and priorities. Most importantly, the evaluation noted that productive connections in PBS areas are being stymied by a near absence of single phase (1Ø) motors. These motors are urgently needed in large volume because most villages are being provided 1Ø current under the RE program. The motors are not available because:

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1) the market for the motors has not been demonstrated and distributors are not handling them; 2) customs duties are 125% on electric motors between 2 HP and 25 HP; 3) private sector distribution/sales systems have not developed because nearly all irrigation pumps and motors/engines are marketed through government agencies at subsidized prices; and 4) consumer credit for the procurement of pumps and motors is available only through government banks which are meeting only a small portion of the demand for loans. Fortunately, the SFYP provides for a massive power pump irrigation program which will provide the necessary pumps and other complementary infrastructure required for electric powered irrigation.

The RE II Power Use Program consists of:

1) $4.8 million AID financing for procurement of power use commodities, mainly 1Ø motors and phase convertors (3Ø to 1Ø).

2) Technical assistance by the Consultant to assist with power use planning and implementation--approximately 112 work months.

3) Power use planning by the REB Directorate for Member Service and Power Use to: a) analyse the potential for productive uses of electricity, notably for irrigation, and the related requirements for electric motors and equipment; b) establish targets for electrification of irrigation pumps and rural industries, for each locality; c) evaluate field progress in connecting irrigation pumps and small industries. Recommend policies and programs for achieving desired targets. Note the need for any revisions in line design criteria or practice; d) monitor the need for and effectiveness of credit for different types of consumers--irrigation groups, rural industries, households, etc. Formulate credit policy recommendations related to the BDG loan program for electric consumers.

4) Coordination of the rural electrification project with irrigation development projects and rural industry projects to induce BDG agencies and donors to procure and install adequate numbers of electric motors.

5) Stimulating private sector supply, distribution and service of electric motors and related equipment. The RE I evaluation noted that BDG government agencies would continue to be important distributors of pumps, motors and other agricultural inputs, but that these agencies were incapable of efficiently meeting total market demand. The SFYP calls for the development of private sector distribution of agricultural inputs. Under RE II, REB will distribute as many

of the imported motors as possible through private distributors. Distribution arrangements will be further detailed in negotiations with private distributors. REB will sell motors to private distributors, probably with the distributors providing bank guarantees of payment to the REB. REB may institute special sales terms, e.g. guaranteed repurchase by REB if motors cannot be sold, etc. A covenant in the Project Agreement will require assurances from the BDG that "with respect to the supply, sale, distribution and service of minor irrigation pumps and engines/motors, the BDG will encourage rapid "privatization" as called for in the SFYP".

6) Reduction of customs barriers on electric motors. A condition precedent will require that the BDG reduce duties on the REB's imported motors to 15% ad valorum or less and that the BDG permit the importation of motors through government and private channels in quantities large enough to meet the motor requirements of rural electrification.

7) Demonstration and distribution of motors and phase convertors through PBS's. To demonstrate the market for single phase and other motors, each PBS will demonstrate several common pump/motor combinations including STW's and LLP's with 1Ø motors. Where demand is created, PBS's will sell motors direct. Under RE I, PBS's are successfully selling a number of housewiring commodities. They are demonstrating the market demand and inducing private distributors to meet it.

8) A $5 million BDG credit program to provide loans to consumers for purchase of electric motors and related equipment for irrigation, and possibly for other types of consumers. The $5 million will be provided by the BDG, possibly from proceeds generated by the USAID Title III program. Loans to consumers will be disbursed largely through the banking system. Commercial supplier credits may be experimented with. The present system of private distributor/public bank financing will be expanded. Private distributors will sell pump sets to farmers and assist the farmers to obtain financing from the Bangladesh Krishi Bank which has funds reserved for such loans.

9) Encouraging local manufacture of electric motors by putting potential Bangladeshi investors in contact with American firms which might be interested in investment or sale of capital equipment or technology. Contacts can be arranged through NRECA/CAI.

In some respects, the power use program is the most difficult part of the project. It necessitates involvements beyond the

traditional scope of rural electrification programs, agencies and Consultants. Also, the problems inherent in the supply and distribution of motors, pumps, credit and other agricultural inputs represent entrenched problems exacerbated by layers of policies, programs and practices. The RE program cannot be the sole vehicle for revamping national input supply systems. The RE power use program must prioritize its interventions. Immediate priority will be importing and distributing the roughly 4,000 5 HP, 7.5 HP and 10 HP single phase electric motors which AID will finance. To the extent possible, this will be done through the private sector. The problems involved in developing private sector capacity cannot be underestimated however. Despite SFYP plans to stimulate agricultural input supply through the private sector, the private sector in practice is undeveloped and constrained by prevalent economic philosophies and practices which favor government controls, subsidies and price fixing. The planning component of the power use program is important for further defining the scope and nature of the problems and possible approaches.

6.5 Development of Private Sector Capability to Design, Construct and Service Electrical Systems

Engineering and Construction

The REB and the Consultant provide extensive classroom and on-the-job training for the local consultants and contractors which design and construct the village distribution systems (owners, managers, workers), and careful supervision of contract performance. Under the Phase II Program, the operations of existing firms will be expanded and new firms will be trained and contracted with. Contract costs will be entirely financed by the BDG. Three main types of contracts will be awarded:

1) Design and Engineering: For detailed line design and construction supervision. The local design and engineering consultants are responsible to: a) survey and map the entire PBS area showing all potential electrical connections (irrigation, small industry, commercial, residential) and related loads; b) determine where lines are to be constructed and what loads connected: c) do the final engineering design (line capacity, transformer requirements, etc.) for the present and future loads; and d) supervise the line construction by local contractors.

2) Construction of Substations: To construct the 50-60 substations planned for the Phase II Program.

3) Construction of PBS Electrical Distribution Systems: Contracts will be signed with about 25 contractors to construct the 20 PBS systems planned,

Electric Supply and Service Industries

A number of electric manufacturing, supply and service industries have developed under RE I.

Under RE II, REB will continue to locally purchase line construction commodities (poles, crossarms, etc.), housewiring materials and equipment (switchboxes, etc.) and power use commodities (motors). As private markets develop, especially for housewiring, power use and repair, private suppliers will increasingly sell direct to buyers. The PBS inspects and approves the wiring of each household and industry before final metering and connection. REB will continue to establish specifications for local products, promote productive uses of power and procure local commodities, when appropriate, to stimulate the private sector.

6.6 Technical Assistance and Training

Technical Assistance

Managerial and technical assistance is a critical ingredient of the project and of the overall rural electrification program. Productivity of the REB, PBS's and other organizations must rise on a sustained upward curve to achieve construction and connection targets without compromising quality. The Phase II Program is planned to achieve the desired balance of the most rapid development possible within existing institutional resources, consistent with RE program standards.

$12.732 million will be provided over the project period to provide managerial and technical assistance for overall project planning and implementation including distribution system design, construction, operation and maintenance, REB development, PBS development, power use and training. Table 7 shows technical asssistance requirements and related costs.

Emphasis of the TA effort throughout is on developing the capability of Bangladeshi organizations to construct, operate and maintain electrical systems in an efficient manner. The program is essentially an on-the-job training program. Approximately $3.246 million of the total TA represents costs of the formal training component, including a $250,000 line item for third country training(ref. 6.6.2 "Training" below).

AID's role in funding the total TA component of the project is highly desirable for maintaining rural electrification progress and standards. The design and implementation of rural electrification involves not only the transfer of technologies and skills but also of basic concepts and management approaches fundamental to the success of the program. Continued success will depend on reinforcing these features.

It is particularly important to avoid undue proliferation of administrative systems and of specifications and standards which could occur in response to the requirements and preferences of numerous donors or consultants. For example, if a new commodity type or specification is introduced into the project which is not compatible or interchangeable with other similar commodities, it causes many kinds of duplication--in inventory, warehouse and logistic records; in replacement parts stocks; in commodity inspection or testing methods or equipment; and in training (consultants, contractors, repairmen or other end users). Such duplication must be minimized.

Another advantage of AID TA financing is the continuation of an experienced and successful Consultant without breaks in service caused by lengthy procurement process, or start-up periods. NRECA/CAI are already in place and would remain so, with some expansion.

Training

A key element for the successful expansion and completion of the project is an effective formal training program. Progress in institutionalizing training within the REB has been excellent. An REB Directorate of Training has been established and is engaged in conducting a long range training program for management and staff. Courses have been attended by REB, PBS, local consultant, contractor and PDB personnel. As of March 31, 1981, curricula and manuals have been developed for a total of 25 courses attended by over 3,200 persons. The greatest difficulty to date has been staffing the Directorate with capable trainers. Consequently, the Consultant advisors continue to carry a large portion of the instruction load.

For the Phase II Program an immense amount of formal training is required. There is a great need for on-the-job training opportunities for the accelerated development of local consultants, local contractors and PBS Management. RE II will establish a model engineering firm, a model construction firm and a model PBS by providing special REB and Consultant assistance to the three organizations. Each organization selected would agree to provide on-the-job training for people from similar organizations. These "model" organizations would be reimbursed by the REB as appropriate.

Third country training will be carried out. Selected REB and PBS officers will be sent to the Philippines for orientation in rural electrification by the National Electrification Administration and the Philippine electric cooperatives. REB officers also attend the "Operations and Management of Rural Electric Distribution Systems in Developing Countries" course which is sponsored annually by AID, NRECA and USDA. The results of both have been excellent and it is planned to continue them. Consideration is also being given to selecting

some systems in both the Philippines and the U.S. to provide short periods of on-the-job training for PBS managers and key employees. Except for BDG contributions, most costs for formal project training (in-country and third country) are financed out of the TA contract. Table 13 presents training targets for RE II.

7. Other Donor Coordination

The Ministry of Finance, External Resources Division (ERD), coordinates all donor funding. ERD directs donor contributions to BDG development priorities and negotiates the related agreements. ERD has proposed that AID finance this $50 million contribution to rural electrification (Annex N). The REB, with the Consultant, is responsible for preparing feasibility work and formulating subprojects for presentation to various donors. The REB is highly conscious of the need to avoid redundant policies, specifications, procedures, and practices which would impede project administration. In dealing with donors, REB has insisted that donor funded support be consistent with established program tenets.

In May 1981, Kuwait approved a $29.6 million loan to the BDG for eight new PBSs. The project is to commence in July 1981 and be completed in June 1985. The loan is for 32 years, with a 7 year grace, at 2% annual interest. Despite some initial reservations about the PBS concept, Kuwait has agreed to finance the program without any changes, except that Kuwait-financed commodities are to be purchased in accordance with World Bank procurement procedures. U.S. commodities will remain very competitive considering existing commodity specifications and the competitive U.S. worldwide position in providing electrical system commodities/equipment. Kuwait has agreed to use the present Consultant (NRECA/CAI) to provide technical services for development of the 8 Kuwait PBSs.

The World Bank is proposing a credit of approximately $50 million for the fourth quarter CY 1981. World Bank appraisal missions have visited Bangladesh several times since Fall 1980, most recently in May 1981, to collect data and to guide REB feasibility work and analysis regarding newly proposed PBS areas. The Bank is scheduled to finalize its appraisal report for submission to the Bank Directors by November 1981.

Coordination between the Bank teams, ERD, REB, the Consultant and AID has been close. The Bank teams have been well impressed with project progress to date and have expressed their intent to minimize program changes. The team indicated basic concurrence with project specifications/standards and has agreed to have AID fund NRECA/CAI technical services for the Bank's eight proposed PBSs. The team also agreed in principle to the method for selecting the 4 new PBSs for AID funding. The Bank's main concern about the design of rural electrification parallels AID's concern, reflected in this PP, i.e., to maximize productive use of electric power for irrigation and rural industry.

Other donors expressing serious interest in RE are Finland and the Asian Development Bank. The Finns contributed $1.9 million of conductors to RE in 1980 and have expressed an interest in contributing similar amounts over coming years. As considerable Finnish equipment is not compatible with RE specifications, REB has requested Finland to contribute basic commodities which do not present compatibility problems, e.g. conductors, poles. The Finns have tentatively concurred with this approach.

The ADB is very involved in Bangladesh with power generation and transmission; they have been sufficiently impressed with the RE program and have tentatively earmarked $20 million for FY 1983.

Given the REB's insistence on adherence by all donors to existing project policies and specifications and the ease with which the RE program can be apportioned into subprojects commensurate with anticipated funding; USAID considers the presently projected level of donor support to be a distinct plus. The BDG and the REB are believed to have the absorbtive and administrative capability to manage the level of donor funding presently anticipated.

PART II - FEASIBILITY

A. Technical Feasibility

1. General:

As noted earlier, USAID will finance all technical assistance and construction of 4 new PBS's and limited expansion of the original 13. In the construction of the 4 new PBS's the same criteria apply as noted in the RE I Project Paper (as amended); e.g. the total construction requirement for the 4 new PBS's includes the provision of both an efficient initial operating system and a foundation for future expansion. Accordingly, substations and main circuits will be designed for final load requirements. The major technical components for these new 4 PBS's include extension of the initial primary (high tension) circuit to the bulk of potential consumers and the development of a solid institutional base to provide the necessary technical expertise for both initial and future operations. The ongoing projett, RE I, demonstrated the validity of this approach. The expansion of the original thirteen (RE I) PBS's will consist mainly of line construction with related equipment such as distribution transformers and protective/sectionalizing devices. These new lines will reach further into remote areas so that more of the potential consumers who signed up under the initial (RE I) PBS membership drive, may be supplied. Under the present (RE I) line-mile allocation per PBS, about 50% of all domestic/commercial members and only 20% of all irrigation loads can be electrified. This RE II PP stresses the importance of electrified irrigation and related cost savings, (see RE I Evaluation) and the increase of line-miles per PBS, with related higher revenue and more economic loading of substations (decrease of loss to load ratio).

2. Technical Responsibilities:

The Rural Electrification Board (REB) is providing assistance to the Rural Electric Cooperatives (PBS) through management of construction, setting of constructinn and operating standards and specifications and establishing training courses and systems.

The REB field inspection staff, with the American Consultant, is supervising the local line design consultants and contractors to ensure compliance with REB standards. This is working well and completed construction reflects an acceptable workmanship as a result of excellent cooperation between the Consultant and the responsible REB supervising engineers. 80% of all local contractors, currently engaged in line construction, are now experienced and need less supervision than one year ago. However, the role of the American advisors remains as important as it was during the initial training stage in order to ensure continuing quality control through on-site inspections and close monitoring of all construction related activities.

Five PBS's have been energized under RE I and are now assuming responsibilities such as inspecting consumers' installations and making service connections. After construction completion, the local PBS's should be sufficiently experienced to assume full operation and maintenance responsibilities, with REB providing general guidance and policies.

The PBS will purchase and take responsibility for bulk power from the PDB at the PBS substation. Operation and maintenance of the 11 kV distribution system emanating from PBS substation will be the responsibility of the PBS. In general, REB will guide and supervise all PBS efforts.

All interior wiring is the responsibility of the consumer. Prior to energization, however, PBS inspectors will certify consumer's installations for conformance with REB standards. This has been successfully done under RE I.

To ensure a smooth transfer of technology, local engineering and surveying firms have been employed from the very beginning, with the Consultant providing guidance and general supervision. This approach has worked very well. There is confidence that these local consultants will become the nucleus for a sound electrical engineering/construction industry in Bangladesh. Appropriate technical assistance is essential for achieving this objective.

As in RE I the technical responsibilities of the local consultants will include:

- prepare detailed line design (staking sheets)
- supervise right of way (ROW) clearing
- prepare system maps
- provide general engineering consulting services
- supervise construction.

3. Power System

The Power Development Board (PDB) is responsible for all power generation and transmission in Bangladesh. Main transmission voltage is 132 kV, sub-transmission voltages are 66 and 33 kV. The latter 33 kV sub-transmission system is of primary concern to USAID and is addressed in detail under Annex D. The unreliability of this 33 kV system makes it mandatory that the Bangladesh Government cause PDB to rehabilitate at least those 33 kV substations and lines feeding the PBS substations. This project has earmarked funds for technical assistance to guide and generally supervise PDB efforts in this matter. Under the ADBs proposed Power Rehabilitation Project, other elements of PDB's generation and transmission systems are to be rehabilitated to acceptable standards.

Regarding generating capacity, present and future, there is evidence to believe that once the ongoing construction of the east-west interconnector is completed the power shortfall for the western grid noted in the RE I Project Paper Amendment will be overcome.

Tables 1, 2 and 3 show: (1) the estimated yearwise growth of peak demand, including total planned rural electrification demand. (2) a schedule of commissioning of power plants, including the peaktime transfer from east to west zone via the east-west interconnector, planned to be operational by 1983, and (3) a summary of ongoing and new generation projects of PDB to be implemented during 1981-1985.

4. System Design

PDB power (33 kV) will be stopped down to 11/6.35 kV as the primary distribution voltage. The primary system will have the Wye configuration with multi-grounded neutral. Main feeders and branch feeders are 4-wire 3phase, whereas primary tap circuits may be either 3 phase or single phase, according to loads encountered, existing or potential. The appropriate mix of 3 phase and single phase primary lines cannot be determined for the time being but field experience has shown that the originally conceived mix of 70% single phase and 30% three phase primary lines will shift towards more three phase due to higher irrigation consumer potential than expected and the unavailability in Bangladesh of single phase motors larger than fractional horsepower. This project has funds earmarked for power use commodities to alleviate the previously noted shortage of motors. Bangladesh will have to revise it's import policy, i.e. current import duties on electric motors rated under 25 HP are very high in order to protect the local motor industry, which, however, is incapable of meeting demand.

In some PBSs, existing PDB line has to be rehabilitated to fit within the PBS system. Under RE I, initial difficulties have been overcome and PDB line conversion/modification and rehabilitation is now progressing.

PBS line routing criteria remain as under RE I, i.e. primary main circuits (backbone lines) will run along existing roads, branch lines will be staked according to load requirements determined by the local consultant from sign up data and field verification. PBS substations are located at sites accessible throughout the year.

Secondary distribution voltage is either 400/230 Volt three phase or 230 Volt single phase according to load requirement. Power frequency is 50 Hertz (cycles per second).

For more details on system design see Annex E.

Table: 1

YEARWISE GROWTH OF PEAK I

Year	East Zone I			West Zone I			Wh	
	BPDB	REB	Total.	BPDB	REB	Total.	BPDB	% of increase over year
1	2	3	4	5	6	7	8	9
1978-79 ..	331	...	331	105	...	105	436	...
1979-80 ..	354	5	359	123*	4	127	477	9.4%
1980-81 ..	383	9	392	142	8	150	525	10%
1981-82 ..	421	17	438	167	14	181	588	12%
1982-83 ..	460	33	493	193	27	225	658	12%
1983-84 ..	503	61	564	234	51	285	737	12%
1984-85 ..	550	113	661	275	97	372	825	12%
1985-86 ..	...	...	742	...	...	417	...	...
1986-87 ..	...	...	831	...	...	467	...	...
1987-88 ..	...	...	931	...	...	523	...	...

* Includes all demands which are now supressed (about 20 MW)

Note: - The average growth of peak demand during 1980-81 to 1984-85 period f has been projected as, 13%, 24% ,16. 3% per annum respectively. Duri assumed to grow at the rate of 12% per annum.

Table 2 Schedule of Commissioning of Power Plan

(Assuming Khulna 110 MW Plant to be Commissioned in June, 1982 and the Interconne

Year	Peak Demand in West Zone	Peak demand in East Zone	Additional Generation capacity in West Zone	Additional generation in East Zone	Retirement of Plants in MW	Total available capacity in West Zone	av ca E
1	2	3	4	5	6	7	
1979-80 ...	127	359	...	...	...	146	
1980-81 ...	150	392	56 (Khulna B-M)	50 (Kaptai)	...	251	
1981-82 ...	181	438	25 (Barisal) (barge mounted	60 (Sikaibaha)	3 (West Zone)	273	
1982-83 ...	225	493	110-56* (Khulna)	56*	25 (West Zone)	302	
1983-84 ...	285	564	...	200** (Ashuganj & (Ghorasal G.T.)	...	302	
1984-85 ...	372	663	**50 (Bheramara ST)	100** (Ashuganj ST)	...	352	
1985-86 ...	417	742	100 (West Zone)	100** (Ghorasal ST)	...	452	1
1986-87 ...	467	831	...	100+100 (Chittagong, Kaptai)	...	452	1
1987-88 ...	532	931	125 (Rooppur)	100 (Ashuganj Ghorasal)	...	577	1

* Transfer of Khulna Barge-Mounted Plants to eastern grid.

** Combined Cycle.

Note- Peak-time transfer of power from East Zone to West Zone is calculated on the be always out of operation in East Zone for Schedule of forced maintenance.

Table: 3 ON-GOINING & NEW GENERATION PROJECTS OF BPDB TO BE IMPLEMENTED DURING 1981-85

Name of the Project	Capacity (MW)	Year of Commissioning	Remarks
A. On-Going:			
1. Karnafuli 3rd Unit (Kaptai)	1x50	1981-82	USAID financed
2. Chittagong SPS (Shikalbaha)	1x60	June, 1982	
3. Khulna SPS	1x110	Dec.'1982	
4. East-Zone Emergency Rehabilitation Programme	50	1981-82	To be financed by ADB.
5. West-Zone Emergency Rehabilitation Programme	39	1981-82	Partly financed by KFW & the rest to be financed by ADB
B. New:			
1. Ashuganj Extension			
a) Gas Turbine	90	July, 1982	Under U.K. Credit, Contract signed between PDB & M/s. John Brown (Supplier)
b) Steam Turbine	100	June, 1983	
2. Ghorashal Extension			
a) Steam Turbine	210	Dec.'1984	Financed by USSR.
3. Barisal Diesel	25	Dec.'1982	Not yet Financed.

5. Procurement:

The ability to effectively procure substantial quantities of materials in a short period of time has been a most significant accomplishment in the initial stages of the RE I Project. This is especially apparent when compared to similar projects in other countries as well as other general international procurement experience in Bangladesh. International procurement funded via this project (RE II) will be carried out along established procedures and it is anticipated that timely procurement will be achieved (IV.A. Procurement Planning).

In the same regard, we anticipate transshipment from entry points will be effectively carried out. Additionally, as original PDB warehousing facilities were insufficient for the magnitude of imported materials required, REB owned and operated warehouses have since been built and are now operating at the ports of Chittagong and Khulna.

6. Local Product Development:

A key element related to procurement is the development of a local product capability to complement the material requirements of the project. The RE I PP assumed all materials except cement, concrete aggregate, reinforcing steel, brick and some miscellaneous items needed to be imported. At the same time, it recognized that development of a local product capability was essential if current electrification efforts and subsequent system expansion were to avoid excessive reliance on foreign products and the attendant heavy foreign exchange requirements. During the first two years of the RE I Project, the REB has made significant progress in helping to develop certain local product capability.

For example, during pole procurement, the Bangladesh Forests Industries Development Corporation (BFIDC) won a competitive international tender for the supply of 5,000 poles and 30,000 cross-arms valued at US$1,058,000. This was in part the result of a sustained REB effort to upgrade the quality of BFIDC production facilities. The REB recruited and trained two wood products inspectors in the U.S. to insure that international quality control standards for Bangladesh-produced products would be maintained. Pole requirements under this project paper are anticipated to be supplied in sizeable part through domestic procurement. Over the long term, this should be especially cost effective for the project, given the heavy freight costs associated with international pole procurement.

There has also been substantial progress in developing products of relatively simple componentry. To date over US$1 million of wire, mounting board, plugs, grounding rods, and switch boxes have been manufactured and purchased in Bangladesh. As the system expands, it is expected those types of industries will be increasingly developed and dispersed into the rural areas.

7. General Plant:

Establishment of the PBSs in the rural areas has required REB financed construction of a headquarters for the administration, warehousing, maintenance and operation of the rural electrification systems. As in the case of the first 13 (RE I) PBSs, adequate facilities cannot be purchased or leased. New construction will be undertaken.

REB has to date completed all buildings of the first 12 PBSs. Furthermore REB has completed two main warehouses in the port cities of Chittagong and Khulna. The Khulna facility is being used primarily as the initial receiving and storage point for the bulk of imported materials such as substations, conductors, etc. In addition, to assist in off-loading of imported items at Khulna, a temporary jetty is operational while a permanent one is under construction.

8. Technical Assistance:

The Consultants for RE I, NRECA/CAI, have performed well in fostering an independent REB operating capability. REB has decided to retain the same Consultant and the Mission agrees.

All in all, given the importance of developing viable institutions at the central and local level, and the need for a large increase in the pool of skilled rural distribution, development and operations personnel, technical assistance will remain a most important factor in this RE II extension project.

9. Rural Electrification and Alternative Energy:

The relationship of rural electrification to alternative energy strategy is complementary. Electrification represents the most pervasive means of providing industrial power for irrigation and rural industry in Bangladesh. The use of electric power generates cost savings compared to diesel fuel. Electricity is generated largely by domestic resources while diesel is entirely imported.

While electrification will remain the primary power source for urban and rural industrial development, projected resources of hydro power and natural gas make it highly unlikely that electrification will be able to provide all of the future energy demand requirements. This is especially apparent when one considers that the government looks to Bangladesh's natural gas reserves for many diversified uses. Thus, while electrification , will remain the primary power source for rural irrigation and industrial development, it will have to be complemented by an increase in alternative energy sources if other in-country demands are to be met.

Because of the above, it is the Mission's strategy to support both rural electrification and the development of other energy sources which would fulfill primary energy needs. The Mission's CDSS has

energy as one of the four key sectors for attention. While development of the energy sector is still very much in the planning stage, the Mission is now in the process of contracting for a number of surveys, training efforts, and feasibility studies that would be the basis for the development of an energy program. A survey of all local agencies and private voluntary agencies involved in rural energy development will soon begin. At the same time, an extensive review of rural energy needs and current rural energy consumption patterns will be done. From these two basic surveys it is hoped that enough information will be obtained so that a follow-on alternative energy program might be developed. At the same time, the Mission is studying the possibility of maximizing hydro sources of electrical generation to insure that the rural electrification program has sufficient power generation to meet all needs, at lowest cost. A study is now underway to determine the feasibility of rehabilitating and upgrading Units 1 and 2 at the Karnaphuli power station. If positive, additional megawatt generation capacity might be available at relatively little cost. The Mission expects to begin soon a prefeasibility analysis of the potential for mini-hydro in Bangladesh. Construction of only a few of these sites could have significant effect on energy generation needs. Other donors are also seeking alternative energy activities.

While all of the above are essential if Bangladesh is to maximize its resources for power, it must be recognized that rural electrification remains the lynchpin of the government's energy strategy. The government is committed to expanding the electrification network; USAID/Dacca's commitment is to do it in such a way that the maximum productive benefit will accrue from such expansion. At the same time, this effort will not be sufficient to meet all latent demands for energy usage in the country and therefore development in other alternative energy sectors must continue.

10. Conclusion:

Judging the past and present performance of the REB, this RE II extension project is technically sound, has reasonably firm cost estimates and reflects the necessary planning needed in both the timing of project components and in the institutional structure required to carry it out. On this basis the project meets the requirements of the Foreign Assistance Act, Section 611 (a).

B. Economic Feasibility

1. Introduction

The approach employed by the feasibility study for this project is essentially the same as that in the Rural Electrification I Project. Only quantifiable economic benefits from the project are measured. Social benefits, and non-quantifiable economic benefits are not included. Benefits shown are therefore conservative.

The feasibility analysis here departs, however, in some ways from that in the Rural Electrification I Project Paper. First, data generated by the feasibility study was used to compile a statistical profile for a typical Phase II PBS rather than for each individual PBS under consideration. Second, an evaluation of the long run marginal cost for wholesale electricity was made and a sensitivity analysis of project feasibility carried out. Third, to show the economic feasibility of expanding the electrical system in the original 13 PBS's, an analysis is provided for a Phase I PBS from the 6th year.

2. Phase II PBS's

The costs and benefits for a Phase II PBS are calculated on the basis of a 17 year period with energization and the first connections occurring in the third year. Benefits occurring in later years are ignored. The real rate of return is calculated at 15.8% (under the present wholesale price for purchased power of Tk 0.266/kWH).

The data sources for the feasibility analysis are the Consultant's (NRECA/CAI) load and financial forecasts. However, financial data were adjusted where necessary to calculate economic shadow costs for a PBS system. Additional data sources are referenced in the Tables in Annex F.

Project benefits are computed for seven consumer groupings: residential, commercial, DTW's, STW's, LLP's, small industry and medium industry. The benefits understate the value of electricity in consumption and should be viewed as minimum calculations. Benefits include: 1) total purchases of electric power by all consumers (total revenue to the PBS); 2) cost savings present as a result of the shift from alternative energy source to electricity; 3) increased agricultural income due to increased operating hours/day in irrigation resulting from the use of electric motors; and 4) increased employment both through the labor requirements of new irrigation wells, commercial firms and small industry, and the staffing requirements of contractors, PBS's and REB.

Costs are calculated as the total of plant investment, operation and maintenance expenditures and wholesale power purchases from PDB.

The benefit-cost calculations are shown in Annex F. While it is impossible to quantify the social benefits from rural electrification, these benefits are discussed in the Social Analysis.

3. Expansion of a Phase I PBS

The costs and benefits for the expansion of a Phase I PBS are calculated assuming expansion begins in the sixth year and continues through the seventeenth year. System costs include the plant costs for this expansion and a certain prorated allocation of the "backbone" system costs. Expansion would not be possible without the previous backbone construction. Purchase power costs are determined assuming a wholesale rate from the PDB of Tk 0.266/kWH.

Benefits are calculated to include total expenditure or total revenue from the connections developed through the seventeenth year. The primary data sources are described in Annex F. The real internal rate of return for expansion is 24%.

4. Bangladesh Balance of Payments Position

Bangladesh's balance of payments is characterized by a large and growing trade deficit, almost entirely financed by foreign aid. Export prospects are not good, at least in the near term, given the largely stagnant world demand for jute and jute goods which account for some 70% of export earnings. Rapidly rising world prices--especially prices of petroleum and petroleum products--are exerting the same sort of pressures on Bangladesh as on non-oil producing LDC's in general.

The following table shows the balance of payments for FY's 1979, 1980 (estimated) and 1981 (projected).

BALANCE OF PAYMENTS FY 79-81
(in millions of US dollars)

	FY 79	FY 80(e)	FY 81(p)
Merchandise exports, fob	610	719	750
Merchandise imports, cif	-1,556	-2,352	-2,550
Trade Balance	- 946	-1,633	-1,800
Services (net)	- 5	- 7	- 52
Private transfers	140	163	234
Current Account balance	- 811	-1,477	-1,618
Amortization of MLT debt	- 57	- 50	- 57
IMF (net)	- 16	118	230
Other capital (net)	- 24	. 37	85
Disbursement of External Aid	1,032	1,232	1,310
Food Aid	179	375	180
Commodity Aid	482	388	510
Project Aid	371	469	620
Changes in reserves (--increase)	- 124	140	50
Reserve level (end of year)	393	251	201

(e) = estimated actuals; (p) = projected

The balance of trade deficit in FY 81 is expected to reach a record of about $1,800 million. Exports have been adversely affected by declining prices, especially prices of raw jute, and will rise by only 4% over the FY 80 level to about $750 million. Imports will rise by some 8% to about $2,550 million. Net of foodgrains, imports of which have declined to $220 million from $630 million in FY 80,

the increase in imports will be one of 22.5 percent. Imports of petroleum and petroleum products will reach about $500 million in FY 81, up from $390 million in FY 80, to account for two thirds of the country's export earnings. Although the country is striving to develop sizeable reserves of natural gas, petroleum imports will continue to increase in the foreseeable future.

In November 1980 Bangladesh completed negotiations for a three year SDR 800 million (approximately $US 1 billion) IMF credit, The effect of this assistance has been offset by reduced aid commitments in the recessionary economic climate characterizing most of the traditional donor countries. The critical commodity aid pipeline will be reduced to $260 million by the end of FY 81, which virtually assures sharply reduced commodity aid disbursements in FY 82 and perhaps beyond. Meanwhile, foreign exchange reserves will be reduced by another $50-55 million in FY 81 to an irreducible minimum of about $200 million (one month's imports at the FY 81 rate).

Thus, the large import increase and accompanying high rate of economic growth in FY 81 was accompanied by--and in part helped cause--a sharply deteriorating balance of payments positions. Prospects for FY 82 are bleak, and will remain poor pending an upturn in aid commitments. Under these circumstances grant aid projects, especially those with commodity aid components, are especially crucial for Bangladesh. Under the circumstances, and even apart from the technical assistance requirements, it is unlikely that Bangladesh could undertake the proposed project on the basis of its own resource availabilities. Further, to the extent the project substitutes electric power for the less economical diesel fuel now used as the main source for irrigation pumps, it will provide a vital foreign exchange saving.

Debt Service Requirements

Bangladesh's outstanding foreign debt obligations, both as to principal and interest, were estimated (by the World Bank) at $3,194 million as of June 30, 1980. If committed but undisbursed aid is included in the reckoning, the figure is $4,897 million. Debt service payments will be about $109 million in FY 81, or 14.5% of projected export earnings. They are projected, on the basis of current obligations, to peak at $221 million in FY 90. Most of Bangladesh's aid is on grant or highly concessional terms. In addition, a growing number of countries have cancelled outstanding debt obligations in recent years. Cancellations totalled $221 million through FY 79, with $142 million in FY 79 alone. The most significant cancellations have been effected by (in order of amount cancelled) the Netherlands, FRG, U.K. and Canada. AID's own assistance is either on grant or concessional loan terms. The PL 480 Title III program provides loan forgiveness upon attribution of foodgrain sales proceeds to approved development projects.

C. SOCIAL SOUNDNESS ASSESSMENT

1. Introduction

Nine out of ten of the 90 million people of Bangladesh live in rural areas in the most densely settled rural country in the world. Population density is 619 per sq. km. in an area approximately that of Iowa. Nearly half the population is under 15; estimated per capita income is $92 per year; and only about one person in five can read his native language. The population of the country is growing at 2.8% a year, and will double within 26 years at present rates.

Travel, transport, and communications within the country are affected by extremes of climate seasonal monsoons, and by the numerous rivers which traverse the country, and are often difficult. Most goods move by water, and the road network is poor. A high percentage of energy use is based on the use of wood, animal, and agricultural residues for domestic and productive purposes. Over 70% of the existing electricity supply is used in the three cities of Dacca, Chittagong, and Khulna. Electricity in the countryside, before the initiation of the Rural Electrification Project, was virtually non-existent and is still in its initial stages.

Bangladesh is linguistically and ethnically homogeneous. Nearly all its population speaks Bangla as a mother tongue. English is used widely among the ruling and economic elites. Bangladesh is the second-largest Muslim country in the world, after Indonesia; eighty-five percent of its population is Muslim, with Hindus making up a majority of the remainder.

Eighty percent of all Bangladeshis derive their livelihood, directly or indirectly, from agriculture. Nearly two-thirds of all land is under cultivation. Rice constitutes 97% of food-crop production; the major export cash crop is jute--amounting to nearly half the world's supply of this material. Social organization and cultural traditions are based on its rice-cultivating agrarian system, operating in a difficult environment under conditions of resource scarcity and increasingly severe population pressure.

2. Social Organization

The family household, and the homestead consisting of a cluster of such households, form the basic units of rural life. The homestead (bari), composed of households centered on a group of men related through patrilineal ties, provides a symbolic as well as an economic foundation for an individual's existence. Homesteads, in turn, are linked into para, usually based on a core of kindred and

associated with a defined area. Para are the settings for most of the important activities of village life. They are centers for economic exchange, political competition, socialization of children, and ritual interaction. Beyond its constituent para, the village tends to be functionally amorphous, with little community-level cohesion.

Rural areas, though isolated in many ways, are linked horizontally to other similar communities through economic and kinship ties, and vertically to administrative units such as the thana, district, and nation. Most vertical ties, however, are infrequent, and are controlled by local elites. The Land Occupancy Surveys (LOS) sponsored by AID in 1977 and 1978 pointed out serious inequality in land control and effective access to productive resources in rural Bangladesh. A number of other studies have noted that population pressure, land scarcity, social and economic inequality, and ineffective administration appear to be accelerating relative disparities of income and social class. The BDG is now attempting to address the problems of equity in the rural sector through implementation of development programs such as the Rural Electrification program, which seeks to increase access to an important source of energy while also increasing productivity and employment opportunity in rural areas.

3. Beneficiaries of the Rural Electrification Project

Information on participating individuals and groups, and on the beneficiaries for the rural electrification program, is based upon the initial feasibility studies carried out in 1977; a number of quick-studies on various topics which have been executed in connection with preparation of the RE I Project Paper Amendment in Spring 1980; the evaluation of RE I in Spring 1981; and preliminary data and observations from the first round of baseline studies. This information has been fed into the process of planning activities of REB, NRECA, and the Mission. As rural electrification expands under RE II and consumer connections begin to rise rapidly, the socio-economic impact evaluation will constitute a significant element in REB and Mission management of the project.

Ultimate beneficiaries of this project will be residents of the PBS areas which have been or will be established in Bangladesh. The initial 13 PBS areas contain approximately 9.2 million people in 1.6 million households. Plans are underway for the establishment of an additional 20 PBS's covering 15.2 million people--a total coverage of roughly 25% of the population. Of these, 10%-20% will receive electric service within the first 6 years of the project. A large number of the rest will benefit indirectly from employment, goods, or services made possible, or more accessible, by electricity.

Electric connections are highly desired, as evidenced by the fact that in the PBS areas so far selected, over 40% of all households have signed up for service--a number far in excess of projected targets. REB files, the studies of sign-ups and the quick-study examination of impact in one PBS area all indicate that in this project, as in all other electrification projects for which data are available here, most connections are for domestic service. Following a policy determination to maximize more productive uses of electricity rather than concentrating on domestic connections, the Mission and REB have sought to encourage agricultural, industrial, and commercial sign-ups. Whereas those who initially receive domestic service tend to come from higher income groups in rural areas, the thrust of production-oriented connections is somewhat different. Agricultural connections for tubewells are to be made available to a wider range of farmers, utilizing s simpler and more reliable form of motor. Discussions with farmers in Dacca I PBS, the first energized, revealed a strong interest in and desire for both conversion of diesel-powered tubewells to electricity, and acquisition of new electric tubewells.

Tubewells are a familiar item of agricultural technology, and one whose benefits are well known, since they allow winter crop production with greater reliability. However, diesel engines require greater outlays of funds for acquisition and maintenance, and are frequently beyond the means of small farmers. With greater availability of electric motors, command areas for wells will also increase, allowing more farmers to participate in tubewell groups.

Provision of electricity to rural areas, coupled with BDG policies encouraging establishment of industries outside major urban centres, is already showing favorable results for both increasing productivity and increasing employment. In Dacca I PBS, an aluminum plant, a carpet factory, a jute processing industry, and a number of smaller enterprises have been established since the founding of the PBS. The jute factory will use the products of an estimated thousand farmers or more. These industries will also provide regular cash income to local unskilled and semi-skilled laborers. And, in turn, such income will not only improve standards of living for low-income groups but also will help to improve the local economies of the PBS areas.

As in virtually all electrification projects for which data are available, electric connections in the energized areas in Bangladesh have gone initially to higher-income households, especially those with a significant cash income. While domestic connections are to be given lower priority under the Phase II project, the benefits from domestic household connections are appreciable, spread beyond the connected household itself, and should be noted. The cost of electric lighting is appreciably less

than that of alternative fuels. According to comparative studies, a year's supply of kerosene for domestic lighting costs Tk 199 (=$11.70). Electric lighting provides the same amount of illumination more efficiently and safely for approximately 30% less than the cost of kerosene. Further, electric appliances such as radios, TVs and fans, are actually used not only by the household owner, but by other members of the homestead.

Beyond domestic use alone, illumination of the homestead and of public places is reported to reduce the incidence of theft and robbery in rural areas. In the quick-study of electrification impact in Dacca I PBS, and in interviews with sign-ups in other PBS areas, enchanced security for self, family, and property is mentioned as a significant benefit for all income groups.

An additional benefit of rural electrification, which is yet to be realized in significant measure, is the opportunity for rural people to participate in the PBS. Although most people who have signed-up or received service know their PBS Director, few are yet familiar with his functions and their relationship to the PBS through him. Directors have yet to be elected in any PBS; they are nominated by REB from "prominent citizens." Elections of the Board of Directors will begin 18 months after energization. Efforts will be made in each PBS to involve its membership in a wide range of activities during the life of the project, and will increase the experience of rural Bangladeshis with participation in institutions which have important effects on their lives.

4. Equity Issues: Distribution of Project Benefits

Higher income households, bigger farmers, and those who can invest in the new technology benefit first and, at least initially, most from electrification of their areas. They have more access to influential officials. They can obtain relatively scarce items such as tubewells and other agricultural inputs. In a society such as that of rural Bangladesh, programs to develop rural areas and improve the overall life-chances of low income villagers must recognize and deal with the inequalities built into the social organization and cultural traditions of the region for thousands of years.

Design of this project has attempted in several ways to cope with the question of unequal access. Most important is the policy shift to productive use of electricity and the impact this will have on employment opportunity for the rural poor. The concept of the PBS itself is a novel one in Bangladesh. Participation in voluntary associations, in rural areas, is not very familiar. Access to decision-making is strongly linked to socio-economic status. Lower income individuals and families are limited by social constraints from direct participation, and usually seek to find a higher-status intermediary to cope with problems on their behalf.

The PBS is located relatively close to its clientele and includes a considerable number of local people in its workforce and in its management, in addition to a set of participating Directors drawn from defined geographic areas of the PBS. While still in its formative phase, this novel organization will allow far more effective and widespread participation in formal management than other organizations in Bangladesh. It remains to be seen how well it will work out over time, and how widely the model set by the PBS will diffuse into other rural development agencies.

The costs of signing up for service in PBS area is low--only Tk 5. Billing and payment procedures have eliminated much red tape and are recognized by users to be convenient. Loans are to be arranged for electric motors for pump groups and small industries, and possibly for housewiring. It is expected that during the life of this Project, as the established PBS's become more imbedded in the life of rural areas and as the PBS concept becomes more familiar, that these measures will increase participation by lower income rural people in rural electrification.

With provision of reliable and inexpensive energy to rural areas, expansion of existing bazaars such as those examined in the evaluation quick-study will continue. As these local growth centres become established, employment opportunities for lower-income, unskilled labor may be generated by the location of industries in PBS areas. Signs of this change were noted in the Dacca-I quick-study; and there are reports of similar activities in several other recently energized PBS's.

A final issue which is to be mentioned is the question of non-users in electrified areas. During earlier quick-studies done for the Project Paper Amendment for Rural Electrification I, a consistent theme in sign-up interview responses was that having electricity would enhance their social prestige. In Bangladesh's status-conscious society, this is an important cultural goal. Those without access to electrification, consequently, may be relatively deprived socially. However, investigation of electrified households indicates that, due to the household-homestead settlement pattern described above, actual users of electric lights and appliances are often many more in number than members of a single household. Electrified areas of the homestead compound provide illuminated work-space, and space as well for socialization after dark. Where TVs are available, they become focal points for neighborhood gatherings--much as in the early days of television in rural America. In the Dacca-I PBS, nearly 10 percent of the small household sample had already purchased TV's, and others intended to do so.

The REB has established an Evaluation Cell, with several professional social science and support personnel. With the experience they have gained in monitoring baseline studies and in assisting on small quick-studies, they are now in a position to operate independently and to

execute good-quality small scale research activities. One major task for this unit will be to examine, on a continuous basis, equity aspects of access to electric service. This information will allow REB and the Mission to make changes as required to improve service while reducing inequalities.

5. Spread Effects of the Project

The indirect effects of providing electric power through the mechanisms of the REB and PBS organizations are expected to be far-reaching, and can only be outlined briefly here. Bangladesh is short of energy resources in its rural areas; and its rural villagers are extremely aware that they need energy to enhance the productivity of agriculture and rural industry. They are familiar with electricity, and know what it can mean to their lives and work. In a quick-study comparison of diesel and electric tubewells, it was found that acreage under irrigation increased significantly with replacement of diesel with electric pumps. In addition, the number of farmers able to make use of pump water for their lands, and the overall yield of winter crops, also increased. Provision of electric power to a PBS stimulates local investment in industry, in both the traditional rice and oil mills and new businesses as well. In Dacca I PBS, an ice cream factory has recently been started; in other PBS areas, new cimema halls, machine shops and welding shops are reported.

Electricity allows a general increase in working hours, in both businesses and homes. The Dacca I PBS quick study of bazaar shopkeepers found that there was s significant increase in business. Customers were attracted to the lights and music of the shop, and shops could remain open for longer hours. Provision of electricity to bazaar villages will promote growth of local trading centres, increasingly supplementing and replacing the present patterns of low-volume cyclical village markets, and drawing more villagers into participation in the cash economy. At the same time, it may reduce the rate of migration to major urban centres, in favor of more restricted migration to these local growth centres.

Domestic, agricultural, commercial, and industrial fuel costs are reduced with electricity; and the reliability of electric power over diesel was reiterated over and over by quick-study respondents.

In the households and homesteads of rural PBS areas, effects other than income enhancement are also likely. Appliances such as fans, hotplates, and TV's are purchased. Studies in electrified villages of Pakistan found that the level of statsfaction with life, and perceived enhancement of the quality of life, were found more in households which were electrified and which possessed domestic appliances. Media exposure, and information about the wider world, is likely to increase in PBS vs. non-PBS areas of the country. Electrification of mosques, shrines, and

temples, likely in PBS areas, will provide better quality facilities for worshippers and pilgrims. Electrification of community facilities such as health centres and schools will enhance the quality of medical care and education in PBS areas.

The establishment of PBS's in the first phase of this project has already created a significant demand, expressed through political leaders, for a rapid expansion of this program throughout the country. Developing the program and responding to these demands while not exceeding management resources, will be a major challenge to the Mission and REB in the execution of the project's second phase.

6. Impact of the Project on Women.

The society of rural Bangladesh is sexually segregated; women from all but the very poorest households keep purdah, and confine themselves to their homestead areas. So far, over 95 percent of all signups have been for domestic service. Electrification of households, therefore, will have a direct and immediate effect upon rural women, whose work and leisure activities are centered in the home. The extent and nature of this impact is not easily quantifiable, but women interviewed in evaluation quick studies in energized PBS's are quick to mention these changes as improvements in their work and leisure.

Women must rise early to prepare meals for their families, as well as for their own prayers and ablutions. As well, they must often work long hours after dark, especially during peak agricultural periods. Electricity facilitates their work, replacing smelly, inefficient, and sometimes dangerous kerosene or wood.

Electricity seems to increase the frequency of inter-homestead visiting by women. Respondents report that, with electrification, their childrem may study more at home. Maternal and child health care is improved with electrification of health centres.

A major issue which has been the subject of much scrutiny by the Mission and by REB is that of potential displacement of rural women from rice-husking jobs because of the spread of rice mills. Critics of the rice mills recognize that the spread of mills is inevitable--the vast majority of mills are diesel powered, in non-electrified areas. The question is rather how to soften the impact of this innovation with respect to low-income, working women. Attempts are being made to determine the dimensions of the issue more carefully, through studies being initiated by the REB Evaluation Cell.

D. Environmental Analysis

The RE II PID (388-0054) approved by AID/W on October 17,1979 contained an Initial Environmental Examination (IEE) with a Negative Determination.

The RE I Project Paper Amendment (388-0021) approved by AID/W on August 19, 1980, including an Environmental Analysis and related annex which discussed environmental issues in depth and reinforced the IEE's negative determination.

USAID has reviewed those documents and found them still valid. Principal findings of those documents with respect to RE I experience are commented below.

1. Effects of Electric Pumps on Water Resources

Concern was voiced about the possible draw-down of groundwater aquifers as a result of the rapid increase in pumping capacity due to electrification.

1.1. Low-lift pumps (LLP's) and shallow tubewells (STW's) which comprise approximately 80% of all irrigation power pumps in Bangladesh should have no significant effect on water tables, i.e. STW's take their water from shallow aquifers and LLP's lift water from canals and rivers, both of which are fully recharged each year by heavy rains and floods.

1.2. Deep tubewells (DTW's) take their water from deeper aquifers, often located below an impervious clay stratum encountered at about 60 ft. in many parts of the country. The principal recharge of these aquifers is probably not local rains and floods but other sources, presumably in the Chittagong Hill Tracts, Assam and the foothills of the Himalayas. None of the approximately 15,000 existing DTW's have ever run dry, indicating adequate recharging of the deep aquifers.

2. Right of Way for Line Construction and Operation

Careful line design, avoiding tree lines and bamboo groves as much as possible will minimize changing of the landscape through tree cutting or trimming. RE I experience has shown that people are willing to provide right of way for electric lines through their agricultural farm land. Rural inhabitants now accept the concept that the electrical system is owned by everyone within the PBS boundaries. To date, no unsurmountable right of way problems have surfaced with about 500 miles of lines presently energized.

3. Miscellaneous

Other issues were pole location, line crossings, possible depletion of forests for service poles and loss of arable land. The former two relate to proper engineering design and have not become a problem. Forest depletion is negligible, i.e. yearly requirements for poles represent only 0.01% of the total wood scheduled for extraction. The loss of 2.25 square feet of arable land per pole is by far outweighed by the increase in cropping intensity due to more efficient and reliable irrigation.

PART III - FINANCIAL ANALYSIS AND PLAN

A. FINANCIAL ANALYSIS

1. Project Participation

For irrigation pumps and small industries the financial benefits of electric power use are sufficient to induce strong demand for conversion to electric service. Economic analysis of the benefits of electric powered irrigation show about a 30 percent cost-savings annually (Annex G). Economic savings and benefits result from fuel cost-savings, lower capital costs (electric motors are cheaper than diesel engines), lower maintenance costs, greater motor and pump efficiency and longer hours of operation at lower risk. The "Quick Study" 8/ demonstrated a strong preference among irrigation pump groups for conversion to electric power. The study also revealed that a significant number of diesel powered DTW's discontinued operation completely in the 1980-81 irrigation season because of what farmers perceived to be insufficient returns under diesel pump conditions. The financial advantages of electric power over diesel should continue over coming years--as diesel costs in Bangladesh will rise at least as fast as the costs of electricity.

For residential consumers, the financial questions are whether they can afford the initial costs of housewiring and the monthly electric bills. The answers depend on family income, how the family values household electric service, and on the cost savings incurred by substituting electric light for kerosene illumination. RE I sign ups for household connections have been greater than expected. Field experience has also revealed that most households seem willing to finance their own housewiring. It is already clear that up to 50 percent of families perceive sufficient benefits from rural electrification and want it.

The quick study indicated that the average family with an electric connection in Dacca I PBS spends about the same per month for electric lighting as they previously spent for illumination with kerosene. Bill collection records in Dacca I PBS show good collection -- 97 percent of electric bills paid within 60 days of the due date.

8/ "Quick Study" of the Socio-Economic Impact of RE I (Ref. Evaluation Annex).

2. REB Budget

The BDG has maintained its budget commitments to RE I. BDG direct contribution to RE I is budgeted at $28.016 million, of which $12.686 million has been expended to date by REB. Direct BDG contributions to RE II through REB is estimated at $18.898 million, which will be allocated in annual increments. REB has submitted the necessary budget request to the BDG for FY 81-82 and no difficulty is anticipated.

3. PBS Financial Viability

The financial viability of the project depends on the ability of the PBS systems to generate sufficient revenues to cover expenses for power, operations and maintenance, debt service and depreciation. To examine the financial viability of PBS's, a 17 year financial forecast was prepared for a typical PBS, based on the characteristics of the 12 new AID and World Bank PBS's as determined by the Feasibility Study. The forecast anticipates that the PBS will begin generating sufficient revenue by the third year of operations to cover administrative costs. By the eighth year, the PBS will have a positive margin on operation with sufficient cash for debt repayment. By the twelth year of operation, the PBS will be able to finance its own expansion. Annex I sets forth a projected PBS "Operations Statement" (Table 1) "Source and Application of Funds" (Table 2) and "Balance Sheet" (Table 3).

The two cost variables which greatly affect PBS financial performance are the wholesale power cost and the consumer rates. These rates should cover costs of generation, fuel, transmission; be fair to consumers, and allow PBS's to be self financing. The wholesale power rates are periodically set by the BDG. At present, PBS's are paying Tk 0.266/KWH for wholesale power. This rate is based on an electric rate study by Coopers and Lybrand9/ which projected costs through 1985. This rate appears to meet the objectives stated. The PBS financial forecasts are based on the Tk 0.266/KWH rate and on the retail rates which average approximately: Tk .85/KWH for household connections; Tk .70/KWH for irrigation; and Tk .80/KWH for rural industries.

As generation and fuel costs increase, the wholesale rate must also increase. The REB has submitted to the BDG a suggested formula which accounts for all "true" costs of generation and transmission but does not cover all the PDB administrative costs. This PP includes a condition precedent that the BDG establish a formula for calculating wholesale

9/ Bangladesh Power Development Board, Tariff Study, Coopers and Lybrand Associates Ltd., November 1979.

rates, so that PBS's are not penalized by having to pay rates to cover excessive PDB administrative costs.

To augment the PBS financial analysis discussed above, and other analysis of the PBS's, the REB and the Consultant will undertake a detailed feasibility study of each of the 12 Bank and AID-financed PBS's during the first few months of RE II. The study will be used as the basis for detailed financial,economic, engineering, organizational analysis and implementation plans for each PBS individually. On the basis of previous feasibility work, these organizations have demonstrated their competence to perform the detailed studies, analysis and plans needed.

B. Project Financial Plan

Total project costs are estimated at $68.898 million; $50 million AID financed and $18.898 million BDG financed. AID funds will finance construction commodities, technical assistance, power use commodities, (mainly electric motors) and others as shown in Table 4. AID financed local costs are for local support to the Consultant. Commodity costs, which comprise about 60 percent of the AID's contribution, are detailed in Tables 5 and 6. Technical Assistance costs, which comprise 25 percent of AID's contribution are detailed in Table 7. Estimated annual expenditures are shown in Table 8.

Total costs for the Phase II Program, of which RE II is one portion, are estimated at $188.8 million. Total estimated costs and sources of funds are shown in Table 9.

TABLE 4 SUMMARY COST ESTIMATE AND FINANCE PLAN
($1000's)

I. Construction Commodities	AID Funds		BDG Funds	
A. Base System (4 new PBSs)	FX	LC	LC	Total
1. Lines	9,683	-	349	10,032
2. Line Rehabilitation	265	-	48	313
3. Transformers	1,955	-	-	1,955
4. Line Protection	225	-	-	225
5. Connections	1,997	-	-	1,997
6. Street Lighting	22	-	-	22
7. Substations	3,265	-	-	3,265
8. Spares	144	-	-	144
9. General Plant	107	-	2,016	2,123
10. Adjustment to 1981 Prices	2,135	-	-	2,135
Subtotal	19,798	-	2,413	22,211
B. System Expansion (13 original PBSs)				
1. Lines	5,305	-	191	5,496
2. Transformers	1,970	-	-	1,970
3. Line Protection	97	-	-	97
4. Connections	1,460	-	-	1,460
5. Adjustment to 1981 Prices	1,076	-	-	1,076
Subtotal	9,908	-	191	10,099
II. Technical Assistance				
1. Local consultants	-	-	6,789	6,789
2. Non-local Consultant 1/	6,900	2,536	-	9,436
3. Training	3,246	-	1,391	4,637
4. Evaluation	50	-	-	50
Subtotal	10,196	2,536	8,180	20,912
III. Power Use Commodities	4,800	-	-	4,800

1/ Excludes technical services related to formal training which are costed in line item II. 3.

TABLE 4 (Cont)

	AID Funds		BDG Funds	
	FX	LC	LC	Total
IV. Support Commodities				
1. Consultants	661	-	165	826
2. REB Office	70	-	256	326
3. Vehicles	263	-	641	904
4. Training	6	-	60	66
Subtotal	1,000	-	1,122	2,122
V. Contingency	1,762	-	632	2,394
VI. Project Loans	-	-	5,000	5,000
VII. Landing Charges & Insurance	-	-	1,360	1,360
Total	47,464	2,536	18,898	68,898
	50,000			

Table 5 Estimates of Construction Commodity Quantity and Costs -- Base Systems (4 New PBSs)

ITEM	UNIT	UNIT PRICE	QTY	COST ($1000)
LINES				
1. 11KV/6.35KV, Phase 4/0 ACSR Neutral 1/0 ACSR	Mile	9,829	128	1,258
2. 11KV/6.35KV, Phase 1/0 ACSR, Neutral # 3 ACSR	Mile	6,457	180	1,162
3. 11KV/6.35KV, Phase # 3 ACSR, Neutral # 3 ACSR	Mile	5,417	244	1,322 1/
4. 6.35KV, Phase 1/0 ACSR, Neutral 1/0 ACSR	Mile	4,758	64	305
5. 6.35KV, Phase # 3 ACSR, Neutral # 3 ACSR	Mile	3,921	364	1,427 1/
6. 230V, Phase 1/0 ACSR, Neutral 1/0 ACSR	Mile	5,119	136	696
7. 230V, Phase # 3 ACSR, Neutral # 3 ACSR	Mile	3,847	380	1,462
8. 230V, 3 Duplex	Mile	5,470	8	44
9. 230V, 6 Duplex	Mile	4,953	424	2,100
10. 400V/230V, 3 Quadruplex	Mile	6,805	12	82
11. 400V/230V, 1/0 Quadruplex	Mile	9,045	4	36
12. 230V, U.B. # 3 ACSR	Mile	882	156	138
			2,100	10,032
Line Rehabilitation				
	Mile	440	712	313
Transformers				
Single Phase	KVA	40	44,200	1,768
Voltage Regulators	Each	3,520	53	187
				1,955
Lite Protection				
Oil Circuit Reclosers	Each	772	200	154
Tie Switches	Each	1,600	20	32
Fused Sectionalizers	Each	51	760	39
				225

1/ Subject to technical analysis, conductor size may be reduced to # 6 ACSR for a portion of the line.

Table 5 (Cont)

	UNIT	UNIT PRICE	QTY	COST ($1000)
Connections				
Residential/Commercial	Each	35	50,564	1,770
Shallow Tube Well/Low Lift Pump	Each	50	828	41
Deep Tube Well/Industrial	Each	290	640	186
			52,032	1,997
Street Lighting				
	Each	55	400	22
Substations				
	Each	233,200	14	3,265
Spares	Lot	36,000	4	144

Table 6 Estimates of Construction Commodity Quantity and Costs -- Expansion of 13 PBSs

ITEM	UNIT	UNIT PRICE	QTY	COST ($1000)
Lines				
1. 11KV/6.35KV, Phase # 3 ACSR, Neutral #3 ACSR	Mile	5,417	130	704 1/
2. 6.35KV, Phase # 3 ACSR, Neutral # 3 ACSR	Mile	3,921	850	3,334 1/
3. 230V, Phase # 3 ACSR Neutral # 3 ACSR	Mile	3,847	340	1,308
4. 230V, U.B., # 3 ACSR	Mile	882	170	150
			1,490	5,496
Transformers				
Substation	KVA	12.5	20,000	250
Single Phase	KVA	40.0	41,250	1,650
Voltage Regulators	Each	3,520	20	70
				1,970
Line Protection				
Oil Circuit Reclosers	Each	772	90	69
Tie Switches	Each	1,600	5	8
Fused Sectionalizers	Each	51	400	20
				97
Connections				
Residential/Commercial	Each	35	34,320	1,201
Shallow Tube Well/Low Lift Pump	Each	50	2,028	101
Deep Tube Well/ Industry	Each	290	546	158
			36,894	1,460

1/ Subject to technical analysis, conductor size may be reduced to #6 ACSR for a portion of the line.

Table 7 TECHNICAL ASSISTANCE

Position	Phase II Supplemental 81-83		Bal.Req.Phase II 84-87		Total Requirement Phase II	
	Man Months	Est. Amount	Man Months	Est. Amount	Man Months	Est. Amount
Team Leader	0	0	36	432,000	36	432,000
Engineer Advisor	0	0	36	432,000	36	432,000
Finance Advisor - REB	4	48,000	36	432,000	40	480,000
Finance Advisor - PBS (1)	24	288,000	72	864,000	96	1,152,000
Material Mgt. Advisor	24	288,000	12	144,000	36	432,000
Inst. Training Advisor	0	0	36	432,000	36	432,000
Tech. Training Advisor	18	216,000	36	432,000	54	648,000
System Oper. Advisor (2)	24	288,000	72	864,000	96	1,152,000
Management Advisor (3)	18	216,000	108	1,296,000	126	1,512,000
Distribution Engineer	18	216,000	18	216,000	36	432,000
Construction Supt.	16	192,000	20	240,000	36	432,000
Construction Advisor (4)	72	864,000	72	864,000	144	1,728,000
Power Use Advisor (1)	40	480,000	48	576,000	88	1,056,000
Model PBS Advisor	24	288,000	0	0	0	288,000
Model Eng. Firm Advisor	24	288,000	0	0	0	288,000
Model Contr. Advisor	24	288,000	0	0	0	288,000
Transmission Engineer	18	216,000	0	0	18	216,000
Short Term Specialists	0	0	24	288,000	24	288,000
TOTAL FIELD	348	4,176,000	626	7,512,000	974	11,688,000
Home Office	80	240,000	170	510,000	250	750,000
Logistic Support		75,000		169,000		244,000
TOTAL		4,491,000		8,191,000		12,682,000

TABLE 8 ESTIMATED ANNUAL EXPENDITURES ($1000s)

	FY1982	1983	1984	1985	1986	1987	TOTAL
AID							
Construction Commodities							
Base Systems (4 PBSs)	2970	4950	5939	4950	989	-	19,798
Expansion (13 PBSs)	1651	1651	1651	1651	1651	1651	9,908
	4621	6601	7590	6601	2640	1651	29,706
Technical Assistance	1850	1850	2610	2610	2610	1202	12,732
Power Use Commodities	3600	1200	-	-	-	-	4,800
Support Commodities	177	177	215	215	215	-	1,000
Contingency	274	392	450	392	157	97	1,762
TOTAL:	10,522	10,220	10,865	9818	5622	2950	50,000
BDG							
Construction Commodities							
Base Systems (4 PBSs)	362	603	724	603	121	-	2,413
Expansion (13 PBSs)	32	32	32	32	32	31	191
	394	635	756	635	153	31	2,604
Technical Assistance	1226	1977	2354	1977	476	98	8,108
Support Commodities	199	200	241	241	241	-	1,122
Contingency	98	141	161	141	56	35	632
Project Loans	-	1000	1000	1000	1000	1000	5,000
Landing Charges & Insurance	211	303	347	303	121	75	1,360
TOTAL;	2128	4256	4859	4297	2047	1239	18,898

Table 9 Phase II Program: SUMMARY COST ESTIMATE AND FINANCIAL PLAN ($000)

		TOTAL	AID	WORLD BANK	KUWAIT	BDG
I.	Construction Commodities	108,282	29,706	39,596	25,200	13,780
	A - 12 New PBS's	66,633	19,798 (1)	39,596 (2)	-	7,239
	B - Expansion - 1st 13 PBS's	10,099	9,908	-	-	191
	C - Phase I Ext. 8 New PBS's	31,550	-	-	25,200	6,350
II.	Technical Assistance	40,543	12,732	-	-	27,811
III.	Power Use Commodities	6,204	4,800	1,404	-	-
IV.	Support Commodities	10,649	1,000	4,000	1,800	3,849
V.	Contingency/Inflation	13,762	1,762	5,000	3,000	4,000
VI.	Project Loans	5,000	-	-	-	5,000
VII.	Landing Charges & Insurance	4,080	-	-	-	4,080
	TOTAL	188,520	50,000	50,000	30,000	58,520

(1) 4 PBS's

(2) 8 PBS's

IV. IMPLEMENTATION

A. Summary Plan

1. Implementation Schedule

Implementation will follow proven procedures developed under RE I. The REB is the main implementing agency responsible for overall project management including: 1) program planning and evaluation; 2) project engineering, design, construction and system operation; 3) procurement and logistics; 4) financial systems, records and accounts; 5) PBS development; and 6) training.

REB, with the Consultant, will carry out project implementation according to the schedule in Table 10, procuring commodities and services as required.

The AID project officer will monitor overall project performance and the institutional development aspects of the project. Similarly, the USAID electrical engineer will have the main monitoring role for technical aspects of the project. The controller, regional legal advisor, research/evaluation officer, and members of the project committee will be called on for specialized assistance when appropriate.

The implementation schedule applies to all 20 PBS's in the Phase II Program. AID funding will be approved some months ahead of World Bank funding, and the detailed planning, procurement and implementation related to the AID supported PBS's will proceed immediately upon obligation of funds.

Detailed Feasibility Studies: Final implementation plans and schedules for each PBS are formulated on the basis of detailed PBS feasibility studies conducted by the REB and the Consultant. These studies will commence in the third quarter of CY 1981 and continue in phases for about 18 months. The detailed feasibility studies include detailed estimates of power requirements, local employment potential, economic benefits, information for engineering line design, and projections of the financial viability of the PBS service area. The studies are the basis for identifying future needs of the individual PBS organizations and how those needs will be met and objectives attained.

PBS: Development and organization of the Phase II PBS's is scheduled to begin in the third quarter CY 1981. The REB Directorate for PBS development now has three years of experience and training in the development and organization of PBS's. They have achieved very satisfactory results in organizing PBS's.

Procurement: The first international tender for materials and equipment will be issued during the fourth quarter 1981. The first shipment of commodities will arrive in the country during the fourth quarter 1982.

Land Acquisition: Will commence during the third quarter 1981 for PBS headquarters sites. The first construction contract will be awarded during the fourth quarter 1981. Construction will include warehouse facilities, office and housing facilities.

Engineering Design: Based on the detailed feasibility study report and individual PBS membership drives, system engineering design will commence during the first quarter 1982.

Line Construction: Line construction will commence at the end of 1982. Approximately 500 miles of line will be constructed in 1983 under RE II while completing the balance of RE Phase I line construction. By 1983 there will be twenty-five experienced line contractors capable of constructing 120 miles of line per year each for a total of 3,000 miles of line construction per year (see construction targets, Table 11).

Training: Institutional and technical training for the PBS operational staff and Boards of Directors of RE Phase II will commence third quarter 1981. The training programs will double in size. 20 new PBS's must be developed and training must continue for the original 13 PBS's. Over 30,000 persons will receive training as targeted in Table 12.

Energization: Electrical energization of PBS's will commence during the second quarter of CY 1983.

Connections: Consumer connections for RE Phase II will commence in the PBS's during the second quarter 1983 (see connection targets, Table 11).

2. Procurement Planning

2.1 Commodities

The project calls for AID funded procurement of construction commodities and other commodities estimated at approximately $36 million. The entire Phase II Program involves commodity procurement estimated at approximately $108 million. This is an enormous amount of complex procurement, involving dozens of different commodities, each with related specifications and procurement schedules. About 90% of these commodities will be procured through international competitive bidding. The estimated cost and timing of AID financed commodity procurement is shown in Table 8.

Detailed commodity requirements are calculated by the REB Engineering Department based on system design. The Director for Procurement and the Director for Equipment and Materials, also in the Engineering Department, are responsible for the international tendering, purchase, receipt and handling of these commodities. Detailed commodity requirements for the four supported PBS's and the thirteen

Table 10 BANGLADESH RURAL ELECTRIFICAT
IMPLEMENTATION SCHE
PHASE II

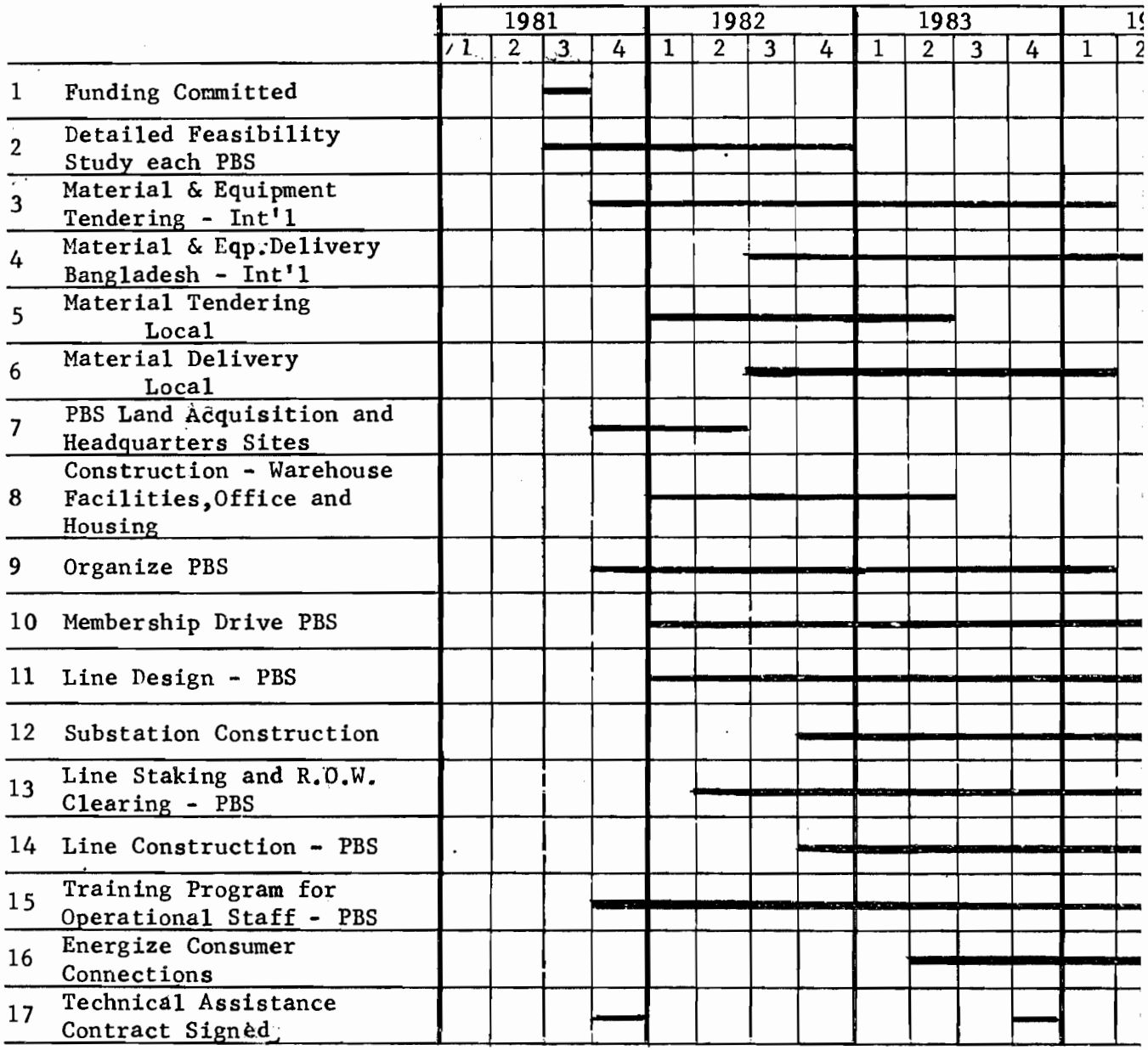

TABLE 11 OUTPUT TARGETS SCHEDULE

ACTIVITY	DATE OF ACHIEVEMENT
1. PBS Headquarters complete (4)	December 1983
2. REB Warehouse Expansion Complete (Khulna)	September 1982

3. Line Construction:

Miles	Designed & Staked	Construction Complete
500	January 1982	December 1982
1500	December 1982	December 1983
2500	June 1983	December 1984
3500	December 1984	December 1985
4300	December 1985	December 1986

4. Substation Construction Complete First 7 June 1983
Second 7 June 1984

5. Consumer Connections

EXPANSION OF ORIGINAL 13 PBSs

HOUSEHOLDS	IRRIGATION	INDUSTRIAL	TOTAL METER CONNECTIONS	
655	17	5	281	January 1983
3,930	98	30	1,700	June 1983
7,905	188	60	3,410	December 1983
11,840	285	90	5,110	June 1984
15,815	375	120	6,820	December 1984
19,760	465	150	8,520	June 1985
23,680	570	180	10,220	December 1985
27,650	660	210	11,930	June 1986
31,600	750	240	13,630	December 1986
35,570	840	270	15,340	June 1987
39,490	945	300	17,040	December 1987
43,500	1,020	320	18,740	June 1988
47,507	1,125	360	20,488	December 1988

TABLE 11
PAGE 2 of 2

FOUR NEW PBSs

HOUSEHOLDS	IRRIGATION	INDUSTRIAL	TOTAL METER CONNECTIONS	
1,690	41	12	730	March 1983
5,070	120	40	2,190	June 1983
10,160	240	70	4,370	December 1983
20,340	400	150	8,680	June 1984
30,110	720	230	13,605	December 1984
42,740	1,005	320	18,420	June 1985
55,240	1,320	420	23,830	December 1985
61,660	1,470	460	26,600	June 1986
69,070	1,635	520	29,780	December 1986
76,520	1,815	580	33,000	June 1987
81,350	1,935	610	35,090	December 1987
88,760	2,115	670	38,290	June 1988
96,420	2,280	730	41,580	December 1988

	ACTIVITY	SCHEDULE
6.	Billing procedures detailed and being carried out in all 4 PBSs.	December 1982
7.	All positions of REB sanctioned and 90-95% filled per Consultant's recommendations	December 1982
8.	Industrial/Irrigation Loan Program	
	10% Utilized by	January 1983
	35% Utilized by	January 1985
	75% Utilized by	January 1987
	100% Utilized by	December 1988
9.	Housewiring Loan Program 1/	
10.	Completion of REB Annual Audit	August(Annually)
11.	Training (Table 12)	

1/ Targets to be determined by June 1982 based on special examination of credit needs for a) housewiring, b) irrigation connections, and c) rural industry.

Table 12 - TRAINING TARGETS FOR PHASE-II
RURAL ELECTRIFICATION PROJECT
1981 - 1987

CATEGORY OF TRAINEE	NUMBER OF TRAINING PROGRAMS	TRAINEES PER PROGRAM	TOTAL TRAINEES
1. REB Officers (New) Orientation	8	49	392
2. Engineering Consulting Firms	6	20	120
3. Construction Contractors -- Linemen & Foremen.	6	50	300
4. PBS Directors and Women Advisors 3 per year/PBS.	18	260	4680
5. General Managers 4 per year	24	20	480
6. Finance Department 12 employees per PBS	13	240	3120
7. Construction, Operation & Maintenance Department			
AGM-CO&M Line Supervisors	18	60	1040
Storekeepers & Stores Assistants	6		
Linemen	4	400	1600
8. Member Services Department			
AGM-Member Services	18	20	360
Power Use Advisor	12	20	240
Wiring Coordinators & Inspectors	6	80	480
9. General Services Department	18	20	360
TOTAL (20 PBSs - Phase-II)	157	1279	13412
10. Continuing Training for 13 PBSs of Phase-I Project	106	888	6019
11. Additional New Trainees from Turnover in PBS & REB (300 per year)	9	300	2700
TOTAL (33 PBSs Phase-I&II)	272	2467	22131
12. Village Electricians			
Number in training Programs (12 classes per PBS).			6000
Number Certified to do Housewiring	3000		
Number of Functional Electricians in PBSs	1500		
13. Job Training and Safety Program			
Phase II - Number of Participants each year	460		
Phase I - Number of participants each year	300		

expanded PBS's are shown on Tables 5 and 6.

Based on the REB's procurement record to date, REB appears to have the capability to handle the planned procurement. During 1980, REB received and distributed to PBS sites 29,000 long tons of purchased material and equipment with a total C&F value of approximately $30 million from U.S. and 941 sources. Specifications and tender documents already exist for most of the commodities AID will fund. Warehousing, logistical and inventory systems developed under RE I are in place and, with some planned expansion, are sufficient to handle the Phase II Program requirements. To the extent that the World Bank and Kuwait require separate procurement procedures or records, the REB's procurement job will be made more difficult. Some changes are expected but REB and the Consultant will attempt to minimize duplication.

AID funded commodity procurement will be U.S., Bangladesh and/or 941 source/origin.

2.2 Technical Services

Technical assistance will be procured by the REB under AID financed host country contract arrangements. The REB is very satisfied with the program approach and performance of NRECA/CAI and proposes to retain the same Consultant for the Phase II Program.

USAID proposes to fund technical assistance in two or more tranches by committing $3 million in FY 81 for immediate TA requirements, another $7 million in FY 83 and the remaining $2.732 million in FY 84. TA funding requirements would be relatively low from FY 81 to 83 because TA is also being funded by RE I during that period. From January 1984, RE II would have to fully fund the TA requirements. Table 7 shows TA cost estimates by FY.

To continue NRECA/CAI services, REB will sign a new contract under negotiated procurement procedures. The draft Project Authorization (Annex C) provides for the AID Administrator's approval of the procurement. The scope of work under the present contract will be expanded to cover the new PBS areas and responsibilities. One Contract, plus two amendments will be needed in December 1981, March 1983, and December 1984. Prior to the March 1983 amendment, REB and AID will reappraise project performance and TA requirements.

B. Administrative Arrangements

Under RE I, project administration has been very good at most levels, in contrast to the managerial and administrative deficiencies which typify most development programs. Management remains thinly spread at most levels however.

Success to date has resulted from strong BDG support, excellent REB leadership and staff, and soundness of the design of RE I. Administrative concepts being demonstrated represent some fairly radical departures from normal practice in Bangladesh, particularly with respect to PBS autonomy, uniform standards and specifications, explicit delineation of responsibilities and authorities, reliance on private sector, and emphasis on training. Continued project success depends on expanding the capability and performance of the REB, the PBS's and the other participating organizations. This project contains REB budget and staff increases, technical assistance and other arrangements designed to develop institutional capacity as needed.

REB

REB responsibilities are listed under Project Description. REB budget is being increased from $710,000 annually to $1,070,000 annually and staff increased from 381 to 456. These staffing increases were jointly planned with the Consultant to achieve expanded REB field capability as the number of PBS's grows from 13 under RE I to a new total of 33. Further discussion on REB organization, responsibilities and staff are presented in Annex J. REB has experienced some difficulties in recruiting qualified staff; carrying out power use programs; maintaining quality control of engineering design and construction; and in a few cases, developing PBS's.

PBS Development

As the organizations which actually own, operate, maintain, and finance the electrical systems and service consumers, PBS's are critical to project success. To date, PBS's have generally displayed good performance and excellent potential (ref. RE I Evaluation). Performance is not uniform from PBS to PBS, however, and some PBS's have developed more slowly than planned. The REB Member for PBS and Training and the Consultant will continue an intensive PBS development program (ref. Project Description, I.C.6). The training program will be expanded to establish a "model PBS" where PBS managers and staff will receive on-the-job training under close supervision. PBS organization is shown in Annex K.

PBS Autonomy and Authority

The concept of local PBS autonomy is central to the strategy for providing reliable electric service in rural areas. This concept must, of course, be very carefully weighed against the REB's needs to sufficiently guide, monitor and control new PBS's under the terms of the development loans. Treading the fine line between too much REB control and too little will be a difficult aspect of project administration. Too much control could stifle local PBS autonomy and development and too little could result in inadequate PBS

capability to properly institute critical management and financial systems. In some rural areas, it has been difficult to obtain management and key staff employees with the needed experience and skills. Therefore, close monitoring and training of PBS staff is necessary. The relationship between the REB and the PBS's will have to be paternal in character in the initial years. The REB will scrutinize PBS development very closely, and monitor and advise at every step during the first few operating years. The REB will monitor PBS performance in achieving fair treatment of PBS employees, adherence to cooperative principles and practices, genuine membership control. As the PBS's develop with experience and achieve financial viability, the monitoring and assistance from the REB will be reduced accordingly.

PBS Boards

The PBS Boards of Directors represent the best interests of the membership in making policy,hiring and holding accountable a general manager and accepting responsibility for the success or failure of the PBS. There is one director from each district (Elaka). Monthly meetings are held by each PBS board. Committee memberships are rotated on an annual basis to allow board members and women advisors to serve on each committee, thereby accelerating their knowledge of PBS functions and procedures. Women are presently serving as directors on seven PBS's. In addition, to introduce more women to the PBS management process, up to five women advisors are appointed to each PBS Board. Women advisors participate in all board discussions. They have the same powers as directors on Board Standing Committees where much of the PBS business is transacted. Advisors do not have a vote at the full Board meetings. Of 183 Directors and Advisors, 36 are women. A study of the 13 Boards of Directors by the REB Evaluation Cell[10] shows that PBS Boards are much more representative of the rural population than might be expected. 40% are farmers, 12% businessmen and 48% from various white collar professions. 29% are from the relatively low income group with average family income below $1,000 per year; 36% are from a middle income bracket with annual income less than $1,300; and 35% from the high bracket with an average annual income of $3,000.

Construction Scheduling

Achieving the implementation schedule depends greatly on whether construction targets can be achieved and standards maintained. The RE I Evaluation discussed construction performance to date. Construction is about six months behind schedule, but the rate of

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(10) "An Analytic Report on Board of Directors of 13 Registered PBS's", REB Evaluation Cell, September 1980.

construction is increasing. RE I end-of-project construction targets are expected to be achieved on schedule.

Maintaining necessary construction quality is more difficult than obtaining quantity. RE II will put emphasis on monitoring the Bangladeshi consultancy firms and contractors. The level of American construction advisors will not be reduced as much as originally expected during the 1981-83 period. To increase their effectiveness in covering large geographic areas, they will provide less direct on-the-job training to contractors and will work more closely with REB supervisory engineers and local consultants to ensure effective construction supervision and corrective action.

The timely completion of the PBS headquarters is essential. Under RE I, 12 of the 13 PBS headquarters sites are complete and construction under way on the thirteenth. REB performance has been very good in this respect. The four RE II PBS headquarters are scheduled for completion by December 1983.

Substation construction must be completed in order to feed the PBS distribution networks. Performance in constructing the substations to date under RE I has been similarly good and on schedule.

Generally, the construction effort will be structured as follows: The REB superintending engineer will delegate construction monitoring in each of the project areas to individual REB executive engineers. They will be assisted by the Consultant's construction superintendent advisors. Local contractors will receive classroom and field training in system construction. Contracts for actual PBS system detailed design and construction are awarded and financed by the REB.

C. Evaluation

Substantial Mission attention has been given to defining evaluation strategy and conducting evaluations appropriate to the level of RE I project development. Three evaluations have taken place including the latest in May 1981. The findings from these evaluations have been incorporated into the present project design.

1981 Evaluation

The May 1981 evaluation is presented in Annex A. Findings were quite favorable. Evaluation methods included an assessment by the Consultant of progress in achieving inputs and outputs, a Quick Study of socio-economic impacts by REB and USAID, a direct assessment of selected issues by the AID project officer and the AID engineer, reference to baseline surveys conducted by the University of Dacca, and reference to the feasibility studies conducted in 1981 by REB and the Consultant for the Phase II Program. Future evaluations of RE I

and RE II will continue to employ some of these methods.

Evaluation Objectives

Evaluation will continue to concentrate on areas of project implementation and socio-economic impact. Emphasis will be given to assessing the potential for electrification of irrigation and rural industries, RE progress and problems in achieving these potentials and the related socio-economic results. The logical framework for RE II has been amplified to better illustrate RE objectives, end-of-project conditions, output magnitudes and schedules as the basis for future evaluation. Log frame targets are further detailed and scheduled in Annex B and Tables 11 and 12.

REB Evaluation Cell

The RE I PP Amendment in August 1980 provided for the creation of an REB Evaluation Cell, assisted directly by the Consultant. The Evaluation Cell has been created with a Director trained in statistics, two evaluation analysts, one tabulator and supporting staff. It is responsible to design surveys and other studies, execute them either directly or through contracts, write or supervise studies, ensure the validity of results and disseminate findings to the REB and other bodies. To facilitate establishment and operation of this unit, RE I allocated $250,000 in AID funding for baseline studies and Evaluation Cell support. In early 1981, the Evaluation Cell was active in supervising baseline studies and assisting with the Quick Study.

To enhance the effectiveness of the Evaluation Cell, it was recently merged with REB's Program Planning Unit (responsible for feasibility work and planning for future RE areas) into a newly created Program Planning and Evaluation Directorate. This reorganization will increase the impact of evaluation by providing a direct means for feeding evaluation results into program planning.

Full time technical assistance is provided by the Consultant's feasibility advisor to the REB's Program Planning and Evaluation Directorate in defining study topics, survey techniques and data processing and analysis.

Baseline Surveys

The Institute of Statistical Research and Training (ISRT), University of Dacca, under direct contract to USAID, has completed baseline data collection and tabulation in four RE I PBS areas and is beginning data collection in four more. Baseline surveys will be completed in all 13 RE I PBS's. The Baseline surveys are comprehensive compilations of socio-economic information which will provide the base for measuring social or economic changes in the PBS's.

Baseline studies collect data on: a) agricultural production; b) community life; c) employment; d) commerce and industry; and, e) quality of domestic life. Research instruments are designed to ensure adequate samples of households, communities, and commercial, industrial and agricultural operators.

Feasibility Studies

To provide sufficient information for selection and planning of new PBS's, the REB Planning and Feasibility Unit, with Consultant assistance, completed a general feasibility study for a large geographic area in May 1981. The top ranked 12 areas were proposed for AID and World Bank Funding under the Phase II program. Beginning by August, 1981, the REB and the Consultant will conduct "detailed feasibility studies" in the 12 areas as the basis for detailed project design of each PBS area--engineering design, construction schedule, organizational requirements, etc. These detailed feasibility studies are also being designed to collect the information normally collected by the baseline surveys. Thus, for new PBS's, special baseline studies will not be needed. This will free the Evaluation Unit to plan and conduct "progress" and "issue" related evaluation studies.

Progress Studies

These studies, also referred to as updated baseline surveys, will be conducted by the REB Evaluation Cell beginning 18 months after energization of PBS's.

Quick Studies

To appraise preliminary indicators of the socio-economic impact of rural electrification in early 1981, the REB Evaluation Cell and USAID staff conducted a Quick Study under the direct supervision of USAID's social anthropologist. This exercise, which involved about six field interviewers over several weeks, provided some findings of importance for project implementation and provided excellent on-the-job training for the REB Evaluation Cell staff. The Evaluation Cell intends to continue this technique for examination of special topics.

Consultant Evaluations and AID Monitoring

The Consultant will monitor project progress on a day-to-day basis, submitting monthly and quarterly progress reports and annual evaluations, especially of input-output-purpose level achievement and administrative progress/problems. Through the project officer, AID will continuously monitor the project and contribute to the regular annual evaluations.

Evaluation Funding

Of the $250,000 allocated for baseline studies and other evaluation work under RE I, about $70,000 has been committed and $180,000 remains available through December 1983. For evaluation purposes in 1984-87, RE II contains an additional $100,000 in AID funding.

D. Conditions, Covenants and Negotiating Status

1. Conditions Precedent to Disbursement beyond US$5 million

US$5 million will be provided to the REB upon signing the Project Agreement. The remaining US$45 million will be made available after achievement of the following conditions precedent:

1.1 The Government of Bangladesh (BDG) will undertake a program to rehabilitate and maintain 33 kV substations and transmission lines which feed rural electrification substations. Objective of the program is to increase power transmission reliability and reduce frequency and duration of outages of power in RE substations to an acceptable level, i.e. not more than 50 outages amounting to no more than 35 hours per substation per year. The program will include:

1) A survey of 33 kV substations and line feeding present and planned PBS substations under the rural electrification program.

2) A short term rehabilitation plan including specific objectives and resources.

3) An 18 month program to physically rehabilitate the 33 kV substations and line.

4) A longer term plan to redesign and reconstruct 33 kV substations and lines with records of excessive outages.

5) An upgraded maintenance program to keep rehabilitated substations and lines in proper condition.

To this end, the BDG will undertake the planning required, and allocate the manpower, commodities and budget needed to carry out the activities presented in Annex D. Failure to adhere to the Annex schedule or provisions at critical points specified below and in the Annex may halt AID disbursements for this project(1).

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(1) Approximately 24 man months of non-local technical services will be provided by the RE II Project to assist the Ministry of Power, Flood Control and Water Resources with the necessary planning and implementation of surveys, studies and rehabilitation/maintenance activities.

a) Submission to and approval by the Ministry of Power, Flood Control and Water Resources and AID of a "survey plan" as described in Annex D within three (3) months of Project Agreement signing.

b) Submission to and approval by the Ministry and AID of an "Interim Rehabilitation Plan", as described in Annex D within eight (8) months of the Project Agreement.

c) Progress in conducting the rehabilitation program reasonably in line with targets established in the "Interim Rehabilitation Plan".

d) Submission to and approval by the Ministry and AID of a "study of 33 kV substation and line maintenance", as described in Annex D within ten (10) months of the Agreement.

1.2 Reduction of customs duty on small electric motors (25 HP and below) to 15% ad valorum or less and arrangements to permit the importation of said motors through official and commercial channels in quantities large enough to meet the motor requirements of the Rural Electrification Programs, Phase I and II, as determined by the REB.

1.3 Satisfactory progress in carrying out the "Action Decisions" in the "Project Evaluation Summary" for the May 1981 Evaluation of the Rural Electrification I.

1.4 Establishment, by the BDG, of an approved REB budget at required funding levels for the first year (1981/82) of the project.

2. Conditions Precedent to Additional Disbursement (beyond the dates indicated)

2.1 Within twelve (12) months of Agreement signing, establishment by the BDG of a formula for determining wholesale power rates (which the PBS's pay the PDB), such formula derived so as to set rates at the national average cost for production and transmission of electricity, except that rates should include only "essential" costs of transmission and not include costs attributable to unnecessary administrative overhead or power losses.

2.2 Within twelve (12) months of Agreement signing, commencement of loans under a new three year BDG financed $5 million loan program for financing purchases by farmers of electric motors and other equipment for irrigation, such loan program to be designed and targeted, insofar as is reasonable, according to the procedures to be recommended by the REB following an REB study of RE related credit needs.

3. Covenants

3.1 The BDG shall diligently plan and carry out programs to ensure adequate power generating and transmission capacity to meet the electric power needs of the areas electrified under the rural electrification program.

3.2 The BDG shall diligently plan and make arrangements to ensure an adequate supply of proper type and size electric motors for productive uses in Bangladesh; such arrangements to include importation of such motors under the nation's various DTW, LLP and STW irrigation development programs.

3.3 With respect to the supply, sale, distribution and service of minor irrigation pumps and engines/motors, the BDG will encourage rapid "privatization" as called for in the SFYP.

3.4 The BDG shall undertake to direct adequate loans from all sources to finance purchases of electric motors and related pumps and equipment to permit rapid adoption of electrified means of production, especially for irrigation.

3.5 The BDG shall cause the PDB to supply electric power to the PBS systems as demand requires and at a rate equal to the national average cost for production of electricity as defined in 2.1 above.

3.6 The BDG shall review annually the consumer rates approved for the PBS areas and adjust such rates as necessary to ensure the financial self-sufficiency of the PBS organizations.

3.7 The BDG shall cause REB to carry out the project with diligence and efficiency, and in conformity with sound administrative, financial and engineering practices applicable to electric power distribution, and shall not take or permit any actions which would interfere with REB's obligations under the Project Agreement.

3.8 The BDG shall make available or cause to be made available to REB, promptly as needed, the funds, facilities, services and personnel required for carrying out the project.

3.9 The BDG shall cause all BDG agencies and corporations located or working in the PBS electrification areas to cooperate and assist in all means possible in the development of the PBS organizations, distribution systems and power use programs.

4. Negotiating Status

During Project Agreement negotiations, USAID will negotiate the above CP's and covenants with the BDG and seek to incorporate

into the Agreement the necessary terms and conditions for achieving the desired objectives.

PD-AAM-623

PP ANNEXES

TO

RURAL ELECTRIFICATION II

PROJECT (388-0054)

(Annexes B through Q -- Annex A is under separate cover)

A.I.D. 1011-1
SUPPLEMENT 1

PROJECT DESIGN SUMMARY
LOGICAL FRAMEWORK

(INSTRUCTION: THIS IS AN OPTIONAL FORM WHICH CAN BE USED AS AN AID TO ORGANIZING DATA FOR THE PAR REPORT. IT NEED NOT BE RETAINED OR SUBMITTED.)

Life of Project:
From FY 81 to FY 87
Total U.S. Funding $50 million
Date Prepared: May 22, 1981

PAGE 1

Project Title & Number: Rural Electrification II

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
Program or Sector Goal: The broader objective to which this project contributes: (A-1)	Measures of Goal Achievement: (A-2)	(A-3)	Assumptions for achieving goal targets: (A-4)
Improved rural standards of living.	1. Agricultural, small industrial and household jobs created per projections (Ref. "Economic Analysis").	1. Evaluation surveys.	1. GOB follows rational investment policies for small industries and irrigation pumps.
	2. Annual increase in second and third crop production.	2. As below:	2. Farmgate prices provide incentives for irrigation.
	2.1 Per projected irrigation power usage.	2.1 Power consumption records.	3. Total number of power pump sets is increased per Second Five Year Plan (SFYP).
	2.2 Average electric pump command area greater than diesel, 25% or more.	2.2 Special power pump quick studies.	
	2.3 Electric pumps demonstrate cost savings of approx. 30%.	2.3 Special power pump quick studies.	
	3. Indirect socio-economic benefits created.	3. As below:	
	3.1 Increase in home study.	3.1 Evaluation surveys	
	3.2 Increased availability and utilization of community services --schools, health centres, pharmacies, etc.	3.2 Evaluation surveys	
	3.3 Illumination quality increased and costs reduced.	3.3 Evaluation surveys--calculations of savings compared to use of kerosene.	

PROJECT DESIGN SUMMARY
LOGICAL FRAMEWORK

Life of Project:
From FY _____ to FY _____
Total U. S. Funding _____
Date Prepared: _____

Project Title & Number: _____

PAGE 2

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
Project Purpose: (B-1)	Conditions that will indicate purpose has been achieved: End-of-Project status. (B-2)	(B-3)	Assumptions for achieving purpose: (B-4)
Provision of reliable electric service at reasonable rates to existing and potential sources of rural employment, to irrigation pumps, rural industries and businesses, community service facilities and rural households.	1. 276,500 MWH sold by PBSs to consumers by Dec. 1986, including: 1.1. 97,800 MWH for irrigation 1.2. 59,100 MWH for rural industries.	1. Power consumption records. 1.1 Ibid. 1.2 Ibid.	1. PDB power supply to PBS substations improves; PDB upgrades 44 KV substations and lines feeding PBS substations.
	2. Outages and downtime have no significant negative impact on the production plans of farmers and other rural producers.	2. Evaluation surveys.	2. PBSs succeed in creating community-wide responsive organizations.
	3. PBS electrical systems maintenance standards enforced.	3. REB/Consultant reports.	
	4. Appropriate percentage of irrigation pumps connected per staking criteria.	4. REB/Consultant review of staking sheets, targets and actual connections of pumps.	
	5. PBS financial position sound: Operations financed by revenues 5 years after energization; loan repayment begun.	5. PBS financial records; loan repayment records.	

1/ Output targets are scheduled over time in Table 11 "Targets".

AID 1330-5 (11-78)
SUPPLEMENT I

PROJECT DESIGN SUMMARY
LOGICAL FRAMEWORK

Life of Project:
From FY _____ to FY _____
Total U.S. Funding _____
Date Prepared: _____

Project Title & Number: _____

PAGE 3 (b)

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
Project Outputs: (C-1)	Magnitude of Outputs: (C-2)	(C-3)	Assumptions for achieving outputs: (C-4)
4. PBS's established, staffed and functioning	4.1 Managers, key staff in place.	4.1 Staffing plans and reports.	
	4.2 Board of Directors' functioning per instruction manuals.	4.2 REB/Consultant appraisal.	
	4.3 Financial records in order.	4.3 REB appraisal of PBS financial records.	
	4.4 Revenue collection sound: as compared to substation output and bills.	4.4 PBS financial records.	
5. Power use program established	5. Plans for adequate national supply and distribution of motors	5. Power use plan.	
	5.1 Public agencies (BADC, BKB etc.) supplying electric motors per plan.	5.1 Appraisal by REB/ Consultant	
	5.2 Private suppliers producing or importing, installing irrigation pumps and motors per plan.	5.2 Appraisal by REB/ consultant .	
	5.3 Dollar 5 million loans to farmers for electric motors; related equipment.	5.3 Bank credit records; REB survey of private dealers.	

AID [illegible]
SUPPLEMENT 1

PROJECT DESIGN SUMMARY
LOGICAL FRAMEWORK

Life of Project:
From FY _____ to FY _____
Total U. S. Funding _____
Date Prepared: _____

Project Title & Number: _____

PAGE 3 (c)

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
Project Outputs: (C-1)	Magnitude of Outputs: (C-2)	(C-3)	Assumptions for achieving outputs: (C-4)
	5.4 Local investors introduced to American firms for manufacture of motors etc.	5.4 U.S. Emb commercial/ economic records.	
6. Self training capacity established	6.1 REB training institute conducting program per plan. 6.2 PBS's train 6,000 electricians.	6.1 Training records.	
7. Private sector mobilized to provide engineering, construction, supply services and commodities.	7.1 4 contracts signed with local 2 engineering consultants. Consultants perform per contract specs, schedules and standards.	7.1 Contract records; appraisal by supervising engineers and REB.	
	7.2 31 contracts signed with 10 construction firms. Contractors perform per contract specs, schedules and standards.	7.2 Contract records; appraisal by supervising engineers and REB.	
	7.3 Construction commodities supplied by local firms (poles, switches, wire etc.) per REB specs/ standards.	7.3 Procurement records.	

AID 1020-28 (1-73)
SUPPLEMENT 1

PROJECT DESIGN SUMMARY
LOGICAL FRAMEWORK

Life of Project:
From FY 1981 to FY 87
Total U.S. Funding $50 million
Date Prepared: May 21, 1981

Project Title & Number: Rural Electrification II

PAGE 4

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
Project Inputs: (D-1)	Implementation Target (Type and Quantity) (D-2)	(D-3)	Assumptions for providing inputs: (D-4)
Reference PP Tables 4, 5, 6 & 7.	Reference PP Table 8	1. AID financial records on commodity and T.A. procurement. 2. REB records on (a) commodity procurement, (b) staffing (c) contracts w:local consultants.	BDG will supply REB with needed staff and budget.

DRAFT PROJECT AUTHORIZATION

BANGLADESH

Rural Electrification II
Project No. 388-0054

1. Pursuant to Part I, Chapter 1, Section 103 of the Foreign Assistance Act of 1961, as amended, I hereby authorize the Rural Electrification II Project. I also authorize planned obligations of not to exceed Fifty Million United States Dollars (U.S. $50,000,000) in grant funds over a three year period (fiscal years 1981, 1983 and 1984) from date of authorization, subject to the A.I.D. OYB/allotment process, to help in financing foreign exchange and local currency costs for the project.

2. The purpose of the project is to provide electric power in rural areas for economic, domestic, and community purposes.

3. I hereby authorize the initiation of negotiations of the Project Agreement and its execution by the officer to whom such authority has been delegated in accordance with A.I.D. regulations and delegations of authority. The Project Agreement that may be negotiated and executed shall be subject to the following essential terms and major conditions, as well as such other terms and conditions as A.I.D. may deem appropriate.

4. Source Origin

Goods and services including ocean shipping financed by A.I.D. under the grant shall have their source and origin in the United States, the Cooperating Country or in the other countries included in A.I.D. Geographic Code 941, except as A.I.D. may otherwise agree in writing.

5. Terms and Conditions

The Cooperating Country is to agree to plan and to carry out diligently programs that will ensure that adequate power generating and transmission capacity is available to satisfy electric power demands of the areas electrified under the rural electrification program.

6. Procurement of Technical Services

Pursuant to Paragraph 2.4.2. of A.I.D. Handbook II, authority is hereby granted to procure services noncompetitively from the National Rural Electric Cooperative Association and Commonwealth Associates Inc.

DRAFT PROJECT AGREEMENT ANNEX
Regarding Rehabilitation and Maintenance
of 33 kV Substations and Lines

As provided in Project Agreement section_____, the Government of the Peoples Republic of Bangladesh (BDG) through the Ministry of Power, Flood Control and Water Resources (the Ministry) will carry out the program specified herein to rehabilitate and maintain 33 kV substations and line which feed present and planned PBS substations indicated by the REB. The program is conducted according to the implementation schedule and provisions of this Annex. AID reserves approval rights, indicated below and in Project Agreement Section _____, related to certain critical planning and implementation phases of this rehabilitation and maintenance program.

1. Survey of 33 kV Substations and Lines

Conduct extensive survey of all PDB substations and 33 kV line feeding present and planned PBS substations under the Phase I and Phase II rural electrification programs. Maps showing PBS substation locations will be supplied by REB. The survey will detail condition of PDB substations and lines and needed rehabilitation, and provide a basis for planning and carrying out the related rehabilitation program. Up to 3,000 miles of line may have to be surveyed. The survey will detail inadequacies with respect to:

1) Tree clearance; 2) Fusing of 33-0.4 kV substations;
3) Protective device serviceability and calibration;
4) Splicings and taps; 5) Serviceability and location of sectionalizing devices; 6) Substation and line maintenance arrangements.

The PDB or other agency assigned to conduct the survey will submit a brief survey plan to the Ministry, with a copy of AID, within three months of Project Agreement signing. The plan is to contain: (1) Identification of substations and lines to be surveyed, and related time schedule for each phase of the survey; (2) Principal survey instruments -- check sheets/questionnaires, etc.; (3) Manpower requirements and arrangements.

Submission of this plan and approval by the Ministry and by AID will be a condition precedent to disbursement beyond $5 million. See Project Agreement Section _____.

An interim report of survey findings is to be prepared within six months of the Agreement, as the basis for initial planning of the rehabilitation program.

2. Rehabilitation Plan

Based on interim survey findings, plan initial phase of the rehabilitation program. The plan should include: (1) Objectives, i.e., what is to be achieved with respect to substations/lines, etc.; (2) Target, i.e., number of substations and miles of line by time period; (3) Scope of work, i.e., what tasks are to be performed; (4) Organizational responsibilities, i.e., what agencies/offices are responsible and their roles; (5) Manpower plans, i.e., (a) manpower requirements -- numbers, workmonths, supervisor and worker skills, when needed; (b) arrangements for acquiring needed workforce; (6) Commodity/Logistic plans, i.e., (a) requirements -- types and quantities of replacement parts, workmen's tools, transport needs; (b) arrangements for acquiring the needed commodities/logistic support; (7) Budget, i.e., (a) requirements for commodities, engineering services, etc.; (b) funding arrangements.

The interim plan shall be submitted to the Ministry of Power and Water with a copy to AID within eight months of the Agreement. Approval of this plan by AID will be a condition precedent to additional disbursement.

3. Eighteen month Rehabilitation Program

1) Tree removal, tree trimming and brush control to reduce vulnerability of 33 kV lines.

2) Fusing for all unfused 33-0.4 kV distribution transformers, either by installing new liquid fuse elements in existing fuseholders, or replacing them with conventional single phase hookstick operated distribution fuse cutouts. Protect new 33-0.4 kV outdoor distribution transformers with conventional single phase hook-stick operated fuse cutouts.

3) Restoration of all 33 kV substations and transmission lines to their original condition; assuring that all circuit breakers, relays and other protective devices in substations and in-line are in good working order, that static wires are installed on all 33 kV transmission lines where originally included in the design, and lightning arresters are fitted in proper locations.

4) Review of relay and recloser calibration in all 33 kV substations, making such changes as necessary to ensure selectivity among all devices. This is necessary to assure interruption to the smallest possible number of customers in case of a line fault. At important manned substations (such as Comilla) with reclosers used on some line positions, install the necessary wiring and devices to make possible position indication and manual operation in the control house.

The R E Consultant will advise on and monitor implementation of the rehabilitation program.

The PDB or other implementing agency will submit progress reports each three months to the Ministry with a copy to AID. Reports will indicate: (1) progress against targets, (2) problems and (3) actions taken/planned or recommended for the period ahead. If progress (quantity and/or quality) falls unreasonably behind targets, this will be cause for a halt or termination in AID-financed disbursements for the R E II Project.

4. Redesign and Reconstruction of 33 kV Substations and Line with Records of Excessive Outages (i. e. frequency of outages in excess of 50 per year)

1. Modify existing 33 kV transmission lines with a record of excessive outages caused by birds or unavoidable tree contacts by replacing steel crossarms with wood crossarms.

2. For future 33 kV and 132 kV transmission lines that supply distribution substations, adopt the following

designs; (a) use wood crossarms, with pin type insulators (or line posts as an alternative) for 33 kV lines; (b) use suspension insulators for 132 kV lines.

3. Provide 33 kV loop supply systems with sectionalizing switches at each distribution substation to the greatest practicable extent, to permit insolation of faulted line elements without long term interruptions to customers.

5. Line Maintenance Program

5.1 The PDB will study the adequacy of arrangements for 33 kV substation and line maintenance. The study shall be submitted to the Ministry with a copy to AID for review and approval within ten months of the Agreement. The study will focus on the reasons for deficiencies in the maintenance program.. The study will recommend a program for improving maintenance, including targets and implementation schedule. The following topics will be examined

1) Administrative:

a) Accountability -- Are individual supervisors and workers responsible for preventative maintenance and repair of particular sections of line or substations.

b) Job Responsibilities -- Are individual job responsibilities clearly defined and understood.

c) Supervision and follow-up -- Do supervisors follow-up their instructions to ascertain whether the job has been done satisfactorily; what recourse do supervisors have if the job is not done.

2) Technical: What additional training do supervisors or workers need.

3) Logistic/Commodity: Are replacement parts available when and where needed. Why or why not? What improvements are needed in inventory control, ordering and distribution of parts?

5.2 The PDB will effect administrative, training and logistic improvements as indicated by the maintenance study.

ANNEX E

SYSTEM DESIGN

Operating Frequency

All electric utility systems in Bangladesh operate at 50 hertz.

Distribution System Voltage and Feeder Loading

The voltage level selected for operation of new electric distribution systems will have a direct bearing on the number and size of distribution substations required, the length of primary feeder lines, the individual feeder loading capability, the consumer exposure to line faults, and to some degree the overall cost of construction. Also a consideration will be the compatibility and interchangeability of components with existing facilities now in operation in the country, and the lack of access roads in areas to be traversed by many feeder and branch lines.

Feeder Proposals

In Bangladesh the standard voltage for distribution systems is 11KV (or 11Y/6.35KV) for the electrified cities, as well as for service to industrial loads, rice mills, bazars and irrigation pump motors in rural areas. In the project areas, most of these existing rural lines will be integrated into the new systems.

Transmission lines at 33KV follow the main highways across areas to be served by the new systems, and therefore substations can be located for good access.

In most areas to be served by new systems it will be necessary to restrict the length of feeder lines because of the problem of poor access for servicing. Since it will not be practical therefore to exploit the advantage of longer feeder lines with a higher distribution voltage level, and given the need to integrate certain 11KV systems now in operation new distribution systems will be operated at 11Y/6.35KV utilizing 15 KV levels of insulation and general design standards. Note the following examples of possible feeder area layouts.

Assuming on 11Y6.35KV distribution system and a maximum primary voltage drop of 7.5 percent, the following feeder areas were determined for various uniform loading conditions.

Main feeder conductor	- 4/0 ACSR	R=0.567/Mile	X=0.644/mile
Branch conductor	- 1/0 ACSR	R=1.08/mile	X= .707/mile
Branch conductor	- 3 ACSR	R=2.04/mile	X= .711/mile

Estimated Uniform Loading after 15 years:

20 KVA/square mile - 0.9 p.f.
30 KVA/square mile - 0.9 p.f.

The four feeder and two feeder substation areas were considered See Exhibit A.

1. Four feeder arrangement - 30 KVA/square mile load
   Main feeder length: 6.25 miles
   Branch feeder length: 7.25 miles

KVA Load			
1575	% Volt drop to end of 4/0	ACSR main feeder	- 3.22
435	% Volt drop to end of 3	ACSR branch	- 2.89
		Total % drop	- 6.11

This would give coverage to 56.25 square miles and serve 1575 KVA per feeder at the projected 15th year (17th year of the project) load level (or 225 square miles and 6300 KVA per substation).

2. Four feeder arrangement 20 KVA/square mile load.
   Main feeder length : 7.25 miles
   Branch feeder length : 8.25 miles

KVA Load			
1360	% Volt drop to end of 4/0	ACSR main feeder	- 3.22
	% Volt drop to end of 3	ACSR Branch	- 2.42
		Total % drop	- 5.64

With the four feeder arrangement, a reduction in load will change the length of the feeder only by a small amount. This results from the large area that is added to the feeder by extending only one additional mile of main circuit. With 20 KVA per square mile the feeder area served would extend approximately 8.25 miles from the substation (7.25 miles of 4/0 ACSR) and the end branches would extend 8.25 miles. Total approximate area served by the feeder would be 58 square miles with the feeder load at 1360 KVA.

3. Two feeder arrangement - 30 KVA/square mile load.
   Main feeder length : 4.5 miles
   Branch feeder length : 8.0 miles

KVA Load			
2640	% Volt drop to end of 4/0	ACSR main feeder	- 3.88
280	% Volt drop to end of 3	ACSR branch	- 3.41
		Total % drop	- 7.29

The feeder area served would extend approximately 5.5 miles from the substation (4.5 miles of 4/0 ACSR) with the branches extending approximately 112 square miles with the maximum feeder load at 2240 KVA.

See Exhibit B for diagrams representing the area served by a substation for the two and four feeder arrangement and load densities of 30 KVA and 20 KVA square mile.

It is apparent that with load densities of 20 and 30 KVA per square mile the four feeder arrangement might be too expensive to consider initially in rural areas.

Until the load develops to 20 or 30 KVA per square mile, the feeder could be extended so that the service area would be larger initially than the final area. This could be done where it would be possible to add another substation at some time in the future. This would reduce the initial substation expenditures in certain areas.

For a two feeder arrangement and 10 and 15 KVA/square mile loading the following would be the feeder details.

3. Two feeder arrangement - 10 KVA square mile load.
   Main feeder length : 9 miles
   Branch feeder length: 8 miles

KVA Load			
1600	% Volt drop to end of 4/0 ACSR main feeder	-	4.71
160	% Volt drop to end of 3 ACSR branch	-	1.14
	Total % drop	-	5.85

With 10 KVA/square mile of load, the feeder area served would extend approximately 10 miles from the substation (nine miles of 4/0 ACSR) with the branches extending approximately eight miles. The total area served by the feeder would be approximately 160 square miles with the maximum feeder load at 1600 KVA.

5. Two feeder arrangement 15 KVA/square mile load.
   Main feeder length: 7.5 miles
   Branch feeder length: 8 miles

KVA Load			
2040	% Volt drop to end of 4/0 ACSR main feeder	-	5.00
240	% Volt drop to end of 3 ACSR Branch	-	1.70
	Total % drop	-	6.70

With 15 KVA/square mile of load, the feeder area served would extend approximately 8.5 miles from the substation (7.5 miles of 4/0 ACSR) with the branches extending approximately eight miles. The

total area served by the feeder would be approximately 136 square miles with maximum feeder load being 2040 KVA.

Where future substation can be added, extended coverage should be considered to reduce the initial cost/customer. Additional substation capacity would then be added at a later date when the load and voltage conditions warrant such installation.

In all of this it needs to be recognized that few, if any, areas will match the uniform distribution of loads and consumers suggested in the models and therefore will have feeder areas of more or less non-uniform configuration as required by local geographic characteristics and varying load patterns.

Insulation Level

The insulation level for the primary distribution system must withstand normal operating voltages and switching surge voltages without failure or flashover. Sufficient impulse insulation (BIL) must also be provided so that the system can be protected by suitable lightning arresters without excessive flashovers. The 50 hertz leakage path in air needs to be adequate to limit the radio interference level. In contaminated areas, extra leakage distances should be provided.

Standards for 15 kv have been in service and proven for many years. The ANSI (American National Standards Institute, New York City, USA) and REA Bulletin 45-3 (Rural Electrification Administration, Washington, D.C. USA) provide specifications and standards for this distribution level.

(1) Basic insulation level (BIL) - 95 kv.
(2) Switching surge voltage - three times normal line to ground voltage.
(3) Minimum leakage distance - 9 inches.
(4) Extra insulation to be provided at line angles and deadends to prevent flashovers of surge voltages due to increased values caused by reflection effect.
(5) Since the areas for construction are under 3000 feet elevation no increase in leakage distance is necessary. Contaimated areas should be considered on an individual case basis if encountered.
(6) Equipment used will be according to standards noted and meeting these insulation and leadage values:

(a) Line insulation, pin insulators use -

ANSI - Class 55-5.
Leakage distance 9 inches.
Wet flashover 40 kv.
Dry flashover 70 kv.
Critical impulse flashover 95 kv.

(b) Line insulation, angles and deadends, suspension insulators, use two insulator units per deadend -

ANSI Class 52-1
Per unit leakage distance 7 inches.
Per unit wet flashover 30 kv.
Per unit dry flashover 60 kv.

(c) Equipment bushing insulation, distribution class -

ANSI - C57.12 Series.
Creepage distance 10.$^1/_2$ + 1/2 inc.
Withstand voltages -

10 seconds wet	30 kv.
1 minute dry	35 kv.

Impulse withstand voltage (BIL) 95 kv.

(d) Transformer winding insulation, distribution Class ANSI-

C57.12 Series

Impulse withstand voltage (BIL) full wave	95 kv.
Impulse chopped wave	110 kv.
Low frequency dielectric	35 kv.

(e) Secondary and service system will be designed using material and equipment for less than 300 volts phase to ground according to ANSI Standards.

(i) Spool insulators for secondary conductors will be ANSI Class 53-2 and 53-4 with the following electrical values:

Low frequency dry flashover	25 kv.
Low frequency wet flashover,	
vertical	12 kv.
horizontal	15 kv.

(ii) Spool insulators for service conductors will be ANSI Class 53-1 with the following electrical values:

Low frequency flashover	20 kv.
Low frequency wet flashover,	
vertical	8 kv.
horizontal	10 kv.

(iii) Insulation on phase conductors of multiple service cable should be cross linked polyethylene (DLP) with minimum thickness of covering:

No. 2 and smaller 0.045 inches.
No. 1/0 through 4/0, 0.060 inches.

Covering should be capable of withstanding continuously from conductor to ground, applied voltage of 1,000 V at 50 hertz for five minutes.

Voltage Levels, Spreads and Drops

The common voltage rating of light bulbs and appliances marketed in Bangladesh is 230 volts, although 250 volt bulbs are also frequently available. Motors are generally three phase and are generally rated at 400 volts. The American National Standards Institute (ANSI C84-1) specified standard voltage levels at the service entrance point and point of utilization.

ANSI Standard Voltage Range

National Voltage	Maximum Voltage	Range B Minimum service voltage	Range B Minimum utilization voltage	Range B Minimum service voltage	Range B Minimum utilization voltage
100%	105%	95%	92%	92%	89%

The international Electro-technical Commission (IEC-Pub. 88) presents standards for supply system voltage levels and corresponding high and low ranges of the supply system.

IEC Standard Voltage Range

Nominal voltage	Maximum voltage	Minimum voltage
100%	110%	90%

The minimum service voltage limit expressed above in Range B of the ANSI standard is considered in American operation to be tolerable if not permanently desirable. Range B also presents low voltage levels well within IEC standards. Taking into consideration both standards, and in the interest of gaining sufficient system voltdrop allowance to permit economic feeder system length and loading, a minimum service voltage in accordance with ANSI Range B has been established for Bangladesh.

A nominal 230 volt service voltage level is presently established in Bangladesh. The 230 volt base level is also being considered by the IEC as the standard base voltage to replace existing IEC standard voltages of 220 volts and 240 volts. The 230 volt base level is therefore consistent with the recent thinking on the major 50 hertz voltage standards.

Service Voltage Range

	Phase to Neutral	Phase to Phase
Maximum (105%)	241.5 volts	418.3 volts
Nominal (100%)	230 volts	400 volts
Minimum (92%)	211.6 volts	366.5 volts

The total system voltdrop permitted on the distribution system is determined as the difference between the maximum service voltage delivered at the customer nearest the 11 kv power supply substation and the minimum service voltage permitted at the customer located furthest away from the substation. The maximum voltdrop on a 230 volt base will be 29.9 volt (241.5 - 211.6 volts). The anticipated distribution of this voltdrop among the various components of the system would be as follows:

Voltage Drop-Maximum Load Condition

	Maximum voltdrop (230 volt base)	Percent voltdrop
From 11 kv supply substation bus to primary terminals of last distribution transformer.	17.2	7.5
Distribution transformer.	3.5	1.5
Secondary and service	9.2	4.0
Total voltdrop at customers service entrance	29.9	13.0

Voltage Levels and Spreads (230 volt base)

Location	Voltage Levels Maximum	Minimum
Substation transformer at 33 kv terminals, low range	245	211
high range	257	222
Substation transformer at 11 kv terminals	257	219
Substation 11 kv bus (regulated)	241	241
Distribution transformer primary terminals (last transformer)	241	224
Service entrance	241	212

The above voltage levels, especially those at point of service, are the basis of system design and the system should be operated within these limits in order that satisfactory operation of customers connected apparatus is attained. The voltage levels expressed above are based on the following:

(1) Values given in the above tables are mid values in the automatic voltage regulator band width.

(2) Only sustained voltages apply to the values given and short duration variations due to surges, motor starting, etc., are not considered.

(3) Input voltages to the power supply substations range between approximately 92 and 112 percent of the nominal subtransmission voltage and with a maximum 16 percent spread at any one particular substation.

Service Voltage (Nominal) and Loadings

(1) 230 volt, two wire, single phase service for residential, institutional, commercial, small industrial and agricultural loads 25 KVA and below- ~~maximum individual motor size below~~ - maximum individual motor size will be 10 hp.

(2) 230/460 volt, three wire, single phase service for institutional, commercial, industrial and agricultural loads 50 KVA and below - maximum individual motor size will be 10 hp.

(3) 230/400 volt, four wire, three phase service for commercial, industrial and agricultural loads, providing three phase equipment has to be installed. Maximum load at this voltage will be 500 KVA.

Transformer and Secondary Systems

All lines in the project should be designed and constructed with minimum vertical ground clearance provisions to carry a two wire, 230 volt, single phase secondary circuit. In market centers having sufficiently high load densities, either three wire, 230/460 volt, single phase or four wire, 400/230 volt, three phase secondary circuits may be established. In market centers, the initial load density is estimated at approximately 50 KVA per mile of distributed load. An annual growth rate of 10 percent, distributed load density will increase to 130 KVA per mile in 10 years. The maximum distance which these load densities can be supplied within acceptable voltdrop limits by various circuit types and capacities is as follows:

Conductor size (ACSR or ACC)	Circuit	KW-Feet (80% P.F.) 3% Voltdrop	At 50 KVA/Mile Maximum Secondary length (feet)	At 130 KVA/Mile Maximum Secondary Length (feet)
3 AWG	2 wire	2250	400	250
1/0 AWG	2 wire	3400	500	300
3 AWG	4 wire	8000	1200	700
1/0 AWG	4 wire	13000	1600	960
4/0 AWG	4 wire	22000	2500	1500

The 3 AWG conductor size provides adequate secondary reach and is recommended for normal installation in market centers. Initial transformer installations to supply distributed load in market centers should be 15 KVA in size and spaced approximately every 1800 feet. As load grows transformers should be changed to the next successive sizes up to 50 KVA maximum. Intermediate transformers will be required if load growth substantially exceeds 150 KVA per mile load density.

In addition to distributed loads, relatively large spot loads consisting of rice, wheat and oil mills will be located in the market centers. These mills currently have 15 to 25 horsepower requirements where three phase motors are applied and it is expected that 10 horsepower mill loads will prevail where single phase applies. The mill load is estimated to constitute another 350 KVA per mile in market centers, but without uniform distribution. It is not recommended that main secondary circuits in market centers be designed with capacity to serve mills, but rather than transformers supplying distributed load be located so far as practical near these spot loads and be sized according to the additional capacity required. When this cannot be achieved, individual transformers should be installed to serve such loads.

Outside the market centers, a distributed load density of 6 KVA per mile, consisting mainly of rural household services, is estimated along the main secondary routes. For design purposes, it is proposed that 230 volt single phase underbuild secondary main or secondary main lines extending into residential load centers be established with 3 AWG ACSR conductor size. Transformers of 10 KVA size should be located along rural branch mains at approximately 10 span intervals to maintain circuit voltdrop within two percent. Limiting voltdrop to two percent will allow a remaining two percent system voltdrop for short branches and services from secondary mains to residential service points.

Conductor Size	Circuit	KW-Feet (80% P.F.) 2% Voltdrop	6 KVA/Mile Maximum Secondary Length (Feet)
3 AWG ACSR	2 wire	1500	1800

Estimated distributed load will not load up transformers of 10 KVA capacity. However, 10 KVA transformers are the smallest standard size currently being manufactured and therefore must be used initially. Estimated peak loading of transformers serving solely residential load will fall in the order of 7 KVA if secondary circuits can be extended in four directions.

The general demand factor of single phase transformers serving areas outside the market centers will be improved by the coordination of transformer locations which can supply single phase pumping requirements as well as distributed load. Pumps and shallow tubewells should generally be considered as spot loads, with transformer being located as near as possible to the load. A 10 KVA transformers can serve a shallow tubewell and still have capacity to supply distributed load within the voltdrop capacity of the secondary circuit. It will sometimes be possible to serve two or three pumps or tubewells by service extensions from one transformer, and appropriately increased transformer sizes should be selected to accommodate the combined pumping loads and secondary distributed load requirements.

Deep tubewells will generally require three phase service and should be handled as spot loads with transformer banks sized as required. Some use of 230 volt legs from three phase supply sources may be applied in isolated locations to serve nearby single phse loads, but this will be undertaken only with careful consideration of maining balanced loading on the three phase transformer.

Services

Services for single phase and three phase customers should generally be multiplex self supporting service drop cable. Cable should have a bare ACSR neutral messenger with standard all aluminum cross linked polyethylene insulated (600 volt) phase conductors. Service to low usage households and small commercial shops may however consist of locally manufactured stranded copper, 600 volt polyvinylchloride two core cable attached to a steel messenger. Size and number of service wires will depend upon the load and physical strength of the wires.

Voltage Regulation

Due to variations in subtransmission voltage, regulation will be required. Three single phase feeder voltage regulators therefore will be installed on the low voltage bus at each substation. For maintenance purposes these single phase regulators may be replaced in the field and taken to maintenance facilities when necessary. Voltage regulation will be plus or minus 10 percent with 1-1/4 percent steps. The capacity of the regulators should be adequate for substation transformer normal full load rating and suitable for operation on an 11.0Y/-6.35 kv multi-grounded system. The bushing and windings should conform to ANSI-C57.12 series standards for 95BIL.

Capacitor Banks

The initial system is to be designed for a 15 year growth and and power factor of 0.9. One of the most important benefits of shunt capacitors is reduction in line losses. In the early years of the system the load will be low, therefore the cost of capacitors does not appear to be justified. Also, voltage regulators will be required initially and the line will not require the supplemental benefit of voltage improvement provided by shunt capacitors.

As the load grows in future years, fixed capacitors may need to be installed to reduce line losses and improve feeder voltages. Fixed capacitors would probably be the first stage and for maximum benefit should then be located two-thirds or more of the feeder length from the source. The installed capacity should not be more than required to bring the power factor near unity at light loaded conditions.

If voltage regulation problems occur, installation of switched capacitor banks might be considered before adding additional line regulators.

Lightning Protection)Arresters)

The voltage rating of a lightning arrester should be based upon the line to ground voltage (not line to neutral) existing in the system under fualt conditions. The system to be protected in this instance is a solidly grounded 11.0Y/6.3kv, four wire multi-gounded neutral. The voltage impressed across the unfaulted phase line to ground will only be a percentage of the line to line voltages under fault conditions. Use of 9kv arrester on a well grounded system therefore will provide acceptable protection. It will be important however that the arrester be located near the equipment being protected and that the connecting leads be kept as short as possible to reduce surge impedance.

Feeder Sectionalizing and Switching

Oil circuit reclosers applied on circuits will normally have 100 ampere continuous rating with 2000 ampere interrupting rating, and be designed for 15kv. Reclosing sequences should be set at two fast and two slow operations.

A sectionalizing plan, complete with short circuit calculations should be prepared for each feeder. When changes are made on the system, applied sectionalizing devices should also be checked to assure that adequate interruption or continuous load capabilities are not exceeded.

Manual line sectionalizing on branch and tap circuits will be provided with reasonable frequency by bolted connectors or hot line clamps at jumper points. Under special circumstances, disconnect switches with hooks accommodating portable load break tools can be installed when rapid sectionalizing ability is desired.

Rural customers with three phase motor loads will be advised to install overload protection with phase unbalance detection on all three phase motors.

Grounding

All poles will have a ground assembly (driven butt wrapped or butt plate) which is solidly connected to the common system neutral.

A driven ground should be provided at each equipment installation, at dead ends of bare secondary circuits, and at least every 1500 feet along the line. Driven grounds should be 5/8" x8'-0" steel rods and should have a resistence of less than 10 ohms after installation when isolated and not connected to the system neutral.

All down guys should be solidly bonded to the common system neutral and pole ground assembly. All major line equipment such as transformers, reclosers and capacitors should have tanks bonded solidly to the common system neutral and driven ground assembly.

All exposed ground wire will consist of galvanized steel or aluminum materials.

Conductors, Type and Kind

Cost factors favor the choice of Aluminum Cable Steel Reinforced (ACSR) bare conductors for general use of primary and secondary lines. In congested market centers where span lengths are necessarily shortened due to other considerations, All Aluminum Conductors (AAC) could be used.

Considering estimated construction costs, feeder loading capabilities, line maintenance and inventory simplicity, it is recommended that only four conductor sizes, 4/0 ACSR AWG, 1/0 ACSR AWG, 3 ACSR AWG and 6 ACSR be applied to all primary and secondary circuit construction

as follows:

Application	No. of Circuit Phases	Size of ACSR Conductor, AWG Phases	Neutral
Main Circuit - Primary	3	4/0	1/0
Branch Circuit - Primary	3	1/0	3
Tap Circuit - Primary	1	3 or 6	3 or 6
Tap Circuit - Primary	3	6	6
Main Circuits-Secondary	3	1/0 or 3	1/0 or 3
Main Circuits-Secondary	1-3 wire	1/0 or 3	1/0 or 3
Branch Circuits-Secondary	1-2 wire	1/0 or 3	1/0 or 3
Branch Circuits-Secondary	1-2 wire	3	3

The following service conductor sizes are recommended:

Size, AWG	Type
# 6 AL	Duplex
# 3 AL	Duplex
# 3 AL	Triplex
# 3 AL	Quardruplex
# 1/0 AL	Quadruplex

Substations

It is expected that all power will be obtained from the Bangladesh Power Development Board (PDB) 33 kv or 66 kv subtransmission system.

New substations will be uniform design consisting of a single incoming supply line, a primary insolating switch and high side fuse, a single three phase power transformer, one three-phase oil circuit bank recloser, three single phase bus voltage regulators, and one or two 11/6.3 kv feeder exists, each having a three phase oil circuit feeder recloser. Reclosers and regulators should be provided with appropriate isolating and bypass disconnects. Station back-up and feeder oil recloser should be rated 400 amperes continuous and 4000 amperes interrupting capability.

Substations will be constructed of galvanized latticed steel structures and completely outdoor equipment. Applicable protions of REA Bulletin 65-1 "Guide for the Design of Substations", will be followed whenever appropriate. Transformers should be three phase, outdoor oil filled, with standard 55°C OA rating and provision for forced air cooling equipment, and contain ± five percent high voltage no-load tape. Transformers should have a least six percent impedence. Sizes, OA 55°C ratings, should be 1500, 2500 or 5000 KVA, and should be 50 hertz delta-wye connected.

A one line diagram of substation features is presented at Exhibit D.

Minimum Vertical Clearance

The minimum ground clearances,generally applied at present in Bangladesh are defined by draft amendment dated January 15, 1976 to Rule 69 of the Electricity Rules 1937 and are included in the minimum clearances below:

Description	Circuit Voltage	
	0-600 Volts	11,000 Volts
Running Line along Street/Road	17'	17'
Running Line Crossing Over:		
Street/Road	18'	19'
Railroad	27'	28'
Navigable River/Channel	22'	23'
Flat Roof Building Bare Conductor	8'	8'
Pitched Roof Building Bare Conductor	8'	8'
Communication Line	4'	6'
Running Line Other Than Above:		
Bare Conductor	15'	15'
Insulated Conductor	13'	13'
Service Conductors Crossing Over:		
Commercial Driveways	15'	-
Non-commercial Driveways	12'	-
Pedestrain Ways	-	-
Bare Conductor	12'	-
Insulated Conductor	10'	-

In rural areas where prolonged flooding up to five feet occurs a general rule will be to install five feet extra pole height on lines crossing such areas. Where flooding exceeds five feet for short duration periods, at least one span in the crossing line at intervals of approximately every half mile will be provided with 10 feet extra height poles. The location of spans with additional 10 foot clearance should be established as much as possible on the basis of local population views with regard to convenience for traffic.

Methanical Line Design Considerations

Where appropriate, structural line design are in accordance with REA Bulletin 160-7, "Distribution Line Design (Mechanical)". Design factors are however modified to conform with Bangladesh weather conditions as follows:

Maximum design wind velocity of 75 miles per hour.
Maximum conductor tension temperature of 60°F.
Maximum conductor sag temperature of 105°F.

System Design

The principal considerations reflected in the system design for the project include:

(1) The source of power supply will be the PDB 33kv subtransmission system.

(2) Stepdown substations which transform voltage from 33kv to the primary distribution voltage level will be owned and operated by the distribution system operating entity (PBS).

(3) Feeder systems should incorporate minimum cost design concepts capable of providing adequate reliable power supply to rural areas. In view of the relatively low load densities to be encountered in rural Bangladesh, and the character of these loads, three phase multiple grounded neutral primary distribution systems utilizing, inasmuch as practical, single phase primary branch extensions, are considered to be both operationally feasible and economically preferable.

(4) Area coverage distribution power supply will be the desired goal of the project.

(5) The establishment of new primary and secondary distribution facilities in project areas will be coordinated and consolidated, inasmuch as practical, with existing PDB primary and secondary voltage distribution facilities. Ownership of all new and consolidated facilities will be placed under a single operating entity (PBS).

(6) Exposure on the PDB subtransmission system will be improved as much as is practicable by cutting over to the new distribution system those existing distribution connections currently directly on the subtransmission system.

(7) Although a considerable portion of feeder lines will be installed across areas which are difficult of access, in order to facilitate routine line patrolling and trouble shooting the location of automatic sectionalizing devices will be restricted, inasmuch as possible within acceptable operating practices, to the main circuit or other locations accessible by vehicles or boats.

(8) Substations will be located only at sites accessible by hard surface roads.

Distribution System

The primary distribution voltage is 11/6.35 kv, 50 hertz. New feeder systems will be designed with multiple gounded neutrals, thus permitting the extension of single phase primary lines. When existing PDB feeders are incorporated into the new distribution system, neutral conductor will have to be installed, or static wires converted to neutral, in order to coordinate the lines.

Taking into account the extensive PDB plans for additional 33 kv subtransmission and considering the relatively small size of the country, the 11 kv primary voltage level is considered adequate for long term development of rural electrification in Bangladesh. The projected development of the 33 kv subtransmission system is sufficiently extensive to reach most of the rural areas of Bangladesh, with 11 kv primary voltage therefore should be adeaquate. The primary 11 kv voltage level is also preferred in terms of maintaining uniformity of distribution voltage in the country and a 50 hertz system standard, and in terms of the benefits of reduced feeder exposure.

Feeder Loadings and Supply Areas

Based on the two feeder substation scheme with maximum primary voltdrop of 7.5 percent, peak feeder loading will reach approximately 2000 and 2600 KVA at 15 and 30 KVA per square mile load densities respectively. The area covers capability per 11 kv feeder at various load densities will be as follows:

Average Load Density (KVA/mi^2)	11 kv Feeder Service Area (mi^2)
10	160
20	112
30	88
40	72

The majority of PBS area load densities will fall between 20 KVA to 30 KVA per square mile after 10 to 15 years of system operation. In the initial years of operation, when load densities are low, primary or branch circuits can be extended longer distances to supply a larger area. In these cases however, feeder development must be coordinated with future substation or circuit relief as load densities grow. Substations are located according to spacings adequate to meet 15 year load projections, and these substations are installed during the initial PBS construction. Consequently, no foreseeable main circuit reinforcement is considered necessary. Primary branch circuits, however, will not be extended beyond the ultimate supply area (approximately eight miles from the main circuit) unless there are definite distribution system development plans by which branch circuit relief will be obtained at the time higher load densities occur.

Line Design

Line design should inasmuch as practical incorporate the conventional REA design standards for 12.5/7.2 kv distribution systems.

In general, the following design criteria are proposed:

(1) Wood poles and crossarms.
(2) 95 kv basic insulation level.
(3) Ground clearances conforming to Bangladesh Electricity Act.
(4) Multiple Gounded neutral primary system.
(5) Three phase main circuits, branch circuits and tap circuits.

(6) Single phase branch circuits and tap circuits.
(7) Minimum numbers of mechanical automatic sectionalizing devices.
(8) Ground clearance provision for 230 volt secondary on all lines.
(9) NESC grade N construction (safety factor-2) where applicable.
(10) Maximum voltdrop criteria as follows:

Primary Circuit	7.5%
Distribution Transformer	1.5%
Secondary Main Circuit	2.0%
Secondary Branch/Service	2.0%
Total:	13.0%

Line Protection

Automatic sectionalizing is restricted to the main circuits or to points on branch circuits which are accessible by vehicle. The purpose of this is three fold, i.e., to:

(1) minimize the number of mechanical devices (oil circuit reclosers) in the feeder system in order to limit sophisticated maintenance requirements.

(2) maintain predominant circuit fuse sizes large enough to absorb normal lightning surges without fuse blowing.

(3) at the risk of affecting larger groups per interruption bring the effect of interruptions closer to main circuits in order that notification of trouble and trouble shooting activities occur more rapidly.

System Environment

The routing of most main primary circuits has been generally planned along improved roads but a substantial amount of the branch circuit construction will necessarily take place where vehicle or boat accessibility is difficult or impossible. While sufficient roads and nevigable rivers will permit bulk movement of materials to general construction depots, a great deal of material will necessarily be transported to the location of final installation by man or animal carry. It is anticipated that lines will not extend much further than five miles from established roads or navigable water ways during the initial project stage. Initial routing will be established along existing communal pathways or future road alignments. In balance, however, load requirements have been given first priority and physical obstacles have not been regarded as a major limitation to the scope of the initial system as proposed.

Flooding occurs on an annual basis during the monsoon season over a considerable portion of Bangladesh. It is estimated that up to 40 percent of the country experiences flooding annually, with depths in some areas varying up to as much as 20 feet. Because of the extent of land involved, a comprehensive rural electrification program cannot avoid extending lines across flooding regions. Also, since considerable travel in rural Bangladesh during the monsoon season is by boat, additional line clearances will be required over flooded areas.

Most PBS area flooding consists of sustained flooding up to six feet in depth. In some cases short duration flooding lasting up to two weeks occurs with water depths reaching to 10 to 15 feet. There are also a few cases where sustained flooding in excess of six feet will be encountered, but available information suggests these to be the excpetion.

The following additional line clearances are proposed across flooded areas in order to accommodate rural boat traffic:

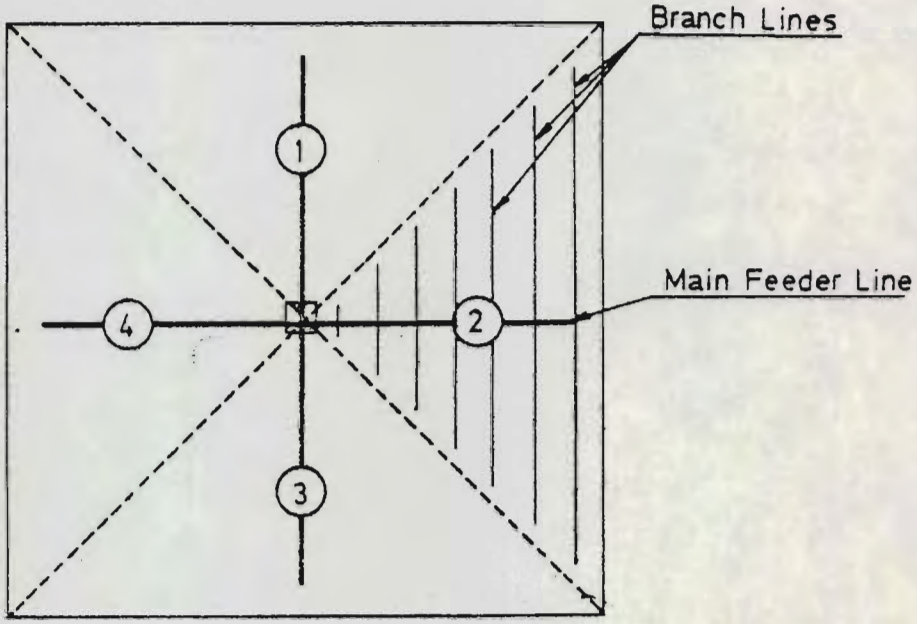
	Type of Flooding	Proposed Design Modification
1)	Sustained or short duration flooding up to two foot depth.	No special modification.
2)	Sustained flooding from two to six foot depth.	Add five foot pole height at all pole locations.
3)	Short duration flooding from two to six foot.	Add five foot pole height to selected spans only.
4)	Sustained flooding from six to 12 foot depth	Add 10 foot pole height at all pole locations.
5)	Short duration flooding from six to 12 foot depth.	Add 10 foot pole height to selected spans only.

Acceptable service reliability will require attention to the adequacy of right of way clearing for distribution lines. Bangladesh contains many species of trees which away easily with the wind and the lines will have to be a sufficient distance from such trees. Trees also have value, either productive or social and many of the social value trees lie in groves within which rural households are located. While it is expected that primary lines generally need not cross such groves, secondary lines will be required to penetrate into them to reach the housing areas. In these cases, extensive right of way clearing can be

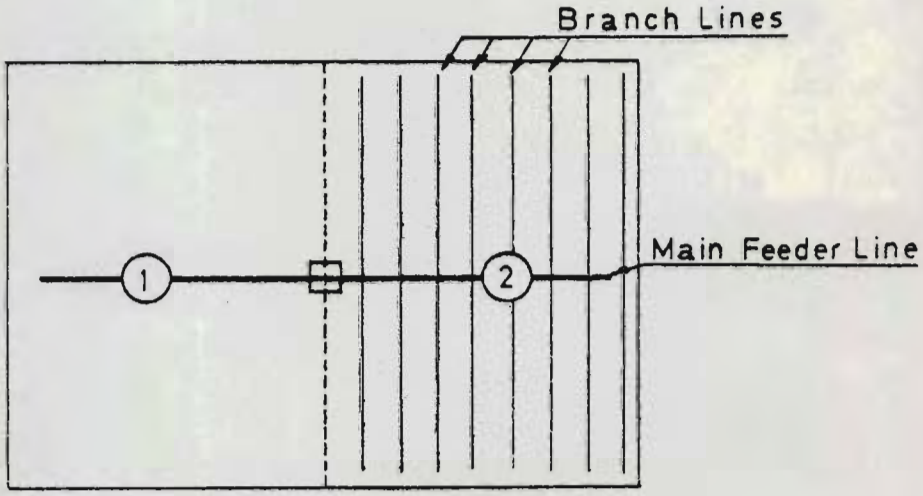
Exhibit - A.

SUBSTATION FEEDER ARRANGEMENTS INVESTIGATED

FOUR FEEDER AREA



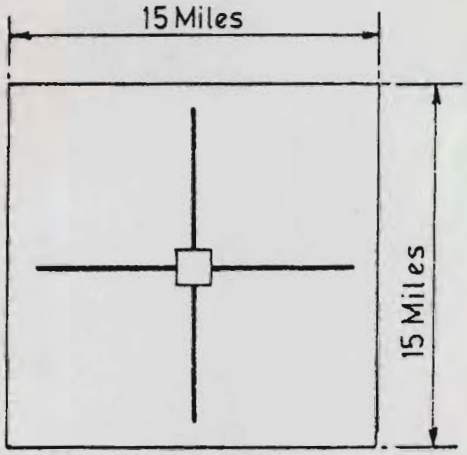
TWO FEEDER AREA



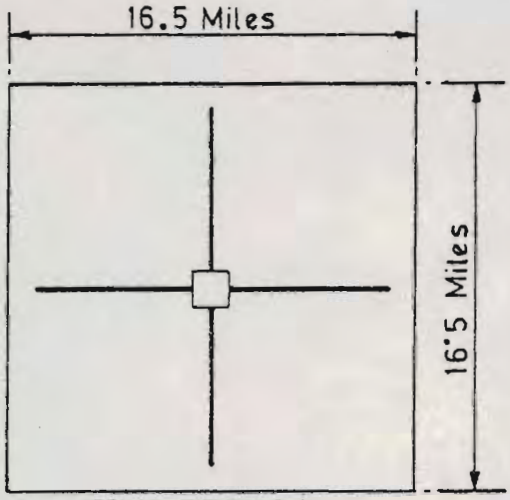
NOTE:- BRANCH CIRCUITS ARE ASSUMED TO BE SPACED EVERY TWO MILES FOR FEEDER SERVICE AREA STUDY PURPOSES.

Exhibit - B

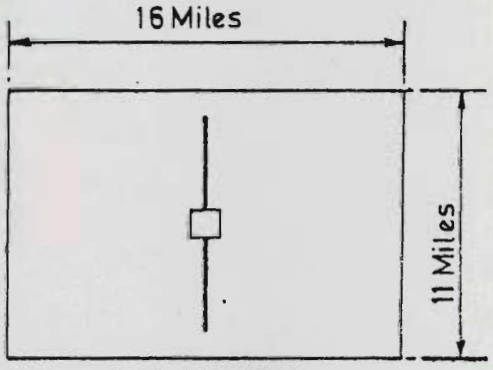
TYPICAL SUBSTATION SUPPLY AREAS



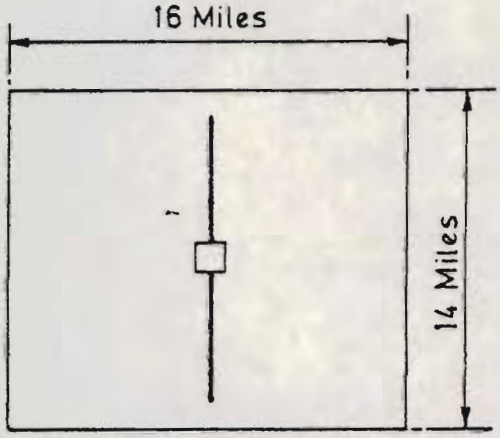
FOUR FEEDER
30 KVA/Square Mile



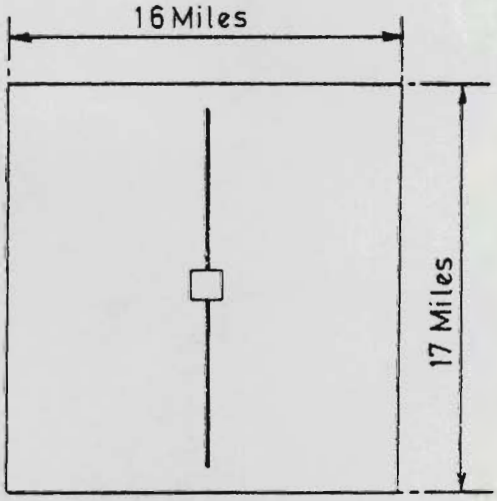
FOUR FEEDER
20 KVA/Square Mile



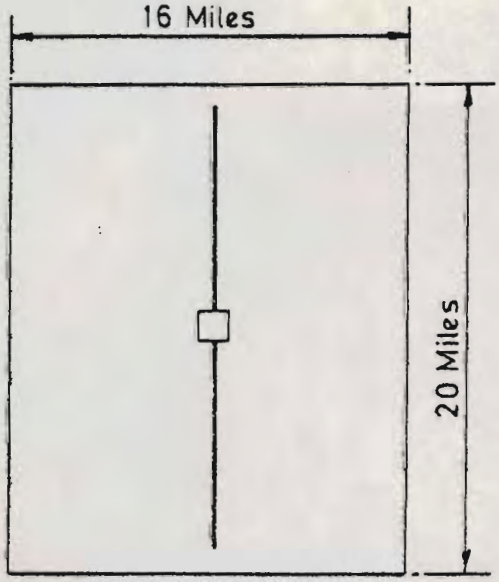
TWO FEEDER
30 KVA/Square Mile



TWO FEEDER
20 KVA/Sqare Mile



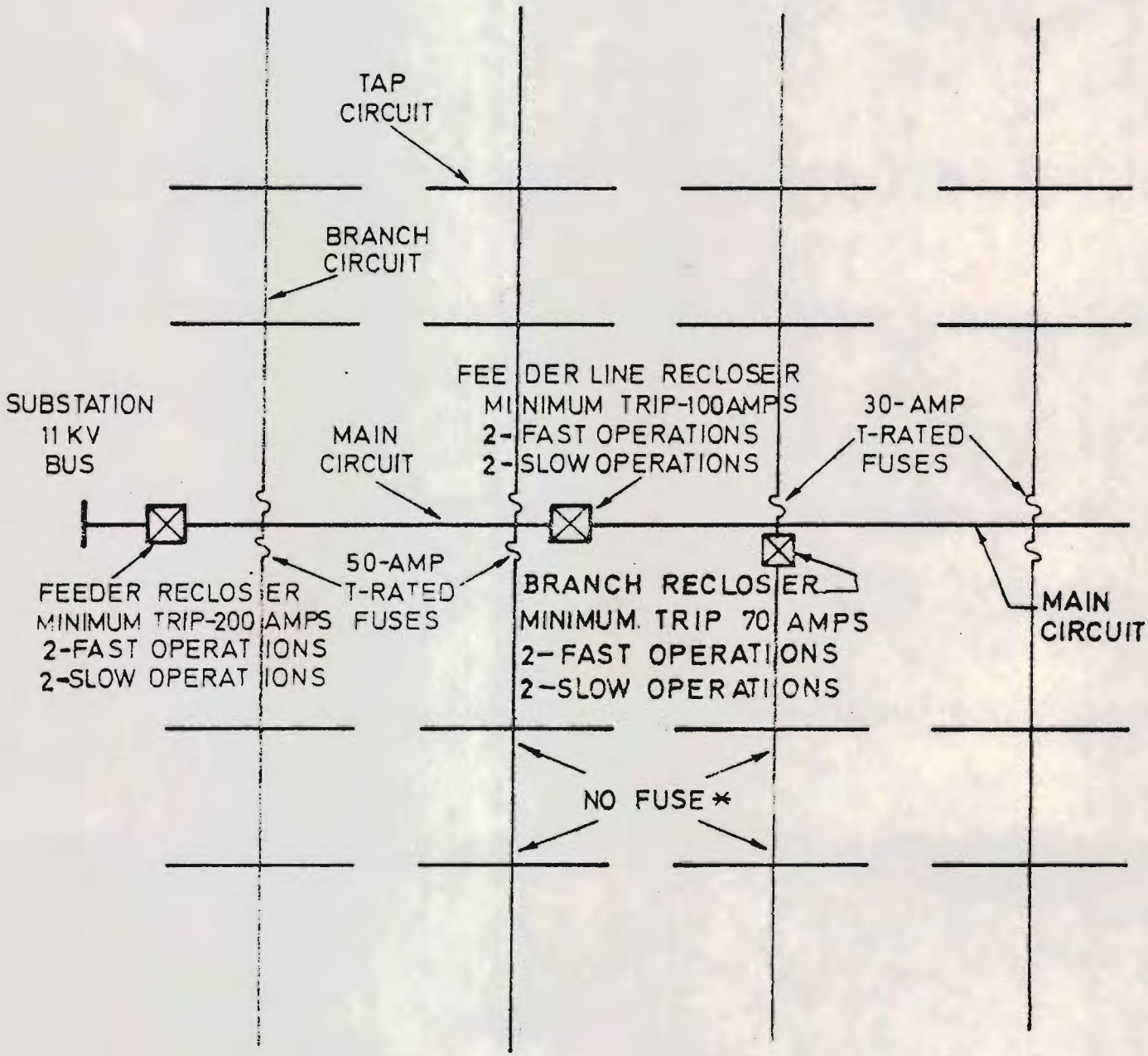
TWO FEEDER
15 KVA/Square Mile



TWO FEEDER
10 KVA/Square Mile

Exhibit - C

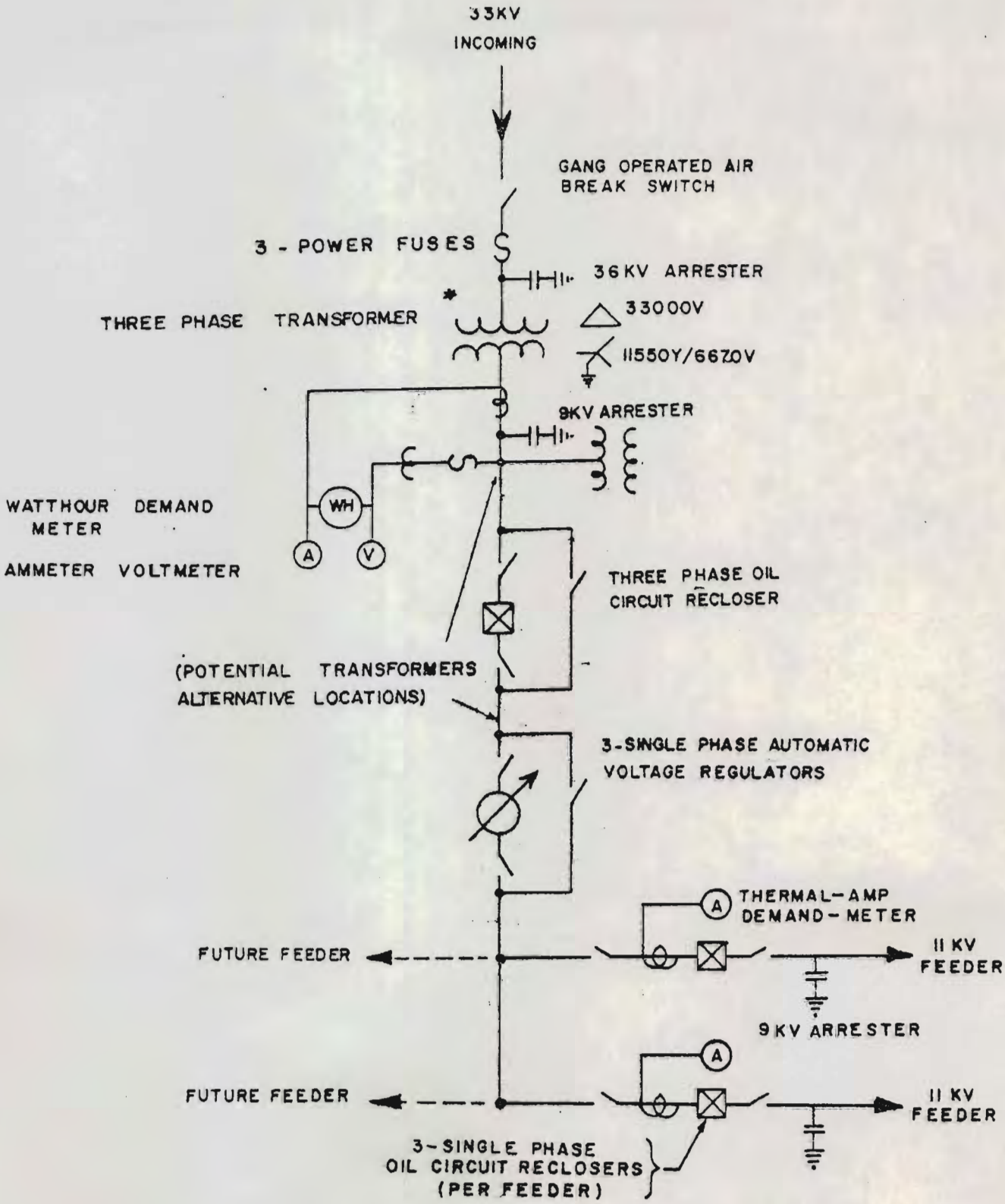
TYPICAL FEEDER PROTECTION SCHEME



* TAP CIRCUITS NORMALLY NOT FUSED UNLESS HAZARDOUS CONDITIONS WARRANT

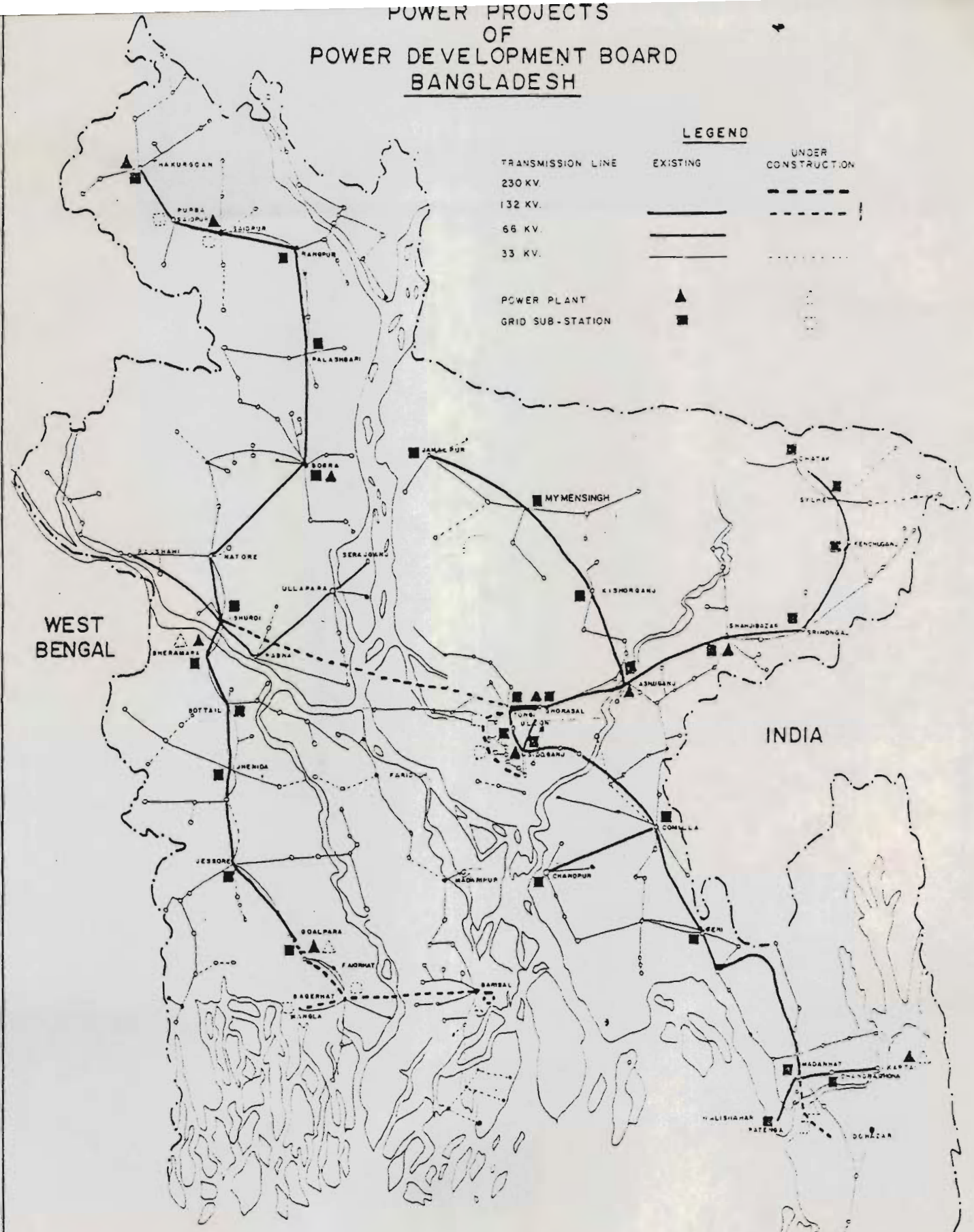
Exhibit - D

SUBSTATION ONE LINE



* TO BE SUPPLIED UNDER ANOTHER CONTRACT

POWER PROJECTS OF POWER DEVELOPMENT BOARD BANGLADESH



BENEFIT-COST ANALYSIS

The Tables A through D2 in this annex contain the assumptions and information used to estimate an internal rate of return on the investment in and operation of a Phase II PBS over a 17 year period with wholesale power priced at the current rate of Tk 0.266/kWH. Tables E-0 through E-2 reestimate a real internal rate of return employing marginal cost estimates for wholesale power and allowing for possible adjustment in retail rates to pass increased power expenses along to consumers. Finally, Tables F-0 through F-2 provide the basis for and estimate of an internal rate of return for investment in and expansion of a Phase I PBS beginning in the sixth year and running through the 17th year. The data sources are referenced in the Tables individually.

Cost/Benefit Analysis: Phase II PBS

Table A shows the system costs for a Phase II PBS computed as the sum of plant investment, O&M expenses and wholesale power purchases. Wholesale power is priced at Tk 0.266/kWH in year one and increases in real terms at approximately 2% p.a. over the period. System revenues were computed at established retail rates which average Tk 0.84/kWH. Cost savings in Table A derive from Table B-0 through B-3. No cost savings estimates were introduced for commercial consumers and medium industry. Medium industry consumers are typically already electrified.

Cost savings calculations for DTW's, STW's and LLP's understate the benefits from converting diesel engines to electric motors. Specifically a U.S. AID study shows that operating hours/day substantially increase and that in practice the average command area of a well is significantly expanded with electric power. These benefits are separately classified as irrigation benefits in Table A and are derived in Tables C-0 and C-1 by evaluating the incremental agricultural income per pump that results.

Finally, Table A includes a measure of employment benefits to Bangladesh that result from new employment: (a) directly arising through the operation of PBS's, contractors concerned with construction and the development of REB, and (b) indirectly through the economic growth in small cottage industry, commercial activities, small industry and agriculture. Tables D-0 through D-1 contain the assumptions and information used to derive these benefits. The analysis and estimated benefits are very conservative. Underemployment in Bangladesh is significant and any increase in employment should result in salary earnings that will be spent and circulated through the economy generating economic activity and additional jobs through a "multiplier" effect.

Sensitivity Analysis: Phase II PBS

One of the most critical elements in the benefit-cost calculations is the economic cost of power generated by PDB and made available at 33kV/11kV to a PBS. Coopers & Lybrand have attempted to estimate a longrun marginal cost for power. While there is significant concern with the reliability and accuracy of their estimate, their methodology is employed in Table E-2, with some modifications in assumptions, to obtain a marginal cost price of Tk 0.80/kWH for power purchased by a PBS. Table E-0 and E-1 calculate the internal rate of return for a PBS for both a price of Tk 0.80/kWH and a higher price of Tk 0.90/kWH. The difference between the two tables is that the results in the first assume no increase in retail electric rates to pass on the marginal cost price and the results in the second assume a token 12% increase. A larger increase would have required revisions in load and financial forecasts for which resources and information were not available. For specificity in the second table (E-1), it was assumed that the price elasticity of demand was approximately .17 (absolute value) so that the 12% increase in price would reduce quantity demanded in the load forecast by 2% - raising total revenue by 10%. In addition, calculations suggested that it would be reasonable to assume an average decrease of 6% in cost savings. The results of the sensitity analysis are that: (1) the real internal rate of return at a marginal cost price of Tk 0.80/kWH is 6.4%, considerably less than the 15.8% at current wholesale price, (2) if retail rates are increased by 12% the rate of return rises to 7.6%.

Cost/Benefit Analysis: Expansion of a Phase I PBS

Table F-0 estimates the real internal rate of return for investment beginning in the sixth year in the expansion of a Phase I PBS at 24%. The plant cost figures assume that part of the Phase I PBS was originally designed and constructed in years 1 and 2 to allow capacity for expansion. The plant costs for years six through 17 were developed using Table F-1 load forecast information and NRECA/CAI estimates of unit costs of extended services to consumers of different types

TABLE A

COST-BENEFIT ANALYSIS : PHASE II - PBS
(1,000's U.S. $)

ANNEX F

	COSTS				BENEFITS					NET BENEFITS	INTERNAL RATE OF RETURN
Year	Plant	O&M	Whole Sale Power	Total	Revenue	Costs Savings	Irrigation Production	Employment	Total		
1	1131.22	0	0	1131.22	0	0	0	19.190	19.190	-1112.032	
2	1885.39	0	0	1885.39	0	0	0	19.281	19.281	- 1866.110	15.8%
3	2262.44	111.11	83.67	2457.22	199.17	149.575	22.100	89.667	460.512	- 1724.248	
4	1885.39	111.11	123.78	2120.28	310.28	269.888	33.896	177,186	791.250	- 1329.030	
5.	377.06	111.11	173.89	662.06	443.94	423.068	45.531	232.738	1145.280	+ 483.235	
6	417.89	111.11	218.89	747.89	572.28	514.302	53.387	284.280	1424.250	+ 675.860	
7	417.89	111.11	267.50	796.50	703.67	603.587	61.243	336.001	1704.500	+ 908.000	
8	417.89	111.11	319.94	848.94	838.23	693.966	69.099	387.903	1989.300	+ 1140.360	
9	417.89	111.11	374.11	903.11	976.11	784.452	77.055	438.237	2275.850	+ 1372.740	
10	417.89	111.11	430.06	959.06	1116.94	874.938	85.011	488.802	2565.690	+ 1606.600	
11	417.89	111.11	487.78	1016.78	1261.00	965.425	92.967	535.576	2854.970	+ 1838.190	
12	417.89	111.11	547.28	1076.28	1408.22	1055.910	100.923	590.601	3155.650	+ 2079.370	
13	417.89	111.11	608.56	1137.56	1558.56	1147.310	109.327	634.635	3449.830	+ 2312.270	
14	417.89	111.11	671.67	1200.67	1712.00	1238.707	117.731	678.570	3747.010	+ 2546.340	
15	417.89	111.11	736.50	1265.50	1868.44	1329.795	126.135	723.543	4047.910	+ 2782.410	
16	417.89	111.11	803.33	1332.33	2028.33	1425.251	136.539	768.378	4358.500	+ 3029.170	
17	417.89	111.11	872.00	1401.00	2191.44	1512.716	142.943	813.552	4660.650	+ 3259.650	

TABLE B-0
TOTAL COST SAVINGS ESTIMATES:
PHASE II PBS
(IN 1,000's U.S.$)

ANNEX F

DOMESTIC LIGHTING		DEEP TUBE WELLS		SHALLOW TUBE WELLS		LOWLIFT PUMPS		SMALL INDUSTRY		TOTAL COST SAVINGS
No.of Meters	Cost Savings	No.	Cost Savings	No.	Cost Savings	No.	Cost Savings	No.	Cost Savings	
0		0		0		0		0		
0		0		0		0		0		
3,147	98.092	35	18.153	32	5.964	20	5.305	56	22.062	149.575
6,294	196.184	47	24.377	64	11.927	40	10.610	68	26.789	269.888
10,490	326.973	53	27.488	110	20.500	67	17.772	77	30.335	423.068
12,573	391.900	60	31.119	125	23.295	87	23.077	114	44.912	514.302
14,596	454.957	67	34.750	140	26.090	107	28.382	151	59.408	603.587
16,649	518.949	74	38.380	155	28.886	127	33.687	188	74.065	693.966
18,702	582.941	81	42.011	171	31.868	147	38.992	225	88.641	784.452
20,755	646.933	88	45.641	187	34.849	167	44.297	262	103.218	874.938
22,808	710.925	95	49.272	203	37.831	187	49.602	299	117.795	965.425
24,861	774.917	102	52.902	219	40.813	207	54.907	331	132.371	1,055.910
26,914	838.909	110	57.052	235	43.795	227	60.118	374	147.342	1,147.310
28,967	902.901	118	61.201	251	46.776	247	65.517	412	162.312	1,238.707
31,010	966.582	126	65.350	267	49.758	267	70.822	450	177.283	1,329.795
33,070	1,030.792	134	69.499	283	52.740	287	76.127	498	196.193	1,425.251
35,120	1,094.690	142	73.648	299	55.722	307	81.432	526	207.224	1,512.716

TABLE B-1 DOMESTIC LIGHTING COST SAVINGS ESTIMATES PER YEAR PER RESIDENTIAL METER: PHASE II PBS

ANNEX F

	Low Income Households		High Income Households	
	Electric	Kerosene	Electric	Kerosene
1. Initial Investment				
a) housewiring/meter annualized at 12 years	30 Tk		35 Tk	
b) 3 kupi lamps annualized at 1 1/2 yr.		15 Tk		
c) 2 hurricane lamps annualized at 3 yrs plus 2 kupi lamps @1 1/2 years				60 Tk
2. Maintenance				
a) housewiring/meter	30 Tk		30 Tk	
b) 10-40W bulbs @12 Tk/bulb	120 Tk		120 Tk	
c) 3 kupi lamps @4 Tk/lamp		30 Tk		
d) 2 hurricane + 2 kupi lamps				120 Tk
3. Energy Costs				
a) 10kwh/household/month (Low Income)	270 Tk			
30 kwh/household/month (High Income)			720 Tk	
b) 96 lb.kerosene/household @3 Tk/lb.		720 Tk		
168 lb kerosene/household @3 Tk/lb.				1,260 Tk
c) One pair batteries/month @20 Tk				600 Tk
4. Total Annual Cost Tk	450 Tk	765Tk.	905 Tk	2,040 Tk
5. Cost Savings Per Year (Tk)	315 Tk ($17.50)		1,135 Tk ($63.06)	
6. Average Cost Savings Per Year ($)	.70x$17.50 + .3x$63.06 = $31.17			

7. Assumptions
   a) 70 percent of households are low income and 30 percent high income with 2.5 households/meter.
   b) price of housewiring = 300Tk, price of a kupi lamp = 3Tk price of a hurricane lamp = 30 Tk., price of kerosene is 3.00 Tk/lb. and the electric rate schedule is 15 Tk for the first 15 kwh and .75 Tk/kwh for additional consumption/worth.

8. References
   a) Survey research by Rural Electrification Board Staff and conducted specifically for this analysis, May 1981.
   b) Exchange rate of $1 U.S. to 18 Taka

TABLE B-2 IRRIGATION COST SAVINGS ESTIMATES PER YEAR PER WELL : PHASE II - PBS

CASE 1 DEEP TUBE WELLS

ASSUMPTIONS:

a) All well components including a 2 cusec Turbine pump (life time of 15 years and priced at rate Tk.35,000) are the same for diesel and electric Motors. However, the electric motor is a vertical motor and a Gear Head with spicer shaft (life time 20 years, price Tk. 10,000).

b) One 3 PH, 25 HP Electric Motor (life time 20 years, price Tk. 15,000) is equivalent in performance to a 30 HP diesel engine (life time 15 years, price Tk. 50,000) there is a 20% salvage valve on motors at end of life time.

c) Average pumping hours per year (Boro & Aus season) = 1,000 hours.

d) Fuel Consumption:

1,000 gal. of HSD Fuel at rate Tk.18.95/gal	=	Tk. 18,940
37.5 gal. of lub & greasing oil at rate Tk.37.02	=	Tk. 1,688
		Tk. 20,628

e) Electric Energy Consumption at rate Electricity rate Tk. .70/KWH. Electric motor is assumed to be 85% efficient so that KWH = .746 x Horsepower x $\frac{1}{\text{Efficiency}}$ x operating hours and KWH = 21,941.

Expenditure on electricity: Tk.15,358.82.

f) Repair and Maintenance Costs:

Diesel Engine & Equipment	:	Tk. 2,000
Electric Motor & Equipment	:	Tk. 500

TABLE B-2 p. 2

ANNEX F

ESTIMATED ANNUAL COST

	Electric	Diesel
1. INVESTMENT		
Gear Head with Spicer Shaft		500
30 HP Diesel		3,333.33
3 Phase, 25 HP Electric Motor	750	
Salvage Vale (-)	- 150	- 666.67
2. Annual Operating Cost & Maintenance		
Diesel Fuel		18,940
KWH	15,358.7	
Lubrication		1,688
Repair and Maintenance	500	2,000
3. Total (Tk.)	16,458.7	25,794.66
4. Cost Savings (U.S. $)	$ 518.66	

REFERENCES

(a) Diesel and Electric Powered Pump Irrigation, A Comparative Cost Analysis by Akhter Ahmed, USAID, May 11, 1981.

(b) NRECA/CAI Advisory Staff.

CASE 2 SHALLOW TUBE WELLS

ASSUMPTIONS:

a) All well components including a 3/4 cusec pump set (life time of 10 years, price Tk.4000) are all the same for diesel and electric motor operated wells.

b) One 4.5 HP electric motor (life time 15 years, price Tk.5,000) is equivalent in performance to a 6 HP diesel engine (life time 10 years, price Tk.6,500).

c) Average pumping hours per year (Boro & Aus) = 700 hours

d) Fuel Consumption: 210 gallons of HSD Diesel at rate Tk.18.95/gal. = Tk. 3,977
5.3 gallons of Lub at rate Tk.37.02/gal = Tk. 296
Tk. 4,273

e) Electric Energy Consumption rate .70 Tk/KWH
(same assumption as for DTW) KWH = 2,764.6, Expenditure = Tk. 1,935.2

f) Repair & Maintenance: Diesel Engine & Equipment : Tk. 1,100
Electric Motor & Equipment : Tk. 300

ESTIMATED ANNUAL COST

	Electric	Diesel
1. INVESTMENT		
6 HP Diesel		650
4.5 HP Electric	333.33	
2. ANNUAL OPERATING COST AND MAINTENANCE		
Diesel Fuel		3,977
KWH	1,935.2	
Lub	100	296
Repair & Maintenance	.300	1,100
3. TOTAL (Tk.)	2,668.5	6,023
4. COST SAVINGS (U.S.$)	$ 186.36	

REFERENCES

a) Diesel and Electric Powered Pump Irrigation, A Comparative Cost Analysis by Akhter Ahmed, USAID, May 11, 1981.

b) NRECA/CAI Advisory Staff.

ASSUMPTIONS:

a) Accessc , Trolley including Coupling and 2 cusec pump (life time 10 years, price Tk. 4,000) are all the same whether a diesel or electric motor is used.

b) One 15 HP motor (life time 15 years, price Tk. 10,000) is equivalent to an 18 HP diesel engine (life time 10 years, price Tk. 20,000).

c) Average pumping hours (Boro and Aus season) = 700 hours.

d) Fuel Consumption : 438 gallons of HSD diesel @ 18.95 Tk./gal. = Tk. 8,296
16 gallons of Lub @ Tk. 37.02/gal. + greasing= Tk. 792
Tk. 9,088

e) Electric Energy Consumption @ Electric rate .70 Tk/KWH (same assumption as DTW & STW) KWH = 9,215, Expenditure = Tk. 6,450.7

f) Repair and Maintenance : Diesel Engine & Equipment : Tk. 1,300
Electric Motor & Equipment : Tk. 300

ESTIMATED ANNUAL COST

	Electric	Diesel
1. INVESTMENT		
18 HP diesel engine		2,000
15 HP Electric Motor	666.67	
2. ANNUAL OPERATING COST AND MAINTENANCE		
Diesel Fuel		8,296
KWH	6,450.7	
Lub	200	792
Repair and Maintenance	300	1,300
3. TOTAL (Tk.)	7,617.4	12,388
4. COST SAVINGS (U.S. $)	$ 265.25	

REFERENCES

(a) Diesel and Electric Powered Pump Irrigation, A Comparative Cost Analysis by Akhter Ahmed, USAID, May 11, 1981.

(b) NRECA/CAI Advisory Staff.

ANNEX F

TABLE B-3 SMALL INDUSTRY COST SAVINGS ESTIMATES PER YEAR PER FIRM : PHASE II - PBS

ASSUMPTIONS:

a) Rice Mills, Flour Mills, Oil Mills, Combination Rice-Flour-Oil Mills, Saw Mills, etc. essentially require or use the same diesel engines or electric motors, the only difference lies principally in operating hours and the use of other equipment independent of the engine or motor.

b) The average running hours/mill per year is 1,575 hours.

c) A 3 PH, 15HP Electric Motor (Life time of 15 years, price @ Tk. 10,000) is equivalent in performance to a 20HP diesel engine (life time 10 years, priced @ Tk. 27,000)

d) Fuel Consumption:

HSD Diesel : 1575 Hours x .72 gal/HR x 18.95 Tk/gal.	=	Tk. 21,489.30
LUB: (.125 gal Lub/HP/100 HR)20 HP x $\frac{1575}{100}$ x 37.02 Tk/gal		Tk. 1,457.66
TOTAL:		Tk. 22,946.96

e) Electric Energy Consumption @ Tk. .90/KWH for first 2500 KWH and .60 Tk/KWH for additional KWH. Electric motor is assumed to be 85% efficient so that KWH = .746 x HP x $\frac{1}{\text{efficiency}}$ x operating hours = 20,734.4 KWH/YR at a cost of Tk. 18,660.96

f) Repair and Maintenance Costs:

Diesel Engine and Equipment	:	Tk. 1,300/Yr.
Electric Motor and Equipment	:	Tk. 300/Yr.

TABLE B-3 p. 2

ANNEX F

ESTIMATED ANNUAL COST

	Electric	Diesel
1. INVESTMENT		
20 HP Diesel Engine		2,700
15 HP Electric Motor	667	
2. ANNUAL OPERATING COST AND MAINTENANCE		
Diesel Fuel		21,489
KWH	18,661	
Lubrication	200	1,457
Repair and Maintenance	300	1,300
3. TOTAL (Tk.)	19,828	26,946
4. COST SAVINGS (U.S. $)	$395/Yr.	

5. REFERENCES

(a) Survey Research by Rural Electrification Board Staff; May 1981

(b) Research by Akhter Ahmed, USAID

(c) NRECA/CAI Advisory Staff.

TABLE C-0: TOTAL BENEFITS FROM INCREASED AVERAGE COMMAND AREA (A.C.A.) PER IRRIGATION WELL FOLLOWING DIESEL TO ELECTRIC CONVERSIONS: PHASE II--PBS

ANNEX F

(In 1000's U.S. $)

YEAR	D T W				S T W				L L P				
	Conversions (No.)	A.C.A. Increase	Net Y Acre	Benefits	Conversions (No.)	A.C.A. Increase	Net Y Acre	Benefits	Conversions (No.)	A.C.A. Increase	Net Y Acre	Benefits	Total Benefits
1	0	44.8	10	0	0	10	10	0	0	16.1	10	0	0
2	0	44.8	10	0	0	10	10	0	0	16.1	10	0	0
3	35	44.8	10	15680	32	10	10	3200	20	16.1	10	3220	22100
4	47	44.8	10	21056	64	10	10	6400	40	16.1	10	6440	33896
5	53	44.8	10	23744	110	10	10	11000	67	16.1	10	10737	45531
6	60	44.8	10	26880	125	10	10	12500	87	16.1	10	14007	53387
7	67	44.8	10	30016	140	10	10	14000	107	16.1	10	17227	61243
8	74	44.8	10	33152	155	10	10	15500	127	16.1	10	20447	69099
9	81	44.8	10	36288	171	10	10	17100	147	16.1	10	23667	77055
10	88	44.8	10	39424	187	10	10	18700	167	16.1	10	26887	85011
11	95	44.8	10	42560	203	10	10	20300	187	16.1	10	30107	92967
12	102	44.8	10	45696	219	10	10	21900	207	16.1	10	33327	100923
13	110	44.8	10	49280	235	10	10	23500	227	16.1	10	36547	109327
14	118	44.8	10	52864	251	10	10	25100	247	16.1	10	39767	117731
15	126	44.8	10	56448	267	10	10	26700	267	16.1	10	42987	126135
16	134	44.8	10	60032	283	10	10	28300	287	16.1	10	46207	134539
17	142	44.8	10	63616	299	10	10	29900	307	16.1	10	49427	142943

TABLE C-1

ANNEX F

BENEFITS PER IRRIGATION WELL RESULTING FROM INCREASED AVERAGE COMMAND AREA FOLLOWING DIESEL TO ELECT. MOTOR CONVERSION: PHASE II -- PBS

ASSUMPTIONS:

a) As a result of conversion from diesel engine to electric motor, operating hours/day increase and according to the raw data from a USAID, Electric and Diesel Power Irrigation Pump Survey (April 1981) of pump operators in the Comilla and Chittagong Districts of Bangladesh, more water is pumped irrigating, on the average, a larger Average Command Area (ACA). From the raw data, the estimate is that the ACA\well increases by:

Deep Tube Well	: 44.8 acres
Shallow Tube Well	: 10 acres
Lowlift Pump	: 16.1 acres

b) Benefits per well were measured by net income per acre (from farming) times the number of acres by which the ACA increases. Net Income per acre from farming is computed assuming a Boro crop. From Volume V, Boro Paddy, Costs and Returns, AGRO-Economic Research Section, Ministry of Agriculture and Forests, December 1979, the following data were collected and net income computed:

Price/maund	= 74 Tk. (78-79)
Yield/acre	= 38.9 Maunds/acre
Cost/acre	= 2761 Tk/acre (78-79)
Net income	= Price x yield-cost = 137 Tk/acre (78-79 prices)

Using G.D.P. deflator from the Statistical Year Book of Bangladesh, Net income V = 181.18 Tk/acre (80-81 prices)

In dollars (U.S.) - Net income $10/acre (80-81 prices)

ESTIMATED ANNUAL BENEFITS/WELL

Deep Tube Well	: 44.8 acres x $10/acre	= $448/well
Shallow Tube Well	: 10 acres x $10/acre	= $100/well
Low Lift Pump	: 16.1 acres x $10/acre	= $ 161/well

TABLE D-1 INDIRECT EMPLOYMENT BENEFITS PER YEAR: PHASE II FBS

(IN 1000's U.S. $)

ANNEX F

TABLE D-0 DIRECT EMPLOYMENT BENEFITS PER YEAR: PHASE II PBS

(IN 1,000's U.S.$)

ANNEX F

	(1)	(2)	(3)	(4)	(5)	(6)	Total Benefits Per PBS
	REB		Contractors		Phase II PBS		
Year	Employment	Salary Benefits (Per PBS)	Employment	Salary Benefits (Per PBS)	Employment	Salary Benefits	(2+4+6)
1	435	3302.78	1140	5137.0	20	10750	19190
2	447	3393.89	1140	5137.0	20	10750	19281
3	459	3485.00	1140	5137.0	53	28488	37110
4	471	3576.11	1140	5137.0	54	29025	37738
5	483	3667.22	1140	5137.0	55	29563	38367
6	495	3758.33	1140	5137.0	57	30638	39533
7	507	3849.44	1140	5137.0	59	31713	40699
8	519	3940.56	1140	5137.0	61	32788	41866
9	531	4031.67	1140	5137.0	63	33863	43032
10	543	4122.78	1140	5137.0	65	34938	44198
11	555	4213.89	1140	5137.0	67	36013	45364
12	567	4305.00	1140	5137.0	69	37089	46531
13	579	4396.11	1140	5137.0	71	38163	47696
14	591	4487.22	1140	5137.0	73	39238	48862
15	600	4555.56	1140	5137.0	75	40313	50006
16	600	4555.56	1140	5137.0	77	41388	51081
17	600	4555.56	1140	5137.0	79	42463	52156

TABLE D-2 INDIRECT AND DIRECT EMPLOYMENT BENEFITS
ASSUMPTIONS AND ANALYSIS: PHASE II PBS

CASE 1 INDIRECT EMPLOYMENT - DTW, STW, LLP

ASSUMPTIONS

a) Average Acres Irrigated per well are: DTW - 60 acres, STW - 15 acres, LLP - 40 acres
b) Working Days/acre = 117.8 days/acre for all wells
c) Wage/day = 18.0 Tk./day

ESTIMATED EMPLOYMENT BENEFITS/WELL

Benefits/well = wage/day x working days/acre x average acres irrigated

DTW = 7068 (U.S. $)
STW = 1767 (U.S. $)
LLP = 4712 (U.S. $)

REFERENCES

a) Acres irrigated/well were obtained from B.A.D.C. and USAID Survey Results
b) Data on other information were collected from Costs and Returns, Vol. V Boro Paddy, Agro-economic Research, Ministry of Agriculture & Forests.
c) Thanawise Statistics on Distribution of Agricultural Inputs, 1978-1979, BADC

CASE 2 INDIRECT EMPLOYMENT - SMALL INDUSTRY

ASSUMPTIONS

a) Average Employment/firm = 6
b) Average Wage = 13.64 Tk./day
c) Working days/year = 240

ESTIMATED EMPLOYMENT BENEFITS/FIRM/YEAR

Employees/Firm x 13.64 Tk x 240 Working days = 19641.6 Tk/year = 109.12/year (U.S. $)

REFERENCES

a) RURAL INDUSTRIES STUDY PROJECT, PHASE I & II REPORTS, 1979, 1980, Bangladesh Institute of Development Studies.

b) Average Daily Wage Rates from Monthly Statistical Bulletin of Bangladesh, Bangladesh Bureau of Statistics, January 1981.

CASE 3 INDIRECT EMPLOYMENT - Commercial and Home Production

ASSUMPTIONS & ESTIMATED BENEFITS/YR/PBS

a) Employment per PBS (Home Production = 45 @ Wage = 20 Tk/day plus Commercial or Small Cottage = 30 @ Wage = 25/Tk/day) = 75

b) Average Income/year - Home Production = 416 (U.S.$)/yr.
Small Cottage = 520 (U.S. $)/yr.

c) Total Income/year = Average Income X Employment

Home Production	$ 18,720
Small Cottage (Com.)	$ 15,600
Total:	$34,320

d) Total Income/yr. is assumed to grow at 6.9%.

REFERENCES

(a) Project Paper Amendment, Annex J, Bangladesh: Rural Electrification Project (380-0021), Department of State USAID, Washington, D.C.

CASE 4 DIRECT EMPLOYMENT - RURAL ELECTRIFICATION BOARD (REB)

ASSUMPTIONS & ESTIMATED BENEFITS

a) REB current employment is estimated to be 435. REB proposed positions are 453, but total employment includes such positions plus contract personnel. It is anticipated that REB will carry 600-453 = 147 contract personnel for a total of 600 employment.

b) Position plus contract personnel will be broken down as:

Officers	=	250
Support Staff	=	350
Total		600

c) Salary/employee is about 750 Tk/month and monthly benefits in addition to salary include:

(i) Medical : 50 Tk/month
(ii) Housing : 30% of base salary/month = Tk.225/month

d) Total Salary : 1025 Tk/month or 12,300 Tk/year or 683.33 U.S. $/year.
e) Employment is assumed to grow smoothly from 435 (current) to 600 AND since there
f) are expected to be 90-100 PBS's, Benefits/phase II-A PBS are obtained by dividing by 90. Therefore, Employment Benefits/yr = $683.33 x Employment/90.

REFERENCES

a) NRECA/CAI Staff & Documents.

TABLE E-O SENSITIVITY ANALYSIS WITH WHOLESALE POWER PRICED AT MARGINAL COST ESTIMATES BUT RETAIL RATES UNCHANGED· PHASE II PBS (In 1000's U.S. $)

ANNEX F

YEAR	SYSTEM COSTS		SYSTEM REVENUE	SURPLUS BENEFITS	NET BENEFITS		IRR	
	Power at Tk. 90/kwh	Power at Tk. 80/kwh			Power @ Tk. 90/kwh	Power @ Tk. 80/kwh	Power @ Tk. 90/kwh	Power @ Tk. 80/kwh
1	20362.00	20362.00	0	19.19	-1112.03	-1112.03		
2	33937.00	33937.00	0	19.28	-1866.11	-1866.11	3.8%	6.4%
3	46761.30	47201.60	199.17	261.34	-1920.35	-1889.26		
4	43344.00	42521.00	310.28	480.97	-1616.25	-1570.58		
5	19143.30	17992.60	443.94	701.34	+ 81.78	+ 145.71		
6	22542.30	21095.60	572.28	851.97	+ 171.89	+ 252.26		
7	25336.80	23579.60	703.67	1000.83	+ 296.90	+ 394.52		
8	28369.80	26275.60	838.33	1150.97	+ 413.20	+ 529.54		
9	31482.00	29042.00	976.11	1299.74	+ 526.85	+ 662.40		
10	34674.30	31879.60	1116.94	1448.75	+ 639.31	+ 794.57		
11	37947.60	34789.20	1261.00	1593.97	+ 746.77	+ 922.23		
12	41299.20	37768.40	1408.22	1747.43	+ 861.25	+1057.40		
13	44731.80	40819.60	1558.56	1891.27	+ 964.73	+1182.07		
14	48245.40	43942.30	1712.00	2035.01	+1066.71	+1305.74		
15	51832.80	47131.60	1868.44	2179.47	+ 1168.31	+1429.49		
16	55508.80	50398.30	2028.33	2330.17	+ 1277.70	+1561.56		
17	59264.10	53737.20	2191.44	2469.21	+ 1368.20	+1675.25		

TABLE E-1 SENSITIVITY ANALYSIS WITH WHOLESALE POWER PRICED AT MARGINAL COST ESTIMATES AND RETAIL RATES INCREASED BY 12: PHASE II - PBS

(In 1000's U.S.$)

ANNEX F

YEAR	SYSTEM COSTS		SYSTEM REVENUE	SURPLUS BENEFITS	NET BENEFITS		IRR	
	Power @ Tk.90/kwh	Power @ Tk.80/kwh			Power @ Tk.90/kwh	Power @ Tk.80/kwh	Power @ Tk.90/kwh	Power @ Tk.80/kwh
1	19954.76	19954.76	0	18.04	-1112.03	-1112.03		
2	33258.26	33258.26	0	18.12	-1866.11	-1866.11	5.3%	7.6%
3	45826.07	46257.57	219.09	245.66	-1903.85	-1873.35		
4	42477.12	41670.58	341.31	452.11	-1593.25	-1548.45		
5	18760.43	17632.75	488.33	659.26	+ 112.28	+ 174.98		
6	22091.45	20673.69	629.51	800.85	+ 212.79	+ 291.49		
7	24830.06	23108.01	774.04	940.78	+ 348.70	+ 444.40		
8	27802.40	25750.09	922.16	1081.91	+ 476.30	+ 590.40		
9	30852.36	28461.16	1073.72	1221.72	+ 601.85	+ 734.65		
10	33980.81	31242.01	1228.63	1361.83	+ 726.51	+ 878.61		
11	37188.65	34093.42	1387.10	1498.33	+ 846.57	+1018.47		
12	40473.22	37013.03	1549.04	1642.58	+ 973.95	+1166.15		
13	43837.16	40003.21	1714.42	1779.77	+1090.93	+1303.93		
14	47280.49	43063.94	1883.20	1912.91	+1206.71	+1441.01		
15	50796.14	46188.97	2055.28	2048.70	+1322.31	+1578.31		
16	54398.23	49390.82	2231.16	2190.36	+1446.10	+1724.30		
17	58078.82	52662.46	2410.58	2321.06	+1551.80	+1943.50		

PDB MARGINAL COST OF SUPPLY AT 33/11 KV TO THE PHASE II A PBS BASED ON COOPERS & LYBRAND STUDY DATA(1)

A. Qualification and Alternative Assumptions:

1. There are a variety of important questions about the methodology and assumptions underlying the Coopers & Lybrand Tariff Study. These questions cannot be settled by reviewing the text and the study should not be employed as a basis for setting wholesale PDB electric rates. However, for the sake of the sensitivity exercise in this feasibility analysis, the Coopers & Lybrand calculations are reworked here with some differences in assumptions.

2. Alternative Assumptions:

a) The power station in section 9.2.7 is assumed to have a 35 rather than a 25 year economic life.

b) The cost of capital is assumed to involve a real rate of return of 5% rather than 10% (see Sections 9.2.7 and 9.2.22).

c) Reserve margin is 20%.

d) System losses are estimated as:

Average Losses:

Auxiliaries	4% of units generated
132 kV	2% of units entering the system
33 kV	4% of units entering the 33 kV system
Total Losses	10%

Peak Losses:

Assume 1.2 times average losses = 12%

B. Marginal Cost Calculations:

1. Marginal Capacity Cost

i) Generating Capacity

Using methods in Ch.9 of Coopers & Lybrand: Tk 697/KW/year in 79-80 prices at "Shadow" exchange rate, Tk 551/KW/year at official exchange rate.

ii) Transmission Capacity

Using C & L methods: Tk 436/KW/year in 79-80 prices at "Shadow" exchange rate, Tk 349/KW/year at official exchange rate.

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(1) Coopers & Lybrand Assoc. Ltd., Tariff Study, Government of Bangladesh, Power Development Board, November 1979.

2. Marginal Energy Cost

i) Natural Gas Opportunity Cost

Method: (a) Marginal production cost plus depletion premium
(b) Real fuel price increase: 3% p.a.
(c) Discount rate: 10%
(d) Reserve life: 30 years (date at which growing demand for fuel has to be increasingly satisfied by oil rather than new gas production).

1979-80 Marginal cost of production and transmission	- Tk. 6.00/MCF
Depletion premium (C&L Section 8.2.3)	- Tk.10.00/MCF
Total gas opportunity cost	- Tk.16.00/MCF

(79-80 prices)

This is about 60% of the gas value of Tk. 26.2 used in the tariff study using official exchange rates rather than "Shadow" one.

ii) Eastern Grid Marginal Energy Cost

	Range: Peak/Off-peak
Tariff Study	Tk.57 - Tk.23/kwh
At 60% gas value (at official exchange rate)	Tk.34 - Tk.14/kwh

iii) Western Grid Marginal Energy Cost

Tariff Study	Tk.2.93 - Tk.1.12/kwh
At official exchange rate	Tk.2.40 - Tk. .92/kwh

iv) Total System Marginal Energy Cost at Generation Level

Tariff Study (70%/30%):	Tk.1.25/kwh-Tk. .40/kwh
With new fuel values and split 90% East/10% West:	Tk. .55/kwh-Tk. .22/kwh

(about 45% of tariff study estimate)

3. System Losses

Average losses : 10%
Peak losses : 12%
(See Section A above)

4. Combined Marginal Cost at 33/11kV Level

i) Capacity

Generation	Tk 551/KW/year
plus margin 20%	Tk 110/KW/ year
	Tk 661/KW/year
	x 1.12 - Peak loss factor
	Tk 740/KW/year
Transmission	Tk 349/KW/year
	Tk1089/KW/year

$1089 \times \frac{.0889}{365}$ = Tk. .27/kWH at 33/11kV in 79-80 prices

ii) Energy

Tariff Study: Tk .835/KWH of generation
Revised: About 45% of tariff study estimates = Tk 38/kWH at generation x average loss factor (1.10) = Tk 42/kWH at 33/11kV level in 79-80 prices.

iii) Total Marginal Cost 79-80 and 80-81

Capacity	Tk .27
Energy	Tk .42
	Tk .69/kWH

Assume 16% inflation between 1979-1980 and 1980-1981.

Marginal Cost 1980/81 Tk .80/kWH at 33/11 kV

This is already in CIF - equivalent prices and does not need to be adjusted by Shadow price factors.

TABLE F-0 COST-BENEFIT ANALYSIS: EXPANSION IN THE 6th YEAR OF A PHASE-I PBS (1000's of U.S.$)

ANNEX F

	COSTS				BENEFITS				Net	
Year	Plant	O&M	Purchase(3) Power Exp.	Total	System Revenue	Cost Savings(1)	Employment Benefits(2)	total Benefits	Benefits	IRR
1	370.75	0	0	370.75	0	0	0	0	- 370.75	
2	370.75	0	0	370.75	0	0	0	0	- 370.75	24%
3	0	0	0	0	0	0	0	0	0	
4	0	0	0	0	0	0	0	0	0	
5	0	0	0	0	0	0	0	0	0	
6	92.63	1.55	7.71	101.89	19.94	11.38	98.01	129.33	+ 27.44	
7	92.63	3.15	15.47	111.26	40.46	22.75	196.04	259.25	+ 148.00	
8	92.63	4.81	23.58	121.02	61.11	34.13	294.04	389.28	+ 268.27	
9	92.63	6.51	31.92	131.06	83.25	45.51	392.07	520.83	+ 389.77	
10	92.63	8.26	40.51	141.40	105.51	56.89	490.08	652.48	+ 511.08	
11	92.63	10.07	49.33	152.03	128.36	68.26	588.09	784.71	+ 632.68	
12	92.63	11.92	58.40	162.95	151.78	79.64	686.11	917.53	+ 754.58	
13	92.63	13.82	67.72	174.16	175.79	91.02	784.12	1050.93	+ 876.77	
14	92.63	15.77	77.27	185.67	201.07	102.39	882.14	1185.60	+ 999.93	
15	92.63	17.76	87.07	197.47	225.55	113.77	980.15	1319.47	+1122.00	
16	92.63	19.81	97.11	209.56	251.30	125.15	1078.17	1454.62	+1245.06	
17	92.63	21.91	107.40	221.94	277.64	136.52	1176.19	1590.35	+1368.41	

Foot Notes:

(1) Cost savings estimates are only for domestic lighting and were computed using load forecast information and cost savings/meter data from Table B-1

(2) Employment benefits involve only what are referred to as indirect employment (Table's D-0 thru D-2) and were computed using load forecast Information for Small Industry, DTW, STW, and LLP.

(3) Purchase power expense is = Tk. .266 x Purchase power (Table F-1) with Tk converted to U.S.$ at the rate of 18 Tk. to 1 U.S.$.

TABLE F-1 LOAD FORECAST FOR 6TH YEAR EXPANSION OF PHASE I PBS

	Year 6	7	8	9	10	11
1. CONNECTIONS:						
a) Residential	365	730	1095	1460	1825	2190
b) Commercial	75	150	225	300	375	450
c) Deep Tube Wells	3	6	9	12	15	18
d) Shallow Tube Wells	17	34	51	68	85	102
e) Low Lift Pumps	9	18	27	36	45	54
f) Small Industry	4	8	12	16	20	24
g) Medium Industry	0	0	0	0	0	0
h) Total	473	946	1419	1892	2365	2838
2. AVERAGE ENERGY USE:						
a) Residential	370	385	400	415	430	445
b) Commercial	460	480	500	520	540	560
c) Deep Tube Wells	16000	16000	16000	16000	16000	16000
d) Shallow Tube Wells	3000	3000	3000	3000	3000	3000
e) Low Lift Pumps	5500	5500	5500	5500	5500	5500
f) Small Industry	30000	30000	30000	30000	30000	30000
g) Medium Industry	42000	42000	42000	42000	42000	42000
3. TOTAL ENERGY:						
a) Residential	135050	281050	438000	605900	784750	974550
b) Commercial	34500	72000	112500	156000	202500	252000
c) Deep Tube Wells	48000	96000	144000	192000	240000	288000
d) Shallow Tube Wells	51000	102000	153000	204000	255000	306000
e) Low Lift Pumps	49500	99000	148500	198000	247500	297000
f) Small Industry	120000	240000	360000	480000	600000	720000
g) Medium Industry	0	0	0	0	0	0
h) Total	438050	890050	1356000	1835900	2329750	2837550
4. LOSSES & PURCHASE POWER:						
a) Losses	16%	15%	15%	15%	15%	15%
b) Purchase Power	521.488	1047.118	1595.294	2159.882	2740.882	3338.294

TABLE F-1 LOAD FORECAST FOR 6TH YEAR EXPANSION OF PHASE I PBS

	12	13	14	15	16	17
1. CONNECTIONS:						
a) Residential	2555	2920	3285	3650	4015	4380
b) Commercial	525	600	675	750	825	900
c) Deep Tube Wells	21	24	27	30	33	36
d) Shallow Tube Wells	119	136	153	170	187	204
e) Low Lift Pumps	63	72	81	90	99	108
f) Small Industry	28	32	36	40	44	48
g) Medium Industry	0	0	0	0	0	0
h) Total	3311	3784	4257	4730	5203	5676
2. AVERAGE ENERGY USE:						
a) Residential	460	475	490	505	520	535
b) Commercial	580	600	620	640	660	680
c) Deep Tube Wells	16000	16000	16000	16000	16000	16000
d) Shallow Tube Wells	3000	3000	3000	3000	3000	3000
e) Low Lift Pumps	5500	5500	5500	5500	5500	5500
f) Small Industry	30000	30000	30000	30000	30000	30000
g) Medium Industry	42000	42000	42000	42000	42000	42000
3. TOTAL ENERGY:						
a) Residential	1175300	1387000	1609650	1843250	2087800	2343300
b) Commercial	304500	360000	418500	480000	544500	612000
c) Deep Tube Wells	336000	384000	432000	480000	528000	576000
d) Shallow Tube Wells	357000	408000	459000	510000	561000	612000
e) Low Lift Pumps	346500	396000	445500	495000	544500	594000
f) Small Industry	840000	960000	1080000	1200000	1320000	1440000
g) Medium Industry	0	0	0	0	0	0
h) Total	3359300	3895000	4444650	5008250	5585800	6177300
4. LOSSES & PURCHASE POWER:						
a) Losses	15%	15%	15%	15%	15%	15%
b) Purchase Power	3952.118	4582.353	5229.000	5892.059	6571.529	7267.412

TABLE F-2 REVENUE FORECAST FOR 6TH YEAR EXPANSION OF PHASE I PBS

Customer Grouping	Year 6	7	8	9	10	11
Residential						
Minimum Energy	3.650	7.300	10.950	14.600	18.250	21.900
Additional Energy	2.890	6.235	9.581	14.296	19.010	24.181
Commercial						
Minimum Energy	.750	1.500	2.250	3.000	3.750	4.500
Additional Energy	.875	1.875	3.000	4.250	5.625	7.125
Deep Tube Wells	1.867	3.733	5.600	7.467	9.333	11.200
Shallow Tube Wells	1.983	3.967	5.950	7.933	9.917	11.900
Low Lift Pumps	1.925	3.850	5.775	7.700	9.625	11.550
Small Industry	6.000	12.000	18.000	24.000	30.000	36.000
Medium Industry	0	0	0	0	0	0
TOTAL REVENUE	19.940	40.460	61.106	83.246	105.510	128.356

TABLE F-2 REVENUE FORECAST FOR 6TH YEAR EXPANSION OF PHASE I PBS

	Customer Grouping	12	13	14	15	16	17
1.	Residential						
	Minimum Energy	25.550	29.200	32.850	36.500	40.150	43.800
	Additional Energy	29.808	35.892	43.116	49.427	56.879	64.788
2.	Commercial						
	Minimum Energy	5.250	6.000	6.750	7.500	8.250	9.000
	Additional Energy	8.750	10.500	12.375	14.375	16.500	18.750
3.	Deep Tube Wells	13.067	14.933	16.800	18.667	20.533	22.400
4.	Shallow Tube Wells	13.883	15.867	17.850	19.833	21.817	23.800
5.	Low Lift Pumps	13.475	15.400	17.325	19.250	21.175	23.100
6.	Small Industry	42.000	48.000	54.000	60.000	66.000	72.000
7.	Medium Industry	0	0	0	0	0	0
8.	TOTAL REVENUE	151.783	175.792	201.066	225.552	251.304	277.638

Comparative Cost Analysis
Diesel vs Electric

Summary of Findings

Cost Savings by Pump Type: Table 1 shows that there are significant cost savings from all types of electrified pumps over diesel powered pumps. The highest savings in monetary terms is from deep tubewells followed by low lift pumps and shallow tubewells. In absolute terms, however, this is just the reverse, shallow tubewells followed by low lift pumps and deep tubewells. This is because cost of deep tubewell is about 7 and 11 times higher than low lift pump and shallow tubewell respectively.

Table 1: Comparative Savings from Electrified over Diesel Powered Irrigation Pumps 1/

(In Taka)

Type of Pumps	Present Value of Cost Streams		Cost Savings	
	Diesel	Electric	Amount	Percent
Deep Tubewell	470,069	364,201	105,868	23%
Low Lift Pump	114,968	82,684	32,284	28%
Shallow Tubewell	74,638	48,565	26,073	35%

1/ Refer to Tables A-3, B-3 and C-3.

Source: Pages 4-6, 16-18 "Diesel and Electric Powered Pump Irrigation", A.U. Ahmed, USAID/Dacca, May 1981.

Cost Savings by Type of Cost: Table 2 shows the composition of cost savings from electrified over diesel powered pumps by type of costs. It reveals that in absolute terms, savings in investment costs is highest from deep tubewells followed by low lift pumps and shallow tubewells, while in case of savings in power, shallow tubewells rank highest followed by low lift pumps and deep tubewells, and in case of operation cost, low lift pumps are followed by shallow tubewells and deep tubewells.

Table 2: Composition of Savings from Electrified over Diesel Powered Irrigation Pumps[1/]

	Type of Savings			
Type of Pumps	Investment	Power	Operation[2/]	Total
Deep Tubewell	48%	29%	23%	100%
Low Lift Pump	35%	35%	30%	100%
Shallow Tubewell	11%	60%	29%	100%

1/ Refer to Tables A-4, B-4 and C-4.

2/ Includes lubricant, operator's salary, repair and maintenance costs.

Cost Savings from Pump Conversion: Table 3 shows cost savings from converted electric pumps. The highest savings in monetary terms is again from deep tubewells followed by shallow tubewells and low lift pumps, while in absolute terms shallow tubewells rank highest followed by deep tubewells and low lift pumps.

Table 3: Cost Savings from Pump Conversion from Diesel to Electric[1/]

(Amount in Taka)

Type of Pumps	Present Value of Cost Streams		Cost Savings	
	Diesel	Electric	Amount	Percent
Deep Tubewell	470,069	407,999	62,070	13%
Low Lift Pump	114,968	102,984	11,984	10%
Shallow Tubewell	74,638	54,792	19,846	27%

1/ Refer to Tables A-5, B-5, and C-5.

Table B-1: Comparative Total Investment Costs of Diesel and Electric Powered Low Lift Pumps 1/*

		Investment Cost (in Taka)	
		Diesel	Electric
a.	2 cusec pump (Life: 10 years)	4,000	4,000
b.	Trolley including coupling (Life: 10 years)	3,000	3,000
c.	Accessories (Pipes, bends, foot valve,etc.)	8,000	8,000
d.	18 HP diesel engine (Life: 10 years)	20,000	-
e.	15 HP electric motor with starter (Life: 15 years)2/*	-	10,000
f.	Total capital cost	35,000	25,000
g.	Trade and transport**	1,750	1,250
h.	Overhead	1,000	1,000
i.	Total investment cost	37,750	27,250

* Refer to the assumptions used in the analysis.

**5% of capital cost (a + b + c + d + e).

Table B-2: Cost Items and Salvage Values at Different Times for Diesel and Electric Powered Low Lift Pumps.

(In Taka)

	Diesel	Electric
Total investment cost	37,750	27,250
10% salvage value of the pump set in 10th year 3/*	3,500	-
10% salvage value of the pump set (excluding motor) in 10th year.	-	1,500
40% salvage value of motor in 10th year	-	4,000
Annual operation and maintenance costs	12,788	9,368
a. 438 gallons of diesel 6/*	8,296	-
b. 9,240 KWH 8/*	-	6,468
c. Lubricant 6/* (16 gallons of lub oil + greasing for diesel; greasing only for electric)	792	200
d. Operator and protection 9/*	2,400	2,400
e. Repair and maintenance	1,300	300

* Refer to the assumptions used in the analysis.

Table B-3: Comparative Cost Streams of Diesel and Electric Powered Low Lift Pumps Applying Discounted Measures

(In Taka)

	Diesel			Electric		
Year	Capital Items	O&M	Total Costs	Capital Items	O&M	Total Costs
0	37,750	-	37,750	27,250	-	27,250
1-10	-	127,880	127,880	-	93,680	93,680
-	(3,500)[a]	-	(3,500)[a]	(5,500)[a]	-	(5,500)[a]

a. Salvage value of pump set, engine/motor.

Assuming 10% discount rate, the present value of cost stream for a diesel powered low lift pump:

$$C_D = 37750 + \sum_{t=1}^{10} \frac{12788}{(1+r)^t} - \frac{3500}{(1+r)^{10}}$$

$$C_D = [37750 + (12788)(6.144)] - [(3500)(0.386)]$$

$$C_D + 114,968$$

Assuming 10% discount rate, the present value of cost stream for an electric powered low lift pump:

$$C_E = 27250 + \sum_{t=1}^{10} \frac{9368}{(1+r)^t} - \frac{5500}{(1+r)^{10}}$$

$$C_E = [27250 + (9368)(6.144)] - [(5500)(0.386)]$$

$$C_E = 82,684$$

Cost savings over diesel powered low lift pump:

$C_D - C_E = 32,284$ or 28 percent.

QUICK STUDY COMPARISON OF DIESEL AND ELECTRIC IRRIGATION PUMPS

In order to compare the findings on impact of electrification for irrigation pump operations in Dacca I PBS with other areas of the country, a quick study of non-PBS areas known to have numerous electric irrigation pumps was mounted by the Mission Research Unit. A total of 46 pump operators, in Comilla and Chittagong Districts, were located and interviewed during April 1981. The sample was "accidental", since no sampling frame for irrigation pump operations was available. The interviewers followed electric wires to pumps, and after interviewing the electric pump respondent sought out and interviewed operators of nearby diesel-operated pumps. While not suitable for elaborate statistical analyses due to their non-random nature, these interviews offer information on major differences between operations of the two types of pumps which may be followed up in more rigorous investigation when time permits.

Fifty-nine percent of the respondents were under age 40; over 80 percent were from families of more than seven members--larger than the national average. Nine out of ten were educated; 34 percent had studied to secondary level or above. All considered themselves agriculturists; however, one-third were also in business, professional, or technical occupations as well.

Table 1 Type of Pump

Type	Electric	Diesel	Total	%
LLP	11	8	19	41
DTW	14	13	27	59
Total	25	21	46	100
%	54	46		100

All twenty-five electric pumps were connected to Power Development Board-supplied power. Slightly over half of all pumps surveyed were 20 horsepower or more. With the exception of one LLP which had been purchased from a Chittagong supplier by an individual, all pumps in the survey were procured from the Bangladesh Agricultural Development Corporation (BADC). Forty-five percent of all pumps had been in operation only since 1979, and 80 percent since 1974. Only one electric DTW and 2 LLP's had been in operation since before 1978--the recency of electric pump establishment in both survey areas is striking. Seven electric DTW pumps and 2 LLP's were begun as such; the rest were converted from diesel.

Pumps are, with one LLP excepted, under group management. Each group is managed by a committee headed by a Chairman, with a separate manager, an operator, and a varying number of members. The committee controls water distribution procedures, and collects the costs of irrigation from individual users.

Comparison of Performance of Electric vs. Diesel Pumps. The following tables summarize data on comparative performance of diesel and electric pumps. These findings may be noted briefly. Electric DTW pumps, while only slightly larger in horsepower on the average (23.9 hp. vs. 21.3 hp.) than diesel, irrigate significantly larger areas (65.8 acres vs. 30.6 acres), operate for much longer periods (825.1 vs. 349.6 hours this season) and serve one-third more users (1241 vs. 805 total, or an average of 88.6 vs. 61.9). Low lift pumps powered by electricity are slightly smaller than their diesel counterparts (14.8 vs. 16.2 hp.). However, they irrigate an average of nearly ten acres more (43.2 vs. 33.9 acres), while operating nearly 25 percent less (308.4 hours vs. 393.7 hours this season), and serving 9 percent more users (92.3 vs. 79.1) on the average.

Virtually all pumps, both electric and diesel, were used to irrigate HYV paddy. A few users at three pump sites were growing wheat, and a few at one pump were growing potatoes.

Table 2. Deep Tube Wells - Diesel Versus Electric

Diesel					Electric				
Pump No.	H.P.	No. of Users	Command Area(Acres)	Hrs. Run to Date	Pump No.	H.P.	No. of Users	Command Area(Acres)	Hrs. Run to Date
1	16	90	50	480	1	20	80	32	480
2	20	100	43.5	720	2	20	70	90	1*
3	20	1	1	5**	3	20	96	52.8	960
4	16	45	80	0***	4	25	80	75	600
5	20	90	35	400	5	25	100	100	1,080
6	20	10	7	120	6	25	125	35	1,360
7	20	95	33	410	7	25	90	70	1,200
8	25	40	20	480	8	30	85	80	900
9	30	150	30	420	9	25	50	60	900
10	25	100	35	480	10	25	40	35	900
11	25	32	20	300	11	25	75	80	750
12	15	2	4	60	12	25	100	140	800
13	25	50	40	670	13	25	150	40	900
					14	20	100	32	720
Total	277	805	398	4,545		335	1,241	921	11,551
Average	21.3	61.9	30.6	349.6		23.9	88.6	65.8	825.1

* The pump has been installed recently.

** The pump has developed mechanical problems and is out of order.

*** The group members are not willing to cultivate HYV due to high cost of diesel.

Table 3. Low Lift Pumps
Diesel Versus Electric

Diesel					Electric				
Pump No.	H.P.	No. of Users	Command Area(Acres)	Hrs. Run to Date	Pump No.	H.P.	No. of Users	Command Area(Acres)	Hrs. Run to Date
1	16	50	60	480	1	15	200	60	200
2	18	67	30	400	2	15	60	60	225
3	18	50	30	300	3	15	150	50	90
4	15	100	40	360	4	13	106	30	240
5	15	106	25	300	5	15	78	30	120
6	15	60	30	520	6	15	100	120	720
7	15	100	26	570	7	15	100	28	456
8	18	100	30	220	8	15	80	30	360
					9	15	1	5	120
					10	15	40	22	180
					11	15	100	40	680
Total	130	633	271	3,150		163	1,015	475	3,392
Average	16.2	79.1	33.9	393.7		14.8	92.3	43.2	308.4

TABLE I

OPERATING REPORT
TYPICAL PHASE II PBS
(THOUSANDS OF TAKA)

ANNEX I

	1	2	3	4	5	6	7	8	9
Revenue	0	0	3585	5585	7991	10301	12666	15090	17570
Purchase Power Expense	0	0	1506	2228	3130	3949	4815	5759	6734
Other O&M Expense	0	0	2000	2000	2000	2000	2000	2000	2000
Total O&M Expense	0	0	3506	4228	5130	5949	6815	7759	8734
Tax Expense	0	0	42	66	94	121	149	178	207
Depreciation	0	0	926	2418	3549	4228	4455	4683	4911
Interest Expense	204	746	1493	2239	2647	2790	2872	2948	3020
Total Cost of Service	204	746	5967	8951	11420	13088	14291	15568	16872
Margin	(204)	(746)	(2382)	(3366)	(3429)	(2787)	(1625)	(478)	598

TABLE I OPERATING REPORT
TYPICAL PHASE II PBS
(THOUSANDS OF TAKA)

	10	11	12	13	14	15	16	17
Revenue	20105	22698	25348	28054	30816	33632	36510	39446
Purchase Power Expense	7741	8780	9851	10954	12090	13257	14460	15696
Other O&M Expense	2000	2000	2000	2000	3000	3000	3000	3000
Total O&M Expense	9741	10780	11851	12954	15090	16257	17460	18696
Tax Expense	238	268	300	333	366	400	434	470
Depreciation	5139	5367	5595	5823	6051	6279	6507	6735
Interest Expense	3086	3146	3126	3102	3075	2968	2859	2748
Total Cost of Service	18204	19561	20872	22212	24582	25904	27260	28649
Margin	1901	3137	4476	5842	6234	7728	9250	10797

TABLE 2

SOURCES AND USES OF FUNDS
TYPICAL PHASE II PBS
(THOUSANDS OF TAKA)

ANNEX I

	1	2	3	4	5	6	7	8	9
Sources									
Previous Cash Balance	0	0	0	37	1328	4095	1853	746	754
Revenue	0	0	3585	5585	7991	10301	12666	15090	17570
Loan Funds Advanced	20362	33937	40724	33937	6787	7522	7522	7522	7522
Total Sources	20362	33937	44309	39559	16106	21918	22041	23358	25846
Uses									
O & M Expense	0	0	3506	4228	5130	5949	6815	7759	8734
Tax Expense	0	0	42	66	94	121	149	178	207
Loan Payment	0	0	0	0	0	6229	6565	6901	7237
Payment of Deferred Interest	0	0	0	0	0	244	244	244	244
Construction Expenditure	20362	33937	40724	33937	6787	7522	7522	7522	7522
Total Uses	20362	33937	44272	38231	12011	20065	21295	22604	23944
Cash Balance	0	0	37	1329	4095	1853	746	754	1902

TABLE 3 BALANCE SHEET

TYPICAL PHASE II PBS

ANNEX I

1	2	3	4	5	6	7	8	9

TABLE 2 SOURCES AND USES OF FUNDS

TYPICAL PHASE II PBS

(THOUSANDS OF TAKA)

ANNEX I

	10	11	12	13	14	15	16	17
Sources								
Previous Cash Balance	1902	4211	7708	5062	11340	10521	11317	13754
Revenue	20105	22698	25348	28054	30816	33632	36510	39446
Loan Funds Advanced	7522	7522	0	7522	0	0	0	0
Total Sources	29529	34431	33056	40638	42156	44153	47827	53200
Uses								
O & M Expense	9741	12780	11851	12954	15090	16257	17460	18696
Tax Expense	238	268	300	333	366	400	434	470
Loan Payment	7573	7909	8077	8245	8413	8413	8413	8413
Payment of Deferred Interest	244	244	244	244	244	244	244	244
Construction Expenditure	7522	7522	7522	7522	7522	7522	7522	7522
Total Uses	25318	26723	27994	29298	31635	32836	34073	35345
Cash Balance	4211	7708	5062	11340	10521	11317	13754	17855

TABLE 3 BALANCE SHEET

TYPICAL PHASE II PBS

	10	11	12	13	14	15	16	17
Plant in Service	173357	180879	188401	195923	203445	210967	218489	226011
CWIP	0	0	0	0	0	0	0	0
Total Utility Plant	173357	180879	188401	195923	203445	210967	218489	226011
Accumulated Depreciation	30309	35676	41271	47094	53145	59424	65931	72666
Net Utility Plant	143048	145203	147130	148829	150300	151543	152558	153345
Cash	4211	7708	5062	11340	10521	11317	13754	17855
Total Assets	147259	152911	152192	160169	160821	162860	166312	171200
Margins and Equities	(12418)	(9281)	(4805)	1037	7271	14999	24249	35046
Loan Balance	153568	156327	151376	153755	148417	142972	137418	131753
Payables	6109	5865	5621	5377	5133	4889	4645	4401
Total Liabilities	147259	152911	152192	160169	160821	162860	166312	171200

Table 4 Summary Cost - For a Phase II PBS

In Million Taka

		Qty	L.C.	F.E.	Total
1.	Line Material	525	1.310	36.300	37.610
2.	Line Rehabilitation Material	178	0.180	0.990	1.170
3.	Substations	3.5	-	11.660	11.660
4.	Distribution Transformers	1188	-	6.630	6.630
5.	Line Protection	-	-	1.550	1.550
6.	Service Connection	13008	-	7.485	7.485
7.	Spares	-	-	.540	.540
8.	Street Lighting	100	-	0.080	0.080
9.	General Plant	-	11.430	1.880	13.311
10.	Line Installation	525	9.460	-	9.460
11.	Rehabilitation	178	.880	-	.880
12.	Substation Installation	3.5	2.280	-	2.280
13.	Engineering & Supv.	-	4.000	-	4.000
	Subtotal		29.540	67.115	96.655
14.	Expatriates		2.270	11.305	13.575
15.	Support Commodity		.620	2.478	3.098
	Subtotal		32.430	80.900	113.330
16.	Insurance		730	-	.730
17.	Landing Charges		4.370	-	4.370
18.	REB Overhead		0.500	0.250	.750
19.	Adjustment to 1981 Prices		-	8.007	8.007
20.	Contingency		2.370	6.190	8.560
	TOTAL		40.400	9[illegible].347	13[illegible].747

Tk. 16 = $US 1

REB Organization and Staffing

The REB Ordinance (No. L1 of 1977) identified the functions of the Board in its mission to bring electric service to the rural areas of Bangladesh. The Orginance provides that the Board be composed of a full-time Chairman and three full-time members to be appointed by the Government, plus four part-time members, one each to be appointed by the PDB, BADC, BSCIC and IRDP. The Ordinance provides that the Chairman and other members shall perform such functions and exercise such powers as the Board may assign them from time to time. In the interest of good management practice the Chairman and each of the three full-time members are assigned to a specific area of responsibility within the framework of the REB organization plan outlined in brief below:

1. Chairman: The Chairman is the Chief Executive of the Board and is responsible for the overall development, management and administration of REB and its affiliated establishments (PBS's etc.) to carry out the rural electrification program as defined in the Ordinance. He will plan, organize, direct, coordinate and control all facets of the program and REB administration through appropriate delegations, whereever needed, to the Member (Engineering), Member (Finance), Member (PBS and Training) and other officers. He will monitor the progress and take corrective steps, if need be, in order to achieve the assigned tasks in consultation with the appropriate authority in the Government. He will, in addition, exercise such other authority of the Board as may be delegated/assigned to him by the Board from time to time.

2. Member (Engineering): The Member (Engineering) will be responsible to the Chairman and the Board for the following functions and assignments and will exercise such authority, in order to fulfil his tasks, as may be delegated to him from time to time.

   a) The Member will have overall charge of the department placed under him in the REB establishment.

   b) The efficient management and administration of his department as assigned in the REB establishment.

c) The engineering system design for REB/PBS.

d) Standards and specifications for equipment and material for electrical and civil projects.

e) Tendering for services and processing of contracts for REB/PBS engineering consultants.

f) Tendering for all engineering project works as directed by the Board.

g) The requisition, customs clearance, inspection, custody, issue and movement of line and building equipment and material as approved by the Board.

h) PBS engineering studies, power supply, electrical operations, electrical maintenance and repair of major equipment.

i) International and local procurement of equipment and material and supplies as approved/directed by the Board.

j) Such other responsibilities as may be assigned by the Chairman or the Board.

3. Member (Finance): The Member (Finance) will be responsible to the Chairman and the Board for the following responsibilities and assignments and will exercise such authority, in order to fulfil his tasks, as delegated to him from time to time.

a) The Member will have overall charge of the department placed under him in the REB establishment.

b) The efficient management and administration of his department as assigned in the REB establishment.

c) Assisting the Chairman, in financial planning and to obtain sufficient capital, including foreign financing, in the various phases of the rural electrification program.

d) The internal accounting and financial control of REB funds according to the utility uniform system of accounts as adopted by the Board.

e) The consolidation and preparation of the annual REB budget for submission to the Board.

f) The preparation of the necessary financial reports as required.

g) PBS loans, accounting systems, financial planning and periodic audit, as laid down by the Board.

h) Such other responsibilities as assigned by the Chairman or the Board.

4. Member (PBS & Training): Will be responsible to the Chairman and the Board for the following responsibilities and assignments and will exercise such authority, in order to fulfil his tasks, as delegated to him from time to time.

a) The Member will have overall charge of the department placed under him in the REB establishment.

b) The efficient management and administration of his department as assigned in the REB establishment.

c) The development and organization and the establishment of boundaries of PBS's in the several districts of the country as approved by the Board.

d) The establishment and enforcement of PBS electric service regulations which lay down the terms and conditions under which PBS members will receive electric service from a PBS.

f) The development and administration of an REB training institute for orientation and training of all levels of leaders and employees in all facets of the Rural Electrification Program as directed by the Chairman and the Board.

g) Such other responsibilities as may be assigned by the Chairman or the Board.

5. Part-time Members: The four part-time members shall serve as a liaison for their respective organization and in an advisory capacity to the full-time members.

6. Secretary: The Secretary of the REB will be responsible to the Chairman and the Board for the following responsibilities and assignments and will exercise such authority, in order to fulfil his tasks, as delegated to him from time to time.

a) The efficient management and administration of the Board Secretariat and Board affairs.

b) Su h other department as may be assigned by the Chairman or the Board from time to time.

c) Such other responsibilities as assigned by the Chairman.

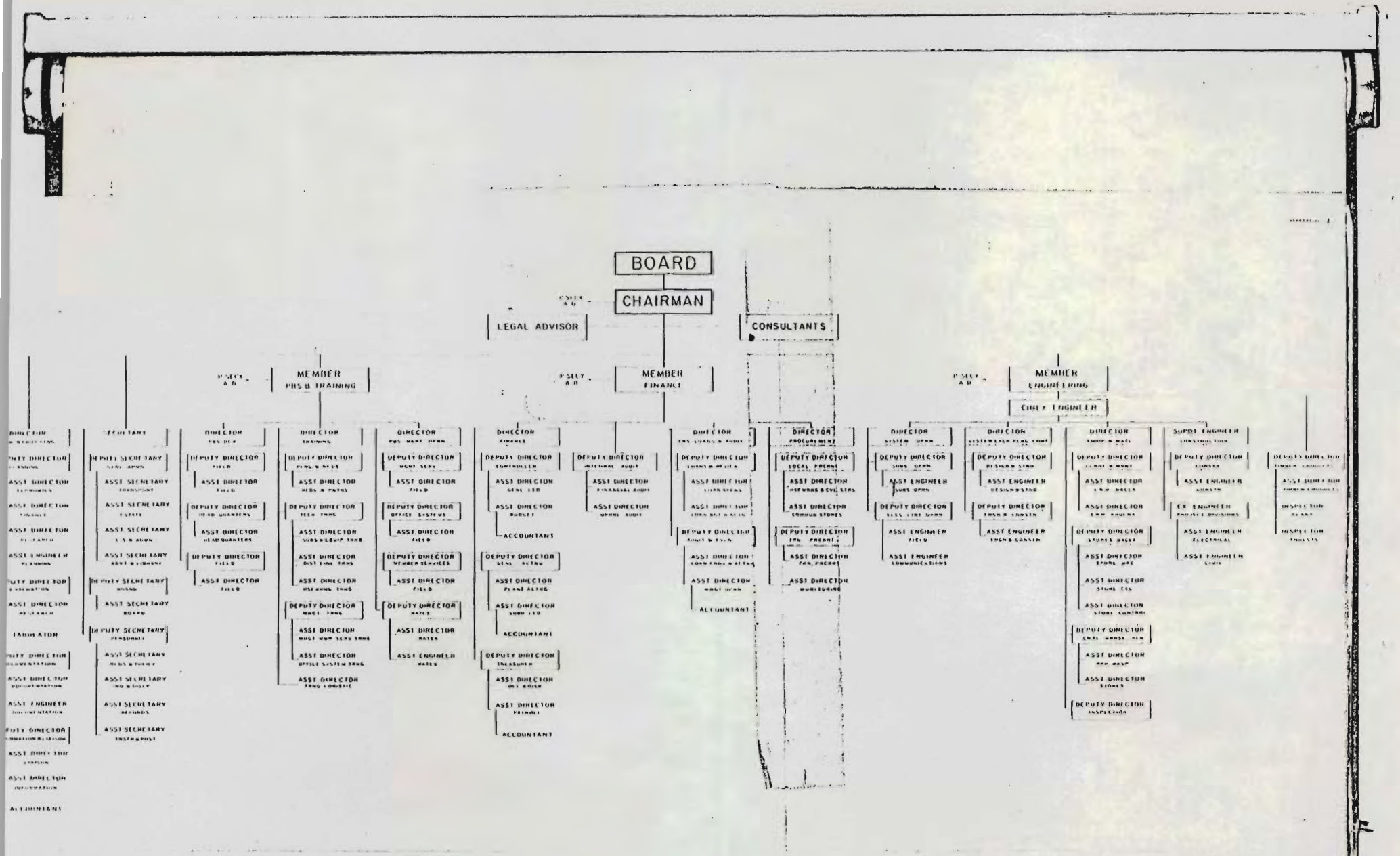
The organization of the REB is as follows:

TABLE 1 REB Staffing

The REB staffing requirements are determined by the scope of authority and functions of the board as defined by the REB Ordinance; the member of PBS in operation and under construction.

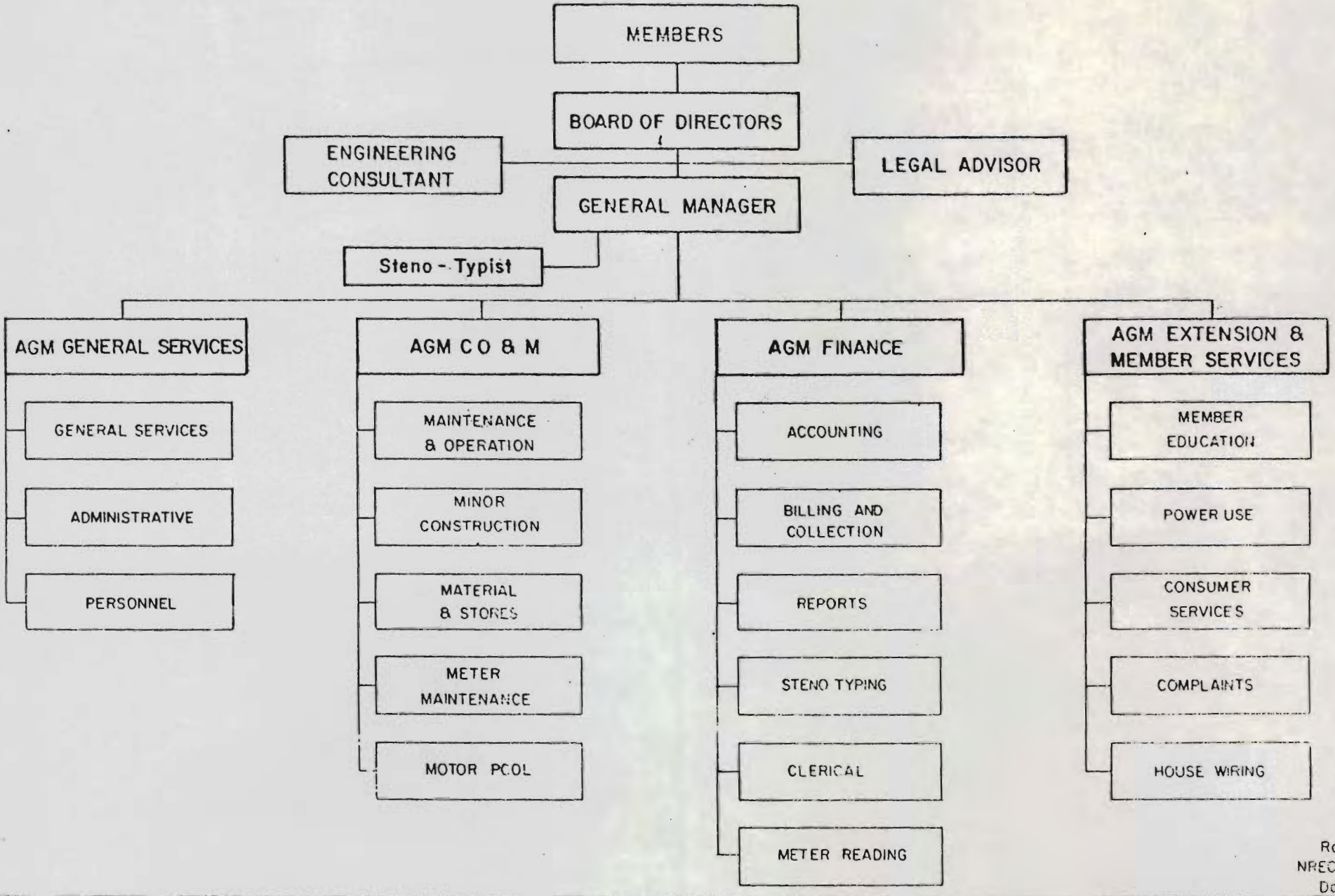
	Sanctioned (3/81)	Required (Phase II Program)
Chairman	1	1
Member	3	3
Chief Engineer	1	1
Director/Secretary	11	11
Superintending Engineer	1	1
Deputy Director/Secretary	36	35
Executive Engineer 1/	6	15
Assistant Director/Secretary 2/	64	66
Assistant Engineer 1/	28	40
Accountant	15	15
Sub-Assistant Engineer 3/	28	40
Tabulator	1	1
Inspector	4	4
Assistant Accountant	15	15
Upper Division Assistant	16	16
Private Secretary	4	4
Draftsman	4	4
Lab. Technician	2	2
Storekeeper	3	3
Clerical and other 4/	63	70
Drivers 4/	40	49
Peon/Messenger 4/	27	36
Guard 4/	23	32
	396	453

1/ Increase for new PBS construction
2/ Assistant Director Finance, Planning; Assistant Director Advertisement and Library, Secretariat
3/ Increase for new PBS Construction - 9, Training - 3
4≠ Increase for new PBS construction and additional staff positions.


BOARD
CHAIRMAN
LEGAL ADVISOR
CONSULTANTS
MEMBER
PRS & TRAINING
MEMBER
FINANCE
MEMBER
ENGINEERING
CHIEF ENGINEER
DIRECTOR
DEPUTY DIRECTOR
ASST DIRECTOR
ASST ENGINEER
DEPUTY SECRETARY
ASST SECRETARY
ACCOUNTANT
TABULATOR
SUPDT ENGINEER
EX ENGINEER
INSPECTOR

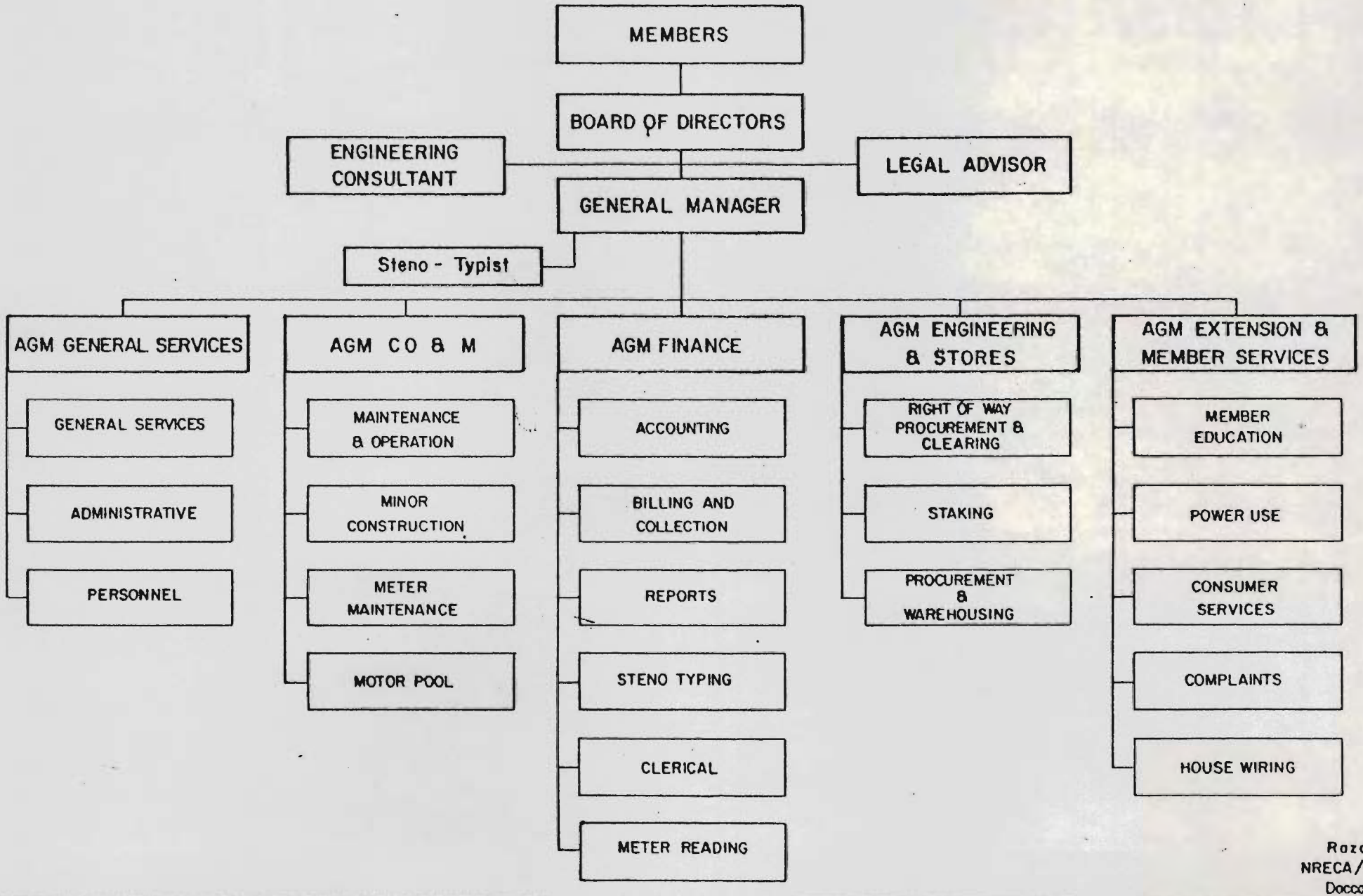
ORGANIZATION CHART
PALLI BIDYUT SAMITY

(UNDER 30,000 METERS)



Rozo
NRECA/CA
Dacca.

ORGANIZATION CHART
PALLI BIDYUT SAMITY
(UNDER 50,000 METERS)



Raza
NRECA/CAI
Dacca.

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

U.S. suppliers/manufacturers are likely to be awarded sizeable contracts. U.S. standards and specifications are being used for all off-shore commodity procurement. Under RE I, 80 of imported commodities were U.S. products. Also, about $12.7 million of technical services will be provided by private U.S. sources.

9. FAA Sec.612(b);Sec.636(h). Describe steps taken to ensure 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 to meet the cost of contractual and other services.

The host country contribution is 27% of the total project cost and 88% of total local currency cost.

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?

No

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. App. Act. If assistance is for the production of any commodity for export, is the commodity for export 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

B. FUNDING CRITERIA FOR PROJECT

1. Development Assistance Project Criteria

a) FAA Sec.102(a);111;113; and 281a. 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 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?

(a) Rural electrification will promote irrigation, rural industries and community services, creating employment for the rural poor and improving health and family planning service centers.

(b) The development of local rural electric cooperatives (PBS's) is a key element of the project.

(c) Local construction and manufacturing will be developed.

(d) Women serve on PBS Boards of Directors. They also benefit from employment in rural industries.

b) FAA Sec.103, 103A, 104, 105, 106, 107.
Is assistance being made available:(include only applicable paragraph which corresponds to source of funds used. If more than one fund source is used for project, include relevant paragraph for each fund source).

1. (103) for agriculture, rural development or nutrition; if so, extent to which activity is specifically designed to increase productivity and income of rural poor; (103A) if for agricultural research, is full account taken of needs of small farmers and extensive use of field testing to adapt basic research to local conditions shall be made (b) extent to which assistance is used in coordination with efforts carried out under Sec. 104 to help improve nutrition of the people of developing countries through encouragement of increased production of crops with greater nutritional value, improvement of planning, research and education with respect to nutrition, particularly with reference to improvement and expanded use of indigenously produced foodstuffs; and the undertaking of pilot or demonstration programs explicitly addressing the problem of malnutrition of poor and vulnerable people; and (c) extent to which activity increases national food security by improving food policies and management and by strengthening national food reserves, with particular concern for the needs of the poor, through measures encouraging domestic production, building national food reserves, expanding available storage facilities, reducing post harvest food losses, and improving food distribution.

Rural electrification will increase rural irrigation, HYV cultivation and food production. This will increase demand for rural industry and services to provide agricultural input and process foodstuffs. Increased rural production will generate rural employment.

2. (104) for population planning under Sec.104(b) or health under Sec.104(c); if so, extent to which activity emphasizes low-cost, integrated delivery systems for health, nutrition and family planning for the poorest people, with particular attention to the needs of mothers and young children, using paramedical and auxiliary medical personnel, clinics and health posts, commercial distribution systems and other modes of community research.

Electrification of health centers will make possible the use of refrigerators, lab equipment, sterilizing equipment, etc. and will provide adequate lighting for better health and family planning care.

3. (105) for education, public administration, or human resources development; if so, extent to which activity strengthens nonformal education, makes formal education more relevant, especially for rural families and urban poor, or strengthens management capability of institutions enabling the poor to participate in development; and (b) extent to which assistance provides advanced education and training of people in developing countries in such disciplines as are required for planning and implementation of public and private development activities.	(a) The rural consumers of electricity are members of the PBSs represented by elected boards and thus influence PBS operations. (b) Extensive institution building and training programs (technical and administrative) are a key factor of this project (PP I.C. and IV.B).
4. (106) For technical assistance, energy, research, reconstruction, and selected development problems; if so, extent activity is: (i) (a) concerned with data collection and analysis, the training of skilled personnel, research on and development of suitable energy sources, and pilot projects to test new methods of energy production; and (b) facilitative of geological and geophysical survey work to locate potential oil, natural gas, and coal reserves and to encourage exploration for potential oil, natural gas, and coal reserves.	(a) REB training programs will turn out skilled administrative and technical personnel. Systematic data collection is incorporated. (b) N/A.
(ii) technical cooperation and development, expecially with U.S. private and voluntary, or regional and international development organizations;	U.S. private sector provides technical services for project. World Bank plans to provide about $50 million for rural electrification.
(iii) research into, and evaluation of, economic development processes and techniques;	Project includes related studies and evaluations.
(iv) reconstruction after natural or man-made disaster;	N/A.
(v) for special development problems, and to enable proper utilization of earlier U.S. infractructure, etc., assistance;	N/A.
(vi) for programs of urban development, especially smaller labor-intensive enterprises, marketing systems, and financial or other institutions to help urban poor participate in economic and social development.	N/A.

c) (107) is appropriate effort placed on use of appropriate technology? (relatively smaller, cost saving, labor using technologies that are generally most appropriate for the small farms, small business, and small incomes of the poor).	Rural electricity is appropriate for small cost saving technologies for irrigation and small businesses.
d) FAA Sec. 110(a). Will the recipient country provide at least 25% of the costs of the program, project, or activity with respect to which the assistance is to be furnished (or has the latter cost-sharing requirement been waived for a "relatively least-developed" country)?	Yes, 27%, even though Bangladesh is a relatively least developed country.
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"?	Yes, for 6 years, Bangladesh is relatively least developed.
f) 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 institutional development and supports civil education and training in skills required for effective participation in governmental and political processes essential to self-government.	This project promotes the development of government institutions (REB) and rural electric cooperatives (PBS's).
g) 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?	Yes, substantial increase in irrigation potential thru electrification of pumps.
2. Development Assistance Project Criteria (Loans Only)	N/A, all grant.
a) FAA Sec.122(b). Information and conclusion on capacity of the country to repay the loan, at a reasonable rate of interest.	
b) FAA Sec.620(d). If assistance is for any productive enterprise which will compete with U.S. enterprise, 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.
3. Project Criteria Soleiy for Economic Support Fund	Yes, through rural economic development.
a) FAA Sec. 531(a). Will this assistance support promote economic or political stability? To the extent possible, does it reflect the policy directions of Section 102?	
b) FAA Sec.533. Will assistance under this chapter be used for military, or paramilitary activities?	No

ANNEX M

BANGLADESH
RURAL ELECTRIFICATION II PROJECT

CERTIFICATION PURSUANT TO SECTION 611(e) OF THE FOREIGN ASSISTANCE ACT OF 1961, AS AMENDED

I, Frank B. Kimball, Mission Director, the principal officer of the Agency for International Development in Bangladesh, having taken into account, among other things, the maintenance and utilization by the Bangladesh Government and its agencies of projects previously financed by the United States, do hereby certify that in my judgement Bangladesh has the financial and human resources capability to utilize effectively the project to be financed by this grant.

This judgement is based upon considerations discussed in the Project Paper to which this certification is attached.

_____

Frank B. Kimball
Director

_____

Date

From: M.A. Matin Lasker,
Deputy Secretary.

ANNEX N

External Resources Division
Ministry of Finance
Sher-e-Bangla Nagar
Dacca-7

D.O. No. ERD/USA(P)-8/75/203

Date June 11, 1981.

Sub:-Request for Financial Assistance for the proposed Rural Electrification Phase-II Project.

Dear Mr. Kimball,

You are aware that the US Government has till now provided assistance to the tune of $ 69.3 million for the Rural Electrification Project which enabled the Bangladesh Government to provide electricity to a large section of the rural people and also to small rural industries.

In this connections you may please refer to the various meetings held between the USAID and the concerned authorities of Bangladesh Government wherein the necessity to enlarge the project activity was felt. In order to enlarge the Rural Electrification programme, a second phase of this project is required to be implemented with US assistance.

It has accordingly been assumed that an additional fund of $ 50 million would be required for the phase II of RE project. Since electrification programme in the rural areas will be beneficial for the major protion of the country's population, the Government attaches much importance to increasing the present programme through implementing the second phase. I understand the relevant project documents will be finalized shortly through mutual consultation between GOB agencies and AID.

We would, therefore, request you to kindly approach the US Government to provide a grant of $ 50 million for the Rural Electrification Phase-II Project & arrange required funding at an early date.

With regards,

Yours sincerely,

11.6.81

(M. A. Matin Lasker)

Mr. Frank B. Kimball,
Director,
USAID Mission to Bangladesh,
Jibon Bima Bhaban (4th Floor),
10, Dilkusha C.A., Dacca.

ANNEX 0

AGENCY FOR INTERNATIONAL DEVELOPMENT

PROJECT IDENTIFICATION DOCUMENT FACESHEET

TO BE COMPLETED BY ORIGINATING OFFICE

1. TRANSACTION CODE: A (A = Add, C = Change, D = Delete)

PID

2. DOCUMENT CODE: 1

3. COUNTRY/ENTITY: BANGLADESH

4. DOCUMENT REVISION NUMBER: N.A.

5. PROJECT NUMBER (7 DIGITS): 388-0054

6. BUREAU/OFFICE: A. SYMBOL: ASIA; B. CODE: 04

7. PROJECT TITLE (MAXIMUM 20 CHARACTERS): Rural Electrification II

8. PROPOSED NEXT DOCUMENT

A. 3 (2 = PRP, 3 = PP)

B. DATE: MM 03, YY 81

9. ESTIMATED FY OF AUTHORIZATION/OBLIGATION

a. INITIAL FY 81

b. FINAL FY 82

10. ESTIMATED COSTS ($000 OR EQUIVALENT, $1 = Tk. 15)

FUNDING SOURCE	AMOUNT
A. AID APPROPRIATED	43000
B. OTHER U.S. 1.	
B. OTHER U.S. 2.	
C. HOST COUNTRY	14000
D. OTHER DONOR(S)	
TOTAL	57000

11. PROPOSED BUDGET AID APPROPRIATED FUNDS ($000)

A. APPROPRIATION	B. PRIMARY PURPOSE CODE	PRIMARY TECH. CODE C. GRANT	PRIMARY TECH. CODE D. LOAN	E. FIRST FY 81 F. GRANT	E. FIRST FY 81 G. LOAN	LIFE OF PROJECT H. GRANT	LIFE OF PROJECT I. LOAN
(1) FN	263	062		20,000		43,000	
(2)							
(3)							
(4)							
			TOTAL	20,000		43,000	

12. SECONDARY TECHNICAL CODES (maximum six codes of three positions each)

13. SPECIAL CONCERNS CODES (MAXIMUM SIX CODES OF FOUR POSITIONS EACH)

CODE

14. SECONDARY PURPOSE CODE

15. PROJECT GOAL (MAXIMUM 240 CHARACTERS)

Improved rural standards of living.

16. PROJECT PURPOSE (MAXIMUM 480 CHARACTERS)

Provision of reliable electric service at reasonable rates to rural residents especially the rural poor, existing and potential sources of rural employment and community service facilities in all project areas.

17. PLANNING RESOURCE REQUIREMENTS (staff/funds)

Estimated 2 months of AID/Wash. TDY support.

18. ORIGINATING OFFICE CLEARANCE

Signature: Frank B. Kimball

Title: Director, USAID/Bangladesh

Date Signed: MM 8, DD 3, YY 79

19. DATE DOCUMENT RECEIVED IN AID/W, OR FOR AID/W DOCUMENTS, DATE OF DISTRIBUTION

MM DD YY

AID 1330-2 (3-76)

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COPY

ANNEX - P

TELEGRAM

UNCLASSIFIED

ACTION : AID

INFO : AMB DCM CHRON

P 080045Z NOV 79

FM SECSTATE WASHDC

TO AMEMBASSY DACCA PRIORITY 0883

BT

UNCLS STATE 291275

AIDAC

E.O. 12065 : N/A

SUBJECT : APAC Review - Rural Electrification II PID - 388-0054

REFS : (A) State 255983, (B) Dacca 6896, (C) State 277132

Subject PID was approved in APAC review held October 17, Following guidance is provided for PP design, in addition to design issues raised in reftel (A).

1. Need for Energy Survey: Appreciate Mission's desire to limit analysis of energy needs/sources to that required for establishing feasibility of this project. APAC agrees approval of RE II should not repeat not be

UNCLASSIFIED

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linked to a comprehensive analysis of traditional and alternative energy resources and needs. In view of the increasing emphasis in the AID legislation on the importance of tapping alternative energy sources, we believe any expansion of an AID supported Rural Electrification program must address the practical energy alternatives for short to medium term needs in areas proposed for coverage. Therefore, the project paper analysis should place the selection of electrification in the context of alternative energy sources and the matching of energy supply and end use needs in project areas. Alternative sources obviously include natural gas but also and specifically the potential for renewable resources. (As the energy PID itself points out, traditional fuels provide approximately 74 percent of Bangladesh energy requirements.) We leave it up to the Mission to decide the extent of analysis required, but this would, at a minimum, entail expansion of the analysis of costs and benefits in comparison to development of alternative sources. The discussion, however, should address both the pace and potential of renewable and alternative energy sources in the prospective project areas, particularly as it would affect the choice of electrification in FY 81. Comparison of electrification with alternative energy sources should also be part of

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the specific feasibility analysis for site selection of each Rural Electrification area. Again we emphasize that the scope and extent of this analysis is up to the Mission. What the PP needs to do is make the case in FY 81 that expanded Rural Electrification is the logical source to provide the energy required for the purposes addressed in the project.

2. Evaluation of Socio-Economic Impact : APAC recognizes that definitive measurable impact, especially in terms of employment and production, will not be possible for several years. PP, however, should include as much evaluative data on RE I as is possible and establish data/benchmarks for RE II. AID/W will provide assistance to ensure that upcoming phase I evaluation of RE I will focus on establishing baseline data essential for eventual measurement of socio-economic impact. Reftel (C) provided suggested changes to scope of work for this Phase I evaluation. AA and DAA also believe that long term evaluation effort of Rural Electrification program should be considered a joint Mission/Asia bureau evaluation and that Asia bureau rep should participate in a wrap-up evaluation to be done prior to submission of PP.

3. FY 80 amendment : Although not a part of RE II, the APAC briefly reviewed the requirements for potential approval of the proposed dols. 21 million FY 80 amendment to RE I. Essentially what would be required is an amended PP which provides in as much detail as possible the record of achievement of RE I to date against the original project targets. This should also be set in context of the proposed objectives or targets of the amended project. We recognize that at the point where the FY 80 amendment is reviewed no systems will have been electrified.

However, data on the numbers, categories and income of users who have signed up will be most important. We need to show that RE I appears to be heading in the right direction with respect to the target beneficiary groups and that we have a track record to take to congress when the congressional notification goes forward. The APAC noted the importance of making the strongest case possible so that the potential for negative response is minimized. The congressional reaction to this amendment may well create the setting for the response to RE II in FY 81.

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4. Pole Procurement: In view of the high costs of importing treated poles, and with the view that an essential result of these AID financed projects will be the development of a continuing domestic Bangladesh capacity for expansion of Rural Electrification, it is essential that the PP address fully the alternative of domestic availability and capacity to produce wood or other types of poles. At the time of the FY 77 project, all parties were agreed that an attempt to resolve all the issues necessary for domestic pole production would unacceptably delay the initial project. Rural Electrification I, however, has provided a grace period within which those problems can now be addressed. Accordingly, we consider it imperative that the Mission make every effort to put RE II on a domestic procurement basis for poles. At least the first steps in this process should also be reflected in the FY 80 dols. 21 million amendment. In the absence of information on results of current efforts, we hesitate to suggest at this point that approval of RE II in particular, but also of the FY 80 amendment, will be conditioned upon progress toward (in FY 80), and total reliance on (in the FY 81 project), domestic production. We can at least say, how-

ever, that in the absence of overriding justification in RE II for imported pole procurement, the project will not be approved.

5. Absorptive Capacity : This will be a key issue for PP. APAC agrees that Mission should continue to review this closely and demonstrate during PP design that institutional structure can handle additional inputs.

6. Financial Plan: Dols. 10 million for contingencies (p.7) seems high for total US FX input of Dols. 38.2 million. Dols. 5 million for TA also appears high. It must be assumed at this time that the large RE I invest ment in TA is producing results in establishing institutional and technical capacity and that TA requirements will decrease as the program matures. Increased capability within Bangladesh should be reflected in reduced TA requirements for RE II and, in particular, expatriate needs should be critically analyzed to keep this component to minimum. Assume Dols. 22 million in FX for construction commodities includes cost of imported poles and that this figure could change dramatically with local pole procurement. We recognize that budget shown is preliminary and that full explanation and justification of these and other items in more

detailed financial plan should be presented in PP. PP should clarify and fully justify all of these items. Also, as indicated in state 269439, PP should identify inflation factor for each major category in financial plan.

7. IEE : Mission's April 2, 1979, paper now received. Bureau environmental officer plans to review environmental issues that have been addressed in similar projects in Indonesia and Philippines during forthcoming TDY. Will advise in early December. VANCE

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ANNEX Q

THANA MAP OF BANGLADESH

SCALE 1 = 15·783 MILES

AREA COVERAGE RURAL ELECTRIFICATION, PHASE - I (AID)

AREA COVERAGE RURAL ELECTRIFICATION, PHASE - I (EXTENSION) (KUWAIT)

AREA COVERAGE RURAL ELECTRIFICATION, PHASE - IIa (AID, World Bank)

33 KV TRANSMISSION LINE ..... EXISTING ——— UNDER/CON. - - - - PROPOSED ——·——