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

PROJECT PAPER

Proposal and Recommendations
For the Review of the
Development Loan Committee

388-021

BANGLADESH - RURAL ELECTRIFICATION

AID-DLC/P-2232

AGENCY FOR INTERNATIONAL DEVELOPMENT

PROJECT PAPER FACESHEET

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10. ESTIMATED COSTS ($000 OR EQUIVALENT $1 - Tk 15

A. FUNDING SOURCE	FIRST FY B. FX	FIRST FY C. L/C	FIRST FY D. TOTAL	LIFE OF PROJECT E. FX	LIFE OF PROJECT F. L/C	LIFE OF PROJECT G. TOTAL
AID APPROPRIATED TOTAL	15,715	285	16,000	45,170	4,830	50,000
(GRANT)	( )	( )	( )	(29,455)	(4,545)	(34,000)
(LOAN)	(15,715)	(285)	(16,000)	(15,715)	(285)	(16,000)
OTHER U.S. 1.						
OTHER U.S. 2.						
HOST COUNTRY	-	2,750	2,750	-	16,667	16,667
OTHER DONORS						
TOTALS	15,715	3,035	18,750	45,170	21,497	66,667

11. PROPOSED BUDGET APPROPRIATED FUNDS ($000)

A. APPROPRIATION	B. PRIMARY PURPOSE CODE	PRIMARY TECH. CODE C. GRANT	PRIMARY TECH. CODE D. LOAN	E. 1ST FY__ F. GRANT	E. 1ST FY__ G. LOAN	H. 2ND FY__ I. GRANT	H. 2ND FY__ J. LOAN	K. 3RD FY__ L. GRANT	K. 3RD FY__ M. LOAN
(1) F & N	263	062			16,000	21,000		13,000	
(2)									
(3)									
(4)									
TOTALS					16,000	21,000		13,000	

A. APPROPRIATION	N. 4TH FY 80 O. GRANT	N. 4TH FY 80 P. LOAN	Q. 5TH FY 81 R. GRANT	Q. 5TH FY 81 S. LOAN	LIFE OF PROJECT T. GRANT	LIFE OF PROJECT U. LOAN
(1) F & N	-	-	-	-	50,000	-
(2)						
(3)						
(4)						
TOTALS					50,000	

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BANGLADESH
RURAL ELECTRIFICATION
FY 1977 PROJECT PAPER

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Definitions and Terms

Geographic /Political Divisions

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

Union - Subdivisions within Thanas (10-20 Unions/Thana)

Government Agencies

BADC - Bangladesh Agricultural Development Corporation, Government Corporation responsible for supplying all 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 multi-purpose cooperatives.

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

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

REB - Bangladesh Rural Electification Board, new agency to assume responsibility for all rural electrification distribution.

TP - Thana Parishad, comprised of elected Union representatives.

Currency

Paisa - 1/100th of One Taka.

Taka - Bangladesh Taka, the assumed exchange rate being Taka 15 = $1.00.

$ - U.S. Dollar

Terms

AAC	-	All Aluminum Conductor
ACSR	-	Aluminum Cable, Steel Reinforced
AMP	-	Ampere
Cusec	-	Cubic feet per second
DTW	-	Deep Tube Well
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 Tube Well
V	-	Volt

BANGLADESH - RURAL ELECTRIFICATION
(388-0021)

RECOMMENDATION AND SUMMARY

A. Recommendation

It is recommended that financing be provided to the Government of Bangladesh ("the Government") for a rural electrification project as described in this Project Paper.

B. Project Funding - AID Funds and Government Contribution

1. AID - $50.0 million, including $16 million loan and $34 million grant. Total foreign exchange requirements are estimated at $45.17 million, the balance of $4.83 million equivalent to be applied to local currency costs.

2. The Government - Minimum contribution of $16.667 million equivalent.

C. Description of the Project

The project provides for construction of 4,000 miles of 11 KV or less distribution line and 24 substations, and rehabilitation of 300 miles of line and five substations, to be owned and operated by 12 local cooperative-type organizations (PBSs) in six project feasibility areas. The Rural Electrification Board (REB), proposed implementing agency for this project, is being established to administer both this project and all future rural electricity distribution activities in Bangladesh.

D. Issues

None.

E. Statutory Criteria

The grant meets all statutory criteria (see Annex M).

F. Project Committees

1. AID Mission

Gordon H. West, Chairman, PDD
James E. Gardner, ENG
W. Thomas Oliver, PRO
Gene C. McCoy, CONT
Douglas D. Robertson, RLA

2. AID/Washington

Rufus Long, ASIA/PD, Chairman
Wilson Hodgin, SER/ENGR
Peter Bloom, GC/ASIA
Robert Meehan, ASIA/DP

Part I - Background, Justification and Detailed Description

A. Background

At the time of the partition of India in 1947, the area which then became East Pakistan (EP) was virtually without electricity, having a total electrical generating capacity of 21 MW and a per capita electricity consumption of approximately .33 KWH per month. The EP Electricity Directorate existed as a coordinating and regulating agency, but with the exception of some minor facilities, it neither owned nor was directly involved in power generation. There was no power transmission at that time in the country, and virtually all load capacity consisted of captive facilities. The major aim of the initial 1950-60 EP power program therefore was directed toward the first step of securing generation capacity through nationalization of private power systems and incorporation of these systems into a national network. These actions were facilitated in 1960 when the Electricity Directorate was merged into the newly-created EP Water and Power Development Authority(WAPDA). This organization was created with authority for construction and operation of all power facilities - generation, transmission and distribution.

During Pakistan's Second Plan (1960-65) nationalization of the power system was completed through purchase of the remaining private utilities. WAPDA at the same time undertook expansion and improvement of the transmission and distribution facilities. While distribution investments were primarily channeled to industrial and agricultural development projects offering high economic returns, the Comilla Kotwali Pilot Electrification Scheme was initiated at this time, the experience of which is to provide a control measurement for evaluation of this project (see Part VI).

In 1964 the AID-financed Master Plan for Power Development in East Pakistan was prepared by the International Engineering Company and this Plan generally provided the basis for the power recommendations of the Pakistan Third Plan (1965-70). At that point, while generation exceeded the capacity of transmission and distribution facilities to deliver power, much of the national system was still composed of scattered small supply systems. Expansion of distribution therefore was postponed in favor of development of a national generation and transmission grid.

Although Pakistan's Fourth Plan (1970-75) was formulated for the united country, the political changes following the independence of Bangladesh did not substantially alter the emphasis of power development for East Pakistan - now Bangladesh - although the disturbances of 1971-72 did prevent or delay project implementation. One result, however,was the cancellation of a contract between USAID/Pakistan and NRECA for a preliminary study of rural electrification for East Pakistan. Another was the 1972 division of WAPDA into separate agencies responsible for water and electric power. The Bangladesh Power Development Board (PDB) under the Ministry of Flood Control, Water Resources and Power was established at that time and remains the implementing agency for the electric power sector.

The early 1970s power program was focussed on rehabilitation of war damaged facilities 1/, with the current "Total Electrification Program" initiated in 1975. The first stage of "Total Electrification" to be completed in 1978, primarily involves extension of the grid into every Thana in the country. With the exception of an east-west connector to join the two major sections of the grid, Bangladesh now has both a sufficient transmission system and generation capacity to support a national system. The "Total Electrification" concept however looks beyond the grid to development of the basic distribution facilities for effective delivery of power to all users in the rural areas. It is to this purpose that the Bangladesh Government has requested AID to provide assistance in development of the rural power distribution system.

B. Project Justification

1. Rural Employment

The distribution phase of Bangladesh's "Total Electrification Program" will take both time and large investment before it has major effect in the rural areas. A beginning is essential however if there is to be a prospect of achieving a basis for sustained rural development, a key to which is rural employment. In Bangladesh, putting to work at least some of the enormous surplus of unemployed rural poor is a condition to any concept of rural growth. Equally, the failure to do so will jeopardize the success of even the best of rural development efforts.

1/ AID contributed $18.3 million toward this effort through the Relief and Rehabilitation Grant.

In 1975 it was estimated that 40 percent, or 8.3 million of the 21.1 million people in the agricultural labor force, were unemployed 2/. This represented an average of 130 unemployed or underemployed workers in each of Bangladesh's 65,000 villages. Given 1) the current estimate that nine million fifteen-year-olds will enter the Bangladesh labor force during the next decade, of whom approximately 93 percent will initially need employment in the rural sector, and 2) an optimistic growth rate in cereal production of 5.5 percent annually, it is estimated that unemployment in the agricultural sector alone 3/ will increase by a minimum of three million persons over the next decade, 4/ with a significant percentage of those able to find employment being seriously underemployed.

To place the issue in its immediate context, recent statistics suggest that up to 50 percent of the rural population may in fact be landless and that the percentage is increasing (see Part II.A, Social Analysis). Even if agricultural yields were to increase

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2/ Includes "underemployed" as representing laborers unable to find work for at least four months of the year or holding part-time employment providing below-subsistence wages.

3/ The agricultural sector currently accounts for 85 percent of the rural labor force. No reliable statistics are available on trends in rural non-agricultural unemployment. However, most untrained, unemployed rural workers are included in the agricultural sector labor statistics.

4/ "Agricultural Employment in Bangladesh", Government of Bangladesh - FAO/UNDP Mission Working Paper II, April 1977. The actual rate of rural unemployment increase will be over five million persons if production increase continues at the current level of between 1.0 and 3.0 percent per year.

greatly, this trend may continue. Quoting from "Agricultural Employment in Bangladesh": 5/

> "A review of evidence on the impact of the seed fertilizer revolution on agricultural employment suggests that previous reviews of agricultural employment have been over optimistic. The evidence does not support employment elasticities (the change in employment resulting from a unit change in productivity per acre)of more than 0.5 for the switch to high yielding varieties. Some changes in cropping patterns resulting in the introduction of high yielding varieties may actually decrease aggregate employment.... The available evidence points to the unambiguous conclusion that the agricultural employment situation has been deteriorating and that a production oriented strategy even with the present largely nonmechanized technology will not improve the situation in the foreseeable future."

Thus, while fertile land is one of Bangladesh's [illegible]test resources, expansion of HYVs alone will not be enough to o[illegible]e steady increase in population. Consequently almost one half of the rural population may soon be without either land or compensating employment unless employment opportunity is expanded through increased cropping or growth in rural non-farm production.

Concern about employment is two-fold. First, a policy of full employment is a prerequisite for maximum utilization of resources given Bangladesh's massive labor surplus. Second, increased employment is equally a condition to improvement in the welfare of the rural poor. Regardless of the amount of investment provided for rural social and physical infrastructure, if this infrastructure does not promote the income generating capacity of the rural poor, these services and resources will continue to benefit the better off and stronger in the rural sector.

A number of Asian countries 6/ have effectively utilized their expanding labor force and a rural full employment policy both to

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5/ Op. cit.

6/ e.g., Japan, China, Taiwan and Korea.

generate growth and improve income distribution. In Bangladesh, where labor represents a greatly underutilized resource in a resource-scarceeconomy, the coming surge of young people entering the labor market could become a main force for development. If the opportunity however is not taken, the swelling ranks of the unemployed will instead become a major obstacle to development.

The alternatives include 1) migration of over 10 million unemployed rural workers to the large urban centers during the next decade; 2) acceptance of rapidly increasing unemployment and severe under-employment within the rural labor force; and 3) initiation of large-scale efforts to encourage increased on-farm, agricultural related, and non-farm employment in the rural areas and market towns. Since encouragement of rural employment can be the only acceptable alternative, what place does electrification have? Rural employment through electrification has been a major factor in the growth and development of several modern Asian countries, most recently China, Korea and Taiwan. The priority accorded to rural electrification over alternative investments in the rural sector, e.g., transport, warehousing, medical facilities and even schools, has in each case been justified by accelerated development results. The results have particularly demonstrated the multiple employment effect of electrification through increased agricultural productive capacity, and agro-processing and related small industry growth in market towns. That these results have not been achieved by electrification alone is obvious. While other conditions required are extensive and often complex, e.g., basic government support to the agricultural sector, availability of inputs and credit, and access to a fair market return, the point nonetheless remains that given concurrent development efforts and a labor force to exploit the opportunity, electrification becomes a primary force in the growth and accelerated development of rural economies through employment generation and the related growth of market towns.

A primary contribution of electricity to employment generation is the supply of heat, refrigeration, light, and concentrated power inputs essential to the most basic production processes and which cannot be supplied by human labor. Electricity also provides an

inexpensive, clean and efficient substitute for other fuels. This is particularly important in Bangladesh where large in-country reserves of natural gas and hydro-power for generation of electricity can greatly reduce the dependence on oil imports and on increasingly scarce local wood supplies. Electrification therefore takes advantage of Bangladesh's natural resources and accordingly should be a necessary component to any long term development of a broad based self-sustaining rural economy.

For Bangladesh, considering the continuing growth in demand for rural employment, the competitive advantage of urban producers, and the time required to establish a complete rural electrification system, the immediacy of the need is clear -- Bangladesh should start now to provide electricity to the rural areas. This should be carried forward as an integral part of the Government's other efforts directed toward increasing production and securing growth in rural employment.

Electrification will impact in different ways and time frames in the rural sector. A realistic assessment of the expected impact, for example, indicates that 75 percent of a given rural community in Bangladesh can immediately afford a direct house connection. This is based on a rate structure in which the minimum cost of connection and power for domestic lighting is based on current expenditure on kerosene for lighting. Accordingly, since 25 percent of the population now spends less on kerosene or other lighting fuels than the minimum electricity cost of $0.60 per month, many of these will not be able to afford domestic service immediately. Although this group would therefore be excluded from the initial domestic benefits of electrification, they will participate from the outset in the broader benefits of electrification, with increased domestic participation following as the program expands and income and production effects multiply. These income and production impacts will include both agricultural and non-agricultural activities.

Specifically, increased irrigation capacity from electricity will promote second and third yearly crops, thereby providing employment opportunities to many of the large percentage of landless laborers who are now only employed at one time during the year. With an inexpensive, reliable power source, smaller agricultural

processing units will become profitable and can therefore be located in rural areas. This will first create jobs for landless laborers. It will also however reduce production losses of small farmers who can then dry their crops, increase the length of storage and sell at a better marketing time. Electricity will particularly make possible the growth of non-farm production units catering both to basic consumption needs of rural areas and even to external markets.

In light of the need to promote irrigation and small production units with potential for immediate employment, this project will give specific emphasis to a power use program. This will include technical and financial assistance by each Rural Electric Society (PBS) aimed at maximizing use of electricity for employment productive purposes. Concurrent AID project assistance is also planned. The electrification project areas will be a primary target for irrigation development under the proposed Rural Irrigation Works Grant (388-0012) and communications improvement under the Rural Roads Grant (388-0032). The Mission is also in the initial project design stage of a Rural Industries Study to determine the policy, credit and institutional needs for stimulating small scale production in rural areas and market towns. Subject to study results, a project will commence during the initial electrification period in which BSCIC and IRDP will foster the development of small-scale and cottage industries in the project areas. In addition, 11 Thanas included in this project are also listed as participants in the World Bank sponsored Integrated Rural Development Projects (RD 1 and 2), and others of the Thanas in this project will almost certainly be included in the Government's proposed expansion from the RD 1 and 2 base.

A second major benefit to the rural poor will be the improvement of education, health, family planning and local Government/community facilities. Electrification of schools, of Union Health Centers for which AID financing is being considered, and of other health and family planning clinics, of markets, Government offices and other common community areas should expand the reach of basic services available to the rural poor. Electricity will also facilitate a major improvement in communications for rural areas. Medical units, disaster reporting stations and other Government services will be able to use telephones. Radios, which often now lie idle because batteries are too expensive, can be better utilized. Television, as has already been demonstrated in several Bangladesh

villages, can be used communally to provide an affordable means of education and entertainment.

The importance of electrification to nation building, through potential for improved communications and greater information flow, can hardly be understated. This extends not only to areas of political communication and awareness, but even more immediately to the potential for information in fields of direct concern to rural communities, e.g., family planning, agricultural extension and basic preventive health and sanitary care. Similarly, electrification is almost a condition to improved educational opportunity within rural communities, both through communication from the outside and through activities which can then be generated within the communities themselves.

For the rural poor who cannot initially afford a domestic connection for electricity,all the above benefits will apply. In addition, for the large number of the poor who can, in-house lighting will increase opportunities for self employment and will provide better quality lighting at a cost comparable to current expenditure on kerosene or other inferior lighting.

Considering the above, and particularly the central role which rural employment must play in any successful effort toward development in Bangladesh, electrification is essential to any sustained rural development. In terms of energy sources, there is probably no effective alternative to electrification. Equally, there is no effective substitute for energy in terms of the requirements for accelerated development. Thus while all other necessary components of a rural development strategy must also be accorded priority - including inputs supply, credit, irrigation works, crop price support, extension services, transportation and road improvement programs - electrification needs to rank among the first as a major step toward full and equitable mobilization of rural productive capacity.

2. Relationship of Project to the DAP

The generation of employment, related to decentralized rural industries and growth of market towns, is the basic growth strategy of the Mission's DAP. Similarly, the target groups identified in the DAP - small farmers (owning two acres or less) and landless

laborers - are also the principal target groups for this project. As discussed below, up to two-thirds of these groups should be able to afford electricity at the rates proposed. An even higher proportion should benefit from the expansion of employment opportunity as well as through the spread generally of the social benefits from electrification. The project therefore is directly responsive to the DAP. See Part II. A, Social Analysis.

C. Detailed Description

1. General

The project sector goal is improved rural standards of living. The purpose is to provide reliable electric service at reasonable rates to existing and potential sources of rural employment, to community service facilities and to rural residents, especially the rural poor, in all project areas.

The provision of electric service during the six year life of the project will entail construction of 4000 miles of distribution line systems (11 KV or less) and 24 transformer substations (33/11 KV), rehabilitation of 300 miles of distribution line and five substations, connection and metering of 250,000 domestic and 18,000 commercial, agricultural and small industrial consumers to the system, assistance in internal wiring for consumers as necessary, and establishment of both central and local organizations required to construct, maintain, administer and promote these systems.

There are 12 initial project areas (also to be referred to as subprojects), representing two areas delineated for administration and technical purposes in each of the six priority feasibility areas. The total area covered by the twelve subprojects includes 52 Thanas (4373 sq. mi.) including approximately 1.1 million households. These project areas were selected in accordance with the feasibility study procedures outlined in Phase I of the Rural Electrification Feasibility Study (See Annex B.7). A listing of subproject areas and a description of the criteria for selection is included at Annex E. The total system construction period for these 12 areas is estimated at 17 years, by which time it is forecast that 880,000 or up to 75 percent of all households will be connected. The 250,000 households to be connected by the

last year of this project therefore represent 30 percent of total connections forecast. The total connections forecast will most likely be revised upward over the 17 year period as the visible and income effects of electrification impact on those people initially not wanting or able to afford electricity. Total commercial, small industries and irrigation connections at the end of the 17 year construction period are initially forecast at 64,000, this initial five year project representing 28 percent of these total connections.

2. Institutional Framework

The central organization for implementation of the Bangladesh rural electrification program will be the Rural Electrification Board (REB), which is to be established as a condition precedent to disbursement for this project. Action is already being taken by the Government formally to establish the REB.

The REB will be co-equal with the PDB as part of the Ministry of Flood Control, Water Resources and Power, with both Boards answering to the Ministry. The principal responsibilities of the REB will be to:

1) Co-ordinate development plans for rural electrification with the Ministry of Power, PDB, IRDP, BSCIC and BADC. This will in part be accomplished by having PDB, IRDP, BSCIC and BADC members on the REB Board.

2) Assume responsibility for carrying out a comprehensive program of full electrification for rural areas of the country. This will be done on a basis of interest free system development loans and technical assistance to the Rural Electric Societies (PBS), provided that the REB will contract directly for many services until the fifth year of this project, at which time the PBS societies are targeted to assume full control of the local construction programs. The REB will continue however to provide directly or fund the monitoring and supervision services for continuing construction. It will be responsible not only for the project areas selected under this grant, but for all future rural distribution development, both donor and Government funded. The current Rural Electrification Division of PDB will therefore gradually shift its rural distribution activities

to the REB also, retaining responsibility for generation and transmission in rural areas.

3) Verify PBS fulfillment of required minimum consumer sign-up and operations levels prior to initial system development loan approval under this grant, and make feasibility studies prior to future loan approvals for additional PBSs. Such approvals will be based upon criteria showing that proposed projects are economical, and will serve the objectives of the rural electrification program and have received a minimum consumer registration. The required level of consumer sign-ups prior to loan approvals for this project per PBS are listed below by feasibility area. This level is calculated as two thirds of the expected connections during the life of this project. The REB will be responsible for allocating the sign-up level between the two PBSs included in each feasibility area. The operational standards to be required of a PBS prior to system development loan disbursement are to be established by the REB.

Feasibility Area	Required initial Consumer Sign-Ups
Chunarughat	27,000
Daudkandi	33,000
Jhikergacha	23,000
Kaliakair	30,000
Natore	30,000
Shahzadpur	23,000
	166,000

Minimum consumer levels for each PBS will be adjusted by the REB as the systems expand and funding support through additional loans will be conditioned upon the maintenance of such levels.

4) Secure repayment of loans on a pre-determined schedule following a grace period, and ensure, through provisions of standard loan agreements, that operating conditions, including consumer levels, in the borrower PBS systems will make such payments possible.

5) Promote development of irrigation and small scale, cottage and commercial concerns through a power use program. This program will:

a) Ensure that small scale industries technical assistance is provided through one BSCIC advisor assigned to each PBS area. The work of these advisors will be coordinated by the BSCIC member on the REB Board. Technical assistance to be provided to both potential and existing small scale electricity using producers will include financial counseling, procurement source and cost information, advice on efficient use of electricity and marketing advice.

b) Provide a $2.5 million equivalent revolving loan fund for credit assistance to be made available to small scale producers receiving technical assistance through the BSCIC local advisors in the PBS areas. Approximately 1200 loans averaging $2000 each in the first cycle are to be made available for the purchase of electrical equipment and appliances. The BSCIC advisors are to be responsible for supervising all loan activities and for ensuring that all loans approved will have a positive impact on employment opportunities.

c) Ensure that technical assistance to electric pump irrigation users is provided through one BADC advisor assigned to each PBS area. The activities of these advisors will be coordinated by the BADC member on the REB Board. Technical assistance to be provided will include advice on second and third crop potential, installation and maintenance of electric motors, efficient time and command area use of pumps and user group arrangements.

6) Assist each subproject in securing adequate supply of bulk power from PDB at the lowest possible cost and maintain right of approval of all power supply arrangements, or directly negotiate such purchase.

7) Determine the standards and specifications for design, construction, materials and equipment for the project systems to assure economy, safety and suitability for rural distribution.

8) Purchase materials and equipment for system construction through international bid, and through local procurement where possible, and provide warehousing, inventory, allocation and trans-shipment as required by the PBS rural systems in accordance with construction schedules. (This task however will be performed by the PDB (with the Consultant as procurement agent) until the third year of this project to allow time for REB staff build-up and development.)

9) Provide a $1.9 million equivalent revolving loan fund to furnish tools and equipment for line, substation and engineering contractors, of whom approximately 52 will be engaged in the initial project.

10) Perform final inspection of all lines and construction before they are placed in operation by a PBS and before final payment is made for engineering and construction.

11) Make interest free loans to the PBSs for re-lending to consumers who cannot otherwise afford internal housewiring costs, and establish standards for housewiring in order to ensure safety. In light of the current constraint imposed by the relatively high cost of housewiring (estimated at an average of $17.35), this lending program is an important component in helping poor families secure electric service. The initial revolving loan fund to be established under this project is $2.5 million equivalent, which will finance wiring of approximately 144,000 residences. Repayment of Tk 3 ($0.20) has been included in the Tk 9 ($0.60) minimum monthly service charge in determining the number of low income consumers who should be able to afford service. At two percent interest the loan period would be approximately seven years. For a description of household services and wiring see Annex B.1.

12) Advise, assist and train the borrower PBS boards of directors, general managers and staffs.

13) Analyze and make recommendations for PBS operations through review of monthly PBS operating and financial reports.

14) Foster research for developing indigenous materials and processes for use in the program to minimize foreign exchange requirements and promote employment.

15) Perform surveys and studies of rural areas for electrification potential, including full feasibility studies prior to approval of the initiation of new systems.

It has been particularly important that development of the basic framework of this organization has been a Bangladesh Government initiative. This underscores the priority which the Government accords to rural electrification, and the Government has undertaken that this organizational structure will be used for future programs funded both by the Government from its own resources as well as with assistance from other donors. Although no specific commitments have yet been made by other donors, the World Bank and German, British and Mainland Chinese foreign assistance agencies have expressed interest in possible future involvement in rural electrification.

With the gradual assumption of all rural distribution activities by the REB, the PDB will become an electricity generation and transmission authority, with system responsibility up to the substations from which power will be distributed by the PBS. However, several technical functions required for construction of the distribution systems will initially be performed by the PDB. This is a necessary and effective use of available resources to meet initial construction requirements in view of the equipment and experienced personnel available within PDB and the time which will be required to train REB and PBS technical personnel to take over construction supervision and support functions.

The PDB's main responsibilities for this project will include procurement, warehousing and transportation of materials and equipment during the first three project years, and initial construction supervision. To expedite procurement, off-shore purchasing however will be carried out by the consultant as agent and with the approval of PDB. At the end of the third year, the REB should have the capacity to accept responsibility for

continuing procurement, warehousing and transportation with the consultant providing technical assistance as necessary.

To perform construction supervision, one separate PDB construction division will be assigned to each subproject area. These divisions now perform construction for PDB, but will be assigned to PBS project construction upon initiation of construction for this project. These divisions will continue to report to the respective PDB Executive Engineers until the end of the second year of this project, at which time all divisions performing construction supervision for this project will be transferred from PDB to REB. (This transfer of divisions will be a condition precedent to disbursement under the FY 1979 grant obligation.) The initial two year period will allow the REB sufficient time to develop support capacity for an enlarged staff. These construction divisions will remain part of the REB's permanent technical capacity to support program construction and expansion for existing and future PBS systems. An organizational chart and staffing for the REB is included at Annex B. 5.

The Palli Bidyut Samity (PBS, or Rural Electric Society) organizations will be established in each of the subproject areas, their establishment also being a condition precedent to initial disbursement for this project. All area residents who want electricity service will be eligible for membership. Such local organizations are an essential component of the program, in order to:

1) provide the degree of consumer responsiveness necessary to service large, newly electrified areas.

2) provide an incentive to maximize the number of connections and users.

3) maximize local participation and responsibility for proper maintenance, financial control, and system operation in the interest of long-range system growth and satisfaction of the people.

The eight initial board members of each PBS will be selected by the local Parishad Committees. This initial board will be composed

of local representatives of the landless, small and large farmers, cooperatives, the business community, educational institutions, family planning clinics and artisans. (See Annex B.5 for initial and subsequent PBS staffing.) The first year of operation of the PBSs will consist mainly of training and consumer sign-up activities. Training will be provided to board members and consumer sign-up representatives of each Union in the project areas. The initial board will serve until the statute for legal establishment of the PBS organizations becomes effective. The legal structure proposed for the PBSs will be essentially a cooperative organization, but a separate statute will be necessary for creation of the PBS organization. Although the PBSs will be cooperative in character, the existing cooperatives statutes are too restrictive for the purposes of the proposed multi-thana PBSs. Also, to avoid conflict with existing cooperatives, the Government has designated the rural electrification groups as societies rather than cooperatives. The nature of the PBSs however will be cooperative, in terms of participation, management and on the principal point of earnings. On the latter, net margins earned in PBS operations will be allocated equally among PBS members. Retained margins will represent the members' equity or share of ownership, and may be used for such purposes as authorized by the statute and approved by the REB.

Upon legal establishment of the PBSs, the initial board members may elect to continue on the board, with vacancies to be filled through membership vote. A PBS manager and basic staff will then be hired, all initial appointments being subject to REB review and approval. Because Bangladesh statutes require several blanket legal actions prior to official establishment of such organizations, the PBSs will not be legally established until approximately one year after project inception. At that time, the PBSs will be eligible for partial or full system loans from the REB. After completion of this project, the REB will make additional loans in succeeding years to assist the PBSs in reaching full areawide coverage.

Staffing is to be phased to reflect initially small but growing systems. Because each PBS will be serving between 20,000 and 25,000 consumers and 30 Unions by the end of this project, each Union in the subproject areas will have a PBS representative to coordinate with the respective central PBS office. PBS tasks will be to connect consumers to the distribution system, train local housewiring specialists, administer the housewiring loan program, bill and collect for service, administer a household power use program to educate consumers on the benefits and uses of electricity, assist in development of the irrigation and small industries power use programs, maintain, operate and expand the local distribution system, and maintain and operate the 33/11 KV substations (See Part III. B, Technical Analysis). Throughout the life of project PBS efforts will be supported by training and technical assistance from REB and the Consultant.

Local contractors for construction of the distribution systems will also be a critical element in the institutional framework. It is estimated that 52 local contractors will be required for this project. These will include approximately 12 local engineering firms providing surveying, staking and construction supervision services, 28 line construction firms erecting the line systems, and 12 substation construction firms. While based on past experience many of these contractors can be expected to perform well, others will necessarily be inexperienced due to the fact that few rural distribution systems have been constructed to date in Bangladesh. Therefore many of the contractors will require substantial onsite supervision and an initial loan of funds to purchase tools and equipment. The process of developing local contractor capability for rural electric distribution will slow the initial progress of the project, but the learning period is essential for the long range success of the Bangladesh rural electrification program.

3. Training and Technical Assistance

Given the importance of developing sound 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, training and technical assistance will be a major factor in this first stage. Although the entire program will necessarily become a continuing on-the-job training at all levels, there will be specific training functions included in this project.

The initial staff of the REB will include senior Government officials with previous experience in the power sector. It is expected that this core of experienced managers will provide direction and on the job training to the whole REB staff. In addition, four consultant advisors will be required for assistance in development of the REB. One will be the consultant project manager to assist the REB Board in all phases of organizational development. The second will work with the Member Engineering and Services. This advisor will in particular assist in preparation of all design standards and plans to be developed for the project areas in accordance with the recommendations to be set forth under Phase II of the Rural Electrification Feasibility Study. The third advisor will work with the Member Finance in developing efficient financial procedures and operations. The fourth will assist in development of REB capability for surveys and conduct of feasibility studies for new project areas. Fourteen work years of technical assistance will be provided REB by the end of the project, with the principal responsibility of these advisors the training of counterpart REB staff.

The bulk of training activities will be provided through the REB for the new PBS staffs. For this purpose two consultant training advisors will assist the REB training division in program development and instruction. It is expected that a large percentage of PBS training will be centralized, these training facilities and programs also being available to the REB staff. In addition, field training will play an important role. Prior to actual construction, trainees will be able to gain field experience on current PDB distribution projects. The role of the consultant training advisors will include not only these training operations but also the development of REB procedures, curriculum and staff to take over future training programs. The expeditious assumption of all training activities by REB staff is essential to the success of the project given the language and cultural requirements for working effectively in rural Bangladesh.

Consultant technical assistance required in addition to the REB and training advisors will include construction supervision, and management and operations advisors for each of the six feasibility areas, one advisor for logistics and warehousing, and one for substation design and construction. The construction supervision, and management and operations advisors will assist in all phases of

construction supervision and PBS management and operations in each feasibility area. Construction and organizational work for the 12 PBS's will be phased, with half initiated the first year and half in the second or third year. Consultant personnel assignments will likewise be phased so that individual advisors will be able to assist more than one PBS during their tours of duty in Dacca. In order to train counterpart personnel these advisors will reside in one of the PBS headquarters in each feasibility area, with an REB assigned counterpart advisor to the second. The two will cooperate closely in all phases of construction management. These advisors will also coordinate on-the-job training as the PBS staffs assume system maintenance and operations responsibilities during the third project year. Construction advisor assistance requirements are estimated at 27 work years.

The logistics and warehousing advisor will work with the delivery and storage of all imported materials, assisting PDB initially and subsequently REB in developing the necessary warehousing and transport procedures. This will require coordination of Chittagong port storage operations, subsequent use of PDB storage facilities, review of all transport actions, and assistance in developing effective intermediate and PBS warehousing and inventory procedures.

The substation advisor will assist in both design and construction supervision of all substation facilities and in development of substation maintenance training for REB and PBS personnel.

This consultant technical advisory staff level represent the considered views of both the Government and the Mission with respect to the skills and assistance necessary to assist in the effective implementation of this project. Notwithstanding PDB operational problems, largely administrative and supervisory problems which PDB itself is working to overcome, the agency has a large resource of trained personnel capable of carrying out the proposed rural electrification program. Thus, while the Consultant for the Feasibility Study has recommended consultant advisory staff considerably in excess of that above, both the Government and the Mission are convinced that the only way this project will develop into a self-supporting, continuing rural electrification program is if project implementation responsibility is vested principally and from the outset with Bangladesh personnel. The consultant technical advisors role will then be focussed on developing the operational organization, procedures and standards for an effective host country role, and on training counterparts in the management and financial aspects of the program, all of which are necessary to

development of a functioning rural electrification distribution system in Bangladesh. Funding for the consultant is detailed in Part IV.A, Financial Analysis and phasing of services is set forth in Part V.B, Implementation Plan.

4. System Operation

During its year of inception, each PBS will carry out a consumer sign-up program. This is to be coordinated with the line lay-out design to be prepared by REB with the assistance of the Consultant. Initial line location priority will be based on long range planning requirements, and potential number of connections and load. This will have a positive impact on number of connections for the rural poor in that high density rural areas tend to have a greater concentration of low income persons in Bangladesh due to small landholdings or squatter conditions. There will be a Tk 5 ($0.33) membership charge and a Tk 12 ($0.80) deposit required of all new members, the deposit being postponable until time of service connection. Initial consumer sign-up programs will be carried out by representatives of each Union in the project areas. As discussed above, in order to ensure that the PBSs reach at the outset and maintain a connection ratio which includes a substantial proportion of the poor, each PBS will be assigned a minimum target number of total consumer memberships, with the number revised as the systems expand. Achieving and maintaining the target will be a condition respectively to the initiation of construction and approval of future loans for expansion. See the table on page 11 above for the initial targets.

After one year, training of locally recruited electricians in housewiring will be underway, so that households having signed up to connect can apply for a housewiring loan and have wiring installed prior to connection. This loan will be repayable in Tk 3 ($0.20) monthly installments. The PBSs will be responsible for reviewing individual loan requests to ensure that loans are only given to families who otherwise could not afford electric service.

As noted above, the PDB will initially provide construction supervision of local contractors, with assistance from consultant construction, and management and operations advisors. After the second year of the project, REB

will take over these construction supervision divisions. This will place the REB in a direct support relationship to the local PBS electrification work. This is essential to the success of the project, as a principal means by which the contractors can be made responsive to the needs of the local communities. The PBS can also assign supplementary construction personnel to work with the REB staff in order to gain on-the-job experience necessary for maintenance and operations programs following construction.

Once lines have been constructed, the PBS will proceed with house connections and system energization. Load forecasts have been made on the basis of lines coming within 100 feet of a potential connection unit. Therefore the PBS will be stringing up to 100 feet of wire for a house connection, and will be installing the meter.

It is expected that average household consumption by the end of the fifth year of operation (seventh year of the project) will be approximately 17 KWH per month. As new consumers are added, their low initial use will tend to offset the increasing consumption figures of the earlier users, causing the average usage to remain low for a number of years. The minimum monthly service charge will be Tk 6 ($0.40), which combined with a Tk 3 housewiring loan, results in a minimum bill of Tk 9 ($0.60). Where a housewiring loan is not necessary therefore the minimum monthly bill would only be Tk 6. It is expected however that most of those who can afford to connect without a loan would also use more than the minimum power, which is sufficient for six KWH of service, enough to light two 40 watt bulbs for the month. The system's load factor will improve as the number of small industrial and commercial consumers increases.

Maintenance and operation of the completed sections will be the responsibility of the PBSs. Staffing requirements for linemen, mechanics, and other technical and office help are included at Annex B.5. Training of PBS operations and maintenance personnel will comprise the bulk of training activity for the PBSs during the latter project years. While all PBS expenditures for operations and maintenance, power purchase and loan repayment are ultimately to be covered by local system revenues, operational loans from the REB may be required for some of the PBSs during the second

through fifth years of the project. These operational loans will be repaid between the fifth and tenth years. See Part IV.A, Financial Analysis.

As evaluation results become available and additional financing is committed or available, the REB will establish feasibility study procedures for selection of follow-on electrification areas. As noted above, this will be a specific area of consultant assistance. Electrification within the initial project areas will also continue for up to twelve years after completion of this project, at which time all households desiring service (as forecast from initial survey data) are expected to be connected. This is based on 50 percent connections by year seven and five percent connections in each of the next 10 years. If as a result of the visible benefits of electrification, more service requests are received than initially estimated, the follow-on construction program will be expanded to accommodate the increased demand.

Part II - Social and Environmental Analyses

A. Social Analysis

1. Social Cultural Feasibility

a. The Social Landscape

The present population of Bangladesh is approximately 80 million with 90 percent living in rural areas and substantially dependent on agriculture and agro-related industries for their livelihood. In addition, many upper and middle class urban dwellers retain title to agricultural land and receive income from agricultural production. Although agriculture accounts for 61 percent of Bangladesh's gross domestic product, yields per acre and per capita food production are among the lowest in Asia.

The key to the social and economic (and often political) hierarchy in rural Bangladesh is the land tenure system. Land is considered the most secure form of investment and a primary determinant of social status. In a situation where institutions are weak, resources scarce and population expanding rapidly, land ownership is the firmest guarantee that one can provide the necessary subsistence for one's family. Further, title to land is usually necessary for a farmer to obtain institutional credit.

Since Moslem inheritance laws ban primogeniture, all sons are legally entitled to equal shares of their father's land while daughters receive lesser shares. This leads to a perceived need to pass on to one's sons sufficient land to ensure their survival and that of their families. Thus the pressure to hold on to the land one has or, if possible, acquire new land is enormous. Given these pressures, profits derived from agricultural production are very likely to be invested in procuring additional land. Conversely, agricultural production losses, over a period of time, are apt to result in the loss of land.

Accordingly, land-ownership is extremely important in the socio-economic setting of rural Bangladesh. Previous research into the land tenure situation has cast most Bangladeshi farmers as a small yeomanry. That is, most farmers own small holdings which they

till with their own and family labor. The Mission's present Land Occupancy Study (LOS), although not complete, has collected sufficient data to indicate this is not the case and, in fact, the owner-cultivator, as defined above, is more the exception than the rule.

For purpose of this analysis, three groups will be used:

1. Sharecroppers - Those who till the land of others in exchange for a fixed share of the crop.

2. Owner-cultivators - Those who till their own land using their own or family labor.

3. Owner-managers - Those who oversee the cultivation of their own land by agricultural laborers.

The LOS defines 16 different tenurial arrangements and the above groups are not necessarily synonymous with any one of the sixteen. Each of the three above covers, in whole or in part, three or four in turn of the 16 in the Study. These three groups offer the most useful comparisons and, at the same time, meet the needs of the present analysis.

In order to assess the land tenure picture in each of the six rural electrification project areas, project villages were taken which had also been included in the LOS. The total cultivable land in each selected village was compared to the area sharecropped or tenant farmed in the same area to arrive at a percentage of land under sharecrop or lease arrangement. By netting out either land given out or land taken in by certain categories of farmers, a rough estimate of owner-cultivator land was derived. By totaling the land cultivated by sharecroppers and that cultivated by owner-cultivators and subtracting that figure from total cultivable land, a percentage of land cultivated by owner-managers was derived. See Table 1 following.

TABLE 1

PRELIMINARY LAND OCCUPANCY DATA FOR THE PROJECT AREAS

Area	Percent of land under sharecrop	Percent of land owner-cultivator	Percent of land owner-manager
Natore	16	23	61
Kaliakair	12	16	72
Daudkandi	15	17	58
Chunarughat	12	33	55
Jhikergacha	7	19	74
Shahzadpur	15	21	64
Bangladesh	34	20	46

Comparisons with the national average show the selected areas to be considerably below the norm for sharecropped land and considerably above it for land under owner-manager operations. Putting it another way, from one-half to three-fourths of the land is actually cultivated by hired labor working for daily wages. The conclusion drawn from these figures is that landowners in these areas find it increasingly more profitable to cultivate their land using daily wage labor than to lease it out on a sharecrop basis. Corollary to this conclusion is that surplus agricultural labor exists in these areas to a greater extent that in the rest of Bangladesh.

b. Employment Patterns

Keith Griffin has noted:

".....an unequal distribution of land ownership, a defective tenure system, and privileged access to the capital market may combine to give landowners monopsony power over laborers and where this occurs the result will be lower wages and less employment than would otherwise be the case." 7/

Empirical evidence has been produced in Bangladesh which lends credence to this hypothesis. A recent UNDP/FAO study notes

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7/ Keith Griffin. The Political Economy of Agrarian Change: An Essay on the Green Revolution, p. 31.

the components of growth in the agricultural sector are such that the growth in crop yields has been greater than the growth in demand for labor. Further, since 1960, the growth of demand for agricultural labor has been only one-half of the rate of growth of the agricultural labor force. The UNDP/FAO study goes on to note that the cost of living index, using 1963-64 as the base of 100, stood at 560 in 1975. On the other hand, the index of real agricultural wages, using 1963 at 100, had regressed to sixty-six. 8/ Thus it is not surprising that although farm output prices have not risen significantly in recent years, landowners have chosen to move from lease and sharecrop arrangements to the use of daily labor in view of the availability of cheap labor and cheap credit.

The Mission expects this will be the national trend for some time to come. Considering the period up to the year 2000, the potential labor force has already been born. The present rate of under-employment is estimated at 40 percent with the rate of growth in the agricultural labor force projected at 2.1 percent over the next decade.

c. The Alternatives

There is, quite obviously, the option of doing nothing, but this is acceptable to no one. Another alternative is through industrial development in the major cities of Bangladesh, i.e., Dacca, Narayanganj and Chittagong. This would involve a major and costly effort, would be at variance with current Government policies and would be an approach with which AID could not associate. Further, it probably wouldn't work, since it would mean a diversion of Government resources to the major urban centers from the rural areas and thus would have little or no effect on growth in the agricultural sector. This in turn would lead either to an inflationary spiral or increased Bangladesh dependence on imported food. Also, as rural labor was drawn into the cities, social services would tend to break down, and finally, rural underemployment would become urban unemployment, with more serious implications for stability.

8/ UNDP/FAO Working Paper XI. Agricultural Employment in Bangladesh. April, 1977. pp. 15-17.

A third alternative is the one which the Government and most donors are at least implicitly following, the spread of HYV technology. It is generally accepted that the use of HYV technology is considerably more labor-intensive than traditional crop technologies, particularly when large-scale mechanization is not introduced. The aforementioned fragmentation of holdings effectively prohibits mechanization. Complementary to the HYV strategy as employment generators have been the Rural Works and Food for Work programs. The HYV strategy, however has had as its primary goal the attainment of foodgrain self-sufficiency with employment as a by-product or secondary goal. Moreover, the UNDP/FAO study notes that only in certain cases does adoption of HYVs create more labor. For example, the adoption of HYV boro (winter rice crop) combined with a transition from traditional to modern irrigation methods leads to a decline in labor demand. 9/ The crop sector employment projection of the study, ".....implies that employment even under the most optimistic agricultural growth assumption will scarely keep pace with the expansion of the agricultural work force." 10/ Given present unemployment and underemployment rates, this is not good enough. Rural Works and Food for Work cannot make up the difference because they would require an ever expanding bureaucracy to administer them at the required levels and ever increasing amounts of donor assistance.

The Mission will continue to support the spread of HYV technology and the full array of rural public works activities but believes another component is needed, rural industrialization.

d. The Case for Rural Industry

A recent AID publication noted:

"The tendency of many LDCs to concentrate industrial investment in only a few central metropolitan areas has had the effect of widening the income gap between rural and urban areas. It has

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9/ Ibid., p. 26.

10/ Ibid., p. 29.

also encouraged urban congestion with all of the accompanying problems. By moving some industries to rural areas, it should be possible to capitalize upon the large supply of underemployed and unemployed rural labor. In the initial stages of decentralization, particularly attractive candidates are those industries which process agricultural raw materials. From the standpoint of the individual entrepreneur, advantages include lower land and labor costs, and reduced shipping charges (by virtue of transporting processed goods rather than raw materials). Early industries could be meat slaughter and packing plants, oilseed processing facilities, fiber mills, fruit and vegetable processors, etc. On the agricultural input side, fertilizer mixing facilities and small equipment manufacturers are possibilities.

Additional investment in infrastructure, particularly in such things as rural electrification, sewage systems, and water purification plants, can contribute substantially to the attractiveness of the move and may in fact constitute a necessary condition to decentralization on a meaningful scale. The experience of Japan and Taiwan in achieving industrial decentralization probably has much to offer other countries contemplating such a course of action." (Underscoring supplied) 11/

The development of market towns and decentralized rural industries is critical for two reasons. First, there is the problem of surplus labor discussed above. Second, there is the problem of surplus capital in the hands of the wealthier farmers. At present, the ownership of relatively large plots of land allows the large farmer access to both cheap credit and cheap labor. The pricing of these two factors enables him to engage in profitable farming operations even if the price of grain remains low. The only outlet for these profits, at this time, is additional investment in more land. Land reform is not a workable option because: 1) there simply isn't enough land to provide supportable farming units to all of the tillers; 2) land ownership ceilings cannot be enforced as a practical matter given the opportunity for subterfuge through the extended family, and 3) reform, even if it were possible in land/population

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11/ Russell H. Brannon and David J. Jessel. "Unemployment and Underemployment in the Rural Sector of the Less Developed Countries." TAB Occasional Paper No. 4, January 1977, p. 61.

ratio terms, is not feasible for domestic political reasons. Market towns however can provide the absorptive capacity for both the surplus labor and capital.

The Mission is presently engaged in a Rural Industries Study (See Part I. B above) as a component in developing of a market town strategy. A number of prerequisites to rural industrial development are expected to be identified by the Study, e.g., transport and communications systems, policy reforms, capital resources, development of local skills, etc. Among these prerequisites will be energy sources for grain drying and storage, commercial fertilizer mixing, milling and processing operations and small repair and maintenance shops.

Of the presently available alternative energy sources, electricity is the cheapest and most reliable. In towns where electricity is available, almost every commercial establishment has a connection. Further, according to a survey conducted by the feasibility Consultant for this project, market bazars which have electricity also tend to have both a greater number and a greater variety of shops. Each electrified bazar covered by the feasibility survey had at least 100 shops, employing primarily family labor but with one or two hired laborers. At present these market bazars serve very localized areas. Thus as the transportation system improves to make these bazars more readily accessible, expansion of commercial and industrial activity in the bazar should increase. As new bazars are electrified they should also expand significantly. In each case, additional labor demand should be created.

2. Social Consequences and Benefit Incidence

a. Access to Resources and Opportunities

One of the main criteria for selection of the project areas is the consideration that 75 percent of the population is estimated to be able to afford the minimum monthly rate charges. Historically, the Mission has defined its rural target group as farmers owning two acres or less and landless tenants and sharecroppers. According to national aggregate LOS data, 75 percent of the rural

population meets this definition. Thus the overlap between the population which can afford electricity and the target group would mean that up to two-thirds of the target group can afford electricity at the rates proposed.

It is not expected that the provision of electricity to the houses of the target group will significantly change their lifestyle in the short term. For the most part it will mean a conversion to electrical lighting from kerosene lamps, although some families may be able to purchase small radios. Over the longer term, assuming significant growth in rural purchasing power, the target group will be able to afford small appliances. Most of the benefits to the target group however will derive from employment creation, discussed above.

There is also a nation-building aspect to rural electrification. The Thana headquarters is the center for the implementation of rural development activities and the main point of interface between the Government and the people. In the selected project areas, ten Thana headquarters do not have electricity. The provision of electricity to these Thana headquarters is expected to enhance their operations through interior lighting for offices, for the classrooms of the Thana Training and Development Center, for telecommunications with District headquarters and Dacca, for health center lighting and refrigeration units, etc. Electrification of Thana headquarters would also make field assignments more attractive to Government personnel.

b. Employment

The generation of employment is the primary focus of the project. As noted above, rural unemployment and underemployment is high and the trend is toward increasing numbers of rural laborers working for a daily subsistence wage. The development of decentralized rural industries is critical to providing employment in the rural areas. With the expected increased spread of pumps through electrification, land currently fallow in the winter season can be brought under production. Thus, the adoption of HYV rice and irrigation will create additional employment also, although

as discussed above this type of activity is subject to limits and does not in any event have the potential of the market towns.

c. Rural Displacement, Migration and Urbanization

The combination of population growth, agricultural input/output pricing policies which favor wealthier farmers, and lack of investment outlets for private capital in the rural areas is displacing small farmers, particularly sharecroppers, at an appalling rate. That large scale migration to the major cities has not already taken place is due probably in the first instance to difficulties of travel but also to the fact that when this hurdle is passed, the migrant comes up against constant Government efforts to move destitute migrants to "squatters' camps" outside the major cities, not an encouraging prospect even for the poor rural unemployed.

Nevertheless, the present urban population is expected to grow from an estimated 10 percent of the total population to an estimated one-third of the total population by 2000. In actual numbers of people, this means a growth from 8.5 million to 50 million people living in urban areas, an increase of nearly 600 percent. This growth is unavoidable unless a catastrophe of major proportions occurs to curtail population growth. Government policies and programs can however influence where this urban population will be located, i.e., whether it will center in a few major metropolitan areas or be spread over a number of small cities serving regional areas. The Mission believes the latter is the preferable course and while no formal Government policy has been announced, Government officials with whom the Mission has discussed the Rural Industries Study have indicated they also favor this approach.

d. Changes in Power and Participation

The structure of the PBS boards, as developed by the Government and the Mission and described earlier, includes representatives of the most disadvantaged groups in the rural society, landless

farmers and women. These representatives may be constrained in their activity on the PBS boards by both cultural and economic factors, but they cannot be excluded and their continued presence should serve as a threshold to broader participation for the groups they represent.

e. The Role of Women

This broader participation should include the attendance of women at the PBS meetings with the probability of increasing involvement as the PBS systems mature and become an accepted part of community life and as a younger generation grows up in this setting.

On the directly beneficial aspects of electrification, women should also share. A great majority of power connections are for households, where availability of lighting should lead not only to a perception of self improvement for women whose families have electricity, but also should contribute to a better sense of security as households and villages are better lit. On the energy side, as households are able to afford appliances, these become a principal means for improving the standards of living of women. On employment, the potential for local handicrafts development should be a particular benefit for women. Finally, the availability of lighting for education both at the home and in the villages, as well as the potential for better health care and preventive sanitary protection, are all benefits which impact first upon women.

It is expected therefore that as the PBS systems grow, the benefits and participation of women in the group will tend to reinforce each other so that whether it is employment, household conveniences, better security, self education or improvement, better lighting, whichever of these alone or together, women should be immediate beneficiaries. The results could not help but improve their status and role within the community, particularly as the next generation matures.

B. Environmental Analysis

The physical components of the project involve only the distribution of electricity, with direct environmental impact being limited

to clearing rights-of-way and sites for substation and PBS headquarters, and the construction of these headquarters facilities as well as the substations and electric distribution lines. Connections and wiring of households will also have environmental effect. To the extent that rural areas are traversed by electric lines, and villages, homesteads and households have wiring and poles through community and living areas, these also will affect the aesthetics of normal living. These effects should not be of any order that would suggest a requirement for underground wire.

Construction standards will be applied by REB to ensure that wiring lines are concentrated to as feasible a degree as possible, and that the related pole and other supporting structures are as unobtrusive as can reasonably be managed. Where it appears necessary to construct lines through parks, scenic, historical or wild life refuge areas, alternative routes will be actively sought and given highest priority. Similarly, standards will be developed so that lines through agricultural areas do not interfere with the usual ways of access or use of areas, and that transport routes are not obstructed.

There will also be indirect impact caused by related irrigation and small-scale industry projects, and by the simple desire of people to move to where the electricity and jobs are. The availability of reliable electricity together with the reduced cost of operating and maintaining electric pumps is expected to result in an expansion of small scale irrigation activity. If there were potential negative impact from such an expansion due to possible transmission of water borne and water related diseases, the risk should be insignificant in terms of the comparable effects and risks of normal heavy every-day water contact which a farmer has in sowing, planting, cultivating and harvesting rice fields.

On the development of agro-based and other small and medium scale industries, again there is potential for adverse environmental impact, but that potential is not great. Such industries should be small in scale and dispersed throughout the market towns of the twelve project areas. They will be typical rural industries, e.g., rice husking mills, flour mills, oilseed presses,

jute presses, garment making, handicrafts, automotive repair and light manufacturing. Given their probable size and dispersion, and that they are not the types of industry that normally cause heavy pollution, any potential adverse environmental impact should be correspondingly limited and site-specific.

There is also a positive environmental impact to be derived from the project. Electricity is safer and cleaner than the traditional methods of heating and light. The danger of fire, injury, or other damage that is inherent in the use of charcoal or kerosene will be significantly reduced with the substitution of electricity. The replacement of diesel and gasoline engines will reduce air pollution and consumption of scarce petroleum products. Street lighting has significant impact on rural security, and makes after-dark travel easier. Schools and other community facilities can be better utilized, with classes and meetings held at night. Clinics are better able to serve their patients when they can obtain refrigeration and sanitation equipment, or even better light to see by. Thus while the project may have some adverse impact on the natural environment, impact on the total environment should be positive. See Annex C, Environmental Assessment.

(Note: This assessment was prepared prior to the availability of guidelines requiring examination of the secondary effects of rural electrification, e.g., the effects associated with new industries, new sets of social behavior, etc. resulting from the availability of electricity. It is important that such potential effects be studied and planning done to minimize their adverse impact upon the environment. For example, careful planning of new commercial centers to accommodate projected traffic flows, channel and treat sewage, control erosion, etc., should be done in anticipation of the growth of such centers in newly electrified areas. It is expected that a supplemental environmental assessment addressing such concerns will be undertaken by AID during the course of the first year of project implementation, and will be reviewed continuously throughout the life of the project).

Part III - Project Feasibility

A. Economic Feasibility

1. The Project

Two methodologies have been employed in determining the economic feasibility of the project. The first of these is the Present Social Value (PSV) approach used in the AID-financed Philippines Project 12/, the second a straight economic benefit/cost method as applied in the IBRD appraisal for the India Rural Electrification program 13/. Given the difficulty of quantifying accurately the social benefits to be derived from the project, it was decided that first only the quantifiable economic benefits would be analyzed, as in the case of the IBRD India appraisal. On completion of this analysis, the resulting economic benefit/cost ratio would then be considered in light of additional non-quantified social benefits, in general terms as was done in the Philippines project.

The benefits and costs for the project were calculated for each of the six feasibility areas 14/over 25 years, based on a 17 year construction period and eight subsequent years of system operation. The 17 year construction period represents the time necessary for developing a distribution system capacity sufficient to serve the total projected consumer population of each respective project area. The full 17 year investment period has been considered rather than the initial five years because 1) all load forecasts are based upon the 17 year system development period and 2) the initial five year investment includes substations, general plant and primary lines designed to accommodate full system operation. It is not feasible therefore to separate these initial costs and benefits from total

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12/ AID Project No. 492-0248, Philippines - Rural Electrification IV, April 14, 1976.

13/ International Bank for Reconstruction and Development, India, Appraisal of Rural Electrification Project, Report No. 688a-IN, June 23, 1975.

14/ Each feasibility area includes two PBSs for which separate data is not available. The area based data however provides a sufficient analysis of the economic feasibility of its parts. See also Part IV.A below, Financial Analysis, which employs the same data base.

costs and resulting benefits. Years 18 through 25 have been considered as the period within which to expect accrual of benefits from construction during the last five years of the 17 year construction period. Current estimates indicate that the economic rate of return on alternative investments lies between eight and fifteen percent. For this project twelve percent was used.

The primary source of data was the feasibility Consultant's (NRECA/CAI) final load forecast and system cost estimates, but the analysis varies from that prepared by the Consultant. NRECA/CAI had employed a methodology which equated total benefits with total revenue from service, an analysis which resulted in a significant underrating of directly derived and quantifiable benefits. Principally, the benefits from increased agricultural production through irrigation and from an expansion of employment were not counted. Accordingly, while the Consultant's analysis of revenue as the measure of benefit was applied for residential, commercial and small industry benefits, revised estimates were employed for the benefits derived from both irrigation and employment. This methodology was reviewed with the Consultant, who indicated that he did not have the data to go beyond the limited revenue benefit measurement, but agreed that the revised approach was also a valid basis for identifying benefits provided the estimation was done on a reasonable basis. As the estimates were developed initially from the Consultant's load forecast, coupled with growth measured against similar experience and projections in India and the Philippines, we consider the basis for the estimates to be reasonable and even understated. To understate further, limiting the analysis to the Consultant's revenue benefit standard, would not reflect the potential of the project, even by conservative measurement.

Accordingly, the benefits as recorded by the Consultant for residential, commercial and small industrial consumers were taken as the estimated revenues to be received from these consumers over the 25 year period. This valuation of benefits is based on the assumption that consumers use electricity because they perceive their benefits as greater than their payment for service. This is a minimum benefit estimate however and results per above in a major under-estimation of benefits in the small industries category. The IBRD India appraisal instead equates small industries benefits with the increased value of production resulting from use of

electricity. In the case of this project, however, reliable estimates of increased production value cannot be determined from available statistics for the project areas, so the Consultant's revenue benefit measurement was used for this category, together with the residential and commercial consumers.

Employment and agricultural benefits however have been recalculated on the basis of jobs created, both in the rural areas directly and in related market towns, and increased crop production as per the IBRD India appraisal. The projections are based respectively upon employment generated through the power use program and additional cropping, and the Consultant's load forecast for irrigation connections.

Costs are calculated as the sum of system investment, operation, maintenance and power costs, with system investment comprising approximately 50 percent of the total discounted cost. The system investment involves not only the initial proposed funding but system expansion funds for 12 additional years (i.e., to year seventeen). At the end of this period each system will have approximately 2.5 miles of distribution line per square mile, providing sufficient coverage to reach all potential consumers. After the 17th year, costs will then include only operation, maintenance and purchase of power, the operation and maintenance costs also reflecting system depreciation and replacement.

The benefits and costs for the six feasibility areas over the 25 year benefit period are shown in Table 2 below. See also the benefit/cost calculations at Annex F. Feasibility area benefit/cost ratios vary from 1.05 in Chunarughat to 1.33 in Kaliakair. The overall benefit/cost ratio is 1.16.

TABLE 2

BENEFIT/COST ($000)

Area	Economic Benefit	Estimated Cost	Economic Benefit/ Cost Ratio
Chunarughat	16,215	15,484	1.05
Jhikergacha	14,282	13,291	1.07
Daudkandi	17,682	16,243	1.09
Natore	17,501	15,171	1.15
Shahzadpur	20,007	15,767	1.27
Kaliakair	18,617	14,009	1.33
Total	104,304	89,965	1.16

While there is no methodology or data available for calculating the social benefits of rural electrification, many of the social benefits will also result in economic returns. Provision of lighting and refrigeration in Union Health Centers and lighting for schools and community service centers should help to increase the productivity of rural people through better health and education. Rural electrification should also improve the ability of rural areas to attract qualified personnel for staffing of medical, educational and other Government services. There are strong indications in other developing countries that electrification assists in population control, a measure that would be of considerable economic benefit to Bangladesh. Inexpensive, reliable communications should also result in substantial economic returns by allowing farmers to be more aware of market conditions, weather forecasts, and Government programs and policies. To the extent that the extension program generally is assisted by electrification, this should result in economic benefit. Better security, better community services, the opportunity for self education, the potential for improved health and sanitary conditions through better information, all of these translate initially into a self-perception of the villagers themselves as being "better off", their increased confidence and well-being eventually being realized in economic terms.

In summary, considering 1) the substantial unquantified social benefits to be derived through rural electrification and 2) the quantified benefits relating to market town development, employment generation, increased crop production and improved standards of domestic accommodation, we conclude that the project is economically sound with respect to the development needs of rural Bangladesh.

2. Justification for Grant Assistance

a. Bangladesh Balance of Payments Position

The following assessment of balance of payments for 1976/77 is excerpted from the World Bank's "Bangladesh: Current Economic Situation and Development Policy Issues" (1469-BD), May 19, 1977.

1) The impact of the extremely good foodgrain harvests and the stabilization policies instituted in 1975/76 were reflected in

Bangladesh's 1976/77 balance of payments (Table 3). The restrictive monetary and fiscal policies of 1975/76 were continued in 1976/77, and they continued to depress demand. This, plus reduced requirements for food imports and lower import prices reduced the value of total imports by 27 percent. Export earnings showed an increase of five percent. Exports benefited from a favorable climate for non-traditional exports, which, in addition, were stimulated by a package of incentives. New items were added to the list of export products eligible for export performance licences, the income tax rebate on earnings derived from non-traditional exports was doubled, exporters were qualified for preferential credit and interest rates, and priority was accorded them in the issuance of import licenses for the purchase of raw material and machinery. These incentives are expected to contribute substantially to a projected large expansion (36 percent) in the value of non-jute exports. Consequently the trade deficit is expected to decline from $909 million in 1975/76 to $537 million. The current account deficit in the balance of payments is expected to total $512 million. However, since external aid disbursements in 1976/77 are expected to reach $572 million (inclusive of a cash grant of $50 million), Bangladesh's international reserves are expected to rise by $72 million to $285 million at the end of June 1977. This would be equivalent in value to about three months anticipated imports in 1977/78.

TABLE 3

BALANCE OF PAYMENTS
(million $)

	1975/76 (Actual)	1976/77 (Estimate)	1977/78 (Projection)
Merchandise Imports (c.i.f.)	-1290/a	-937	-1274
Merchandise Exports (f.o.b.)	381	400	425
Trade Balance	- 909	-537	- 849
Other Current Account	1	25	15
Current Account Balance	- 908	-512	- 834
Other Receipts & Payments(net)	122	46	50
Amortization: Long-term debt)			
Short term capital movements(net))	- 78	- 21/b	- 13
(including IMF)		- 13/c	- 51
Changes in Reserves(- = increase)	50	- 72	32
External Capital Disbursements	814	572	816
of which:			
Food	307	128	286
Commodity	378	220	300
Project	129	174	230
Cash	-	50	-

/a Includes an estimated settlement of $24 million of outstanding letters of credit carried over from 1974/75.

/b Including repayment of $6 million on USSR Wheat Account.

/c Including refund of a deposit of $21 million made by the Kuwait Central Bank.

Source: Bangladesh Planning Commission and the World Bank.

2) The economic outlook for Bangladesh in 1977/78 will depend very substantially on the performance of the agricultural sector. Favorable weather conditions and the availability of agricultural inputs would determine the extent to which the output targets for foodgrains (13.2 million tons), and raw jute (5.0-5.5 million bales), are realized. Industrial output is likely to maintain its momentum. The Government has indicated its intention to continue prudent monetary and fiscal policies, and it is therefore expected that price increases

will be kept within manageable limits. The terms of trade may show a decline of six percent in 1977/78. While export prices are not expected to change markedly as compared with 1976/77, import prices for a few key commodities are likely to rise. It is hoped that almost all foodgrain requirements in 1977/78 could be obtained through foreign aid, so that Bangladesh's scarce foreign exchange resources do not have to be utilized for purchases of foodgrains. Other commodities which are likely to show cost increases are petroleum (18 percent), crude petroleum (10 percent), fertilizer (30 percent) and cement (11 percent). No large development projects are expected to come on stream in 1977/78, but it is expected that as a result of improved policy planning, the rate of implementation of projects on stream would show significant improvement.

3) The improvement in international demand for raw jute in 1976/77, led to a substantial increase in the domestic price of raw jute and consequently in the jute/rice price ratio. It is therefore expected that the area under jute and the volume of production would increase substantially in 1977/78 and that, despite a lower opening stock, exports would rise. Export receipts from raw jute are expected to increase by about $11 million to $125 million. The volume of jute goods exports is expected to increase marginally, and the average price may rise by about two percent, leading to an increase of about $6 million in earnings to $186 million. The high level of tea exports in 1976/77 depleted stocks and since production of tea cannot be expanded rapidly in the short run, the quantity of exports in 1977/78 is expected to be 65 million lbs. and export earnings about $33 million. Non-traditional exports should continue to benefit from a substantial array of export incentives, and are expected to increase in value by 11 percent to about $81 million in 1977/78. Total exports are therefore projected at $425 million --- about $25 million (6 percent) higher than in 1976/77.

4) The projected export and import levels would yield a trade deficit of about $850 million. A surplus of approximately $65 million is projected for other current receipts and payments and a $64 million deficit on capital account. The use of international reserves may amount to $32 million. This would leave a gap of $816 million to be financed from foreign assistance.

b. Debt Service Requirements

Bangladesh's debt service burden at the close of FY 1976/77 rose to $87 million, more than double the preceding year's $35.0 million and five times the $17.0 million of FY 1974/75. Nonetheless Bangladesh has been fairly successful thus far in securing aid on either grant or concessional loan terms. Bangladesh's need for this type of assistance for example has been recognized recently by Canada's change of all assistance to a grant basis, including converting of previous loans to grant. We expect that all donors will continue to provide assistance either on such grant or concessional loan terms and believe that the economic condition and prospects of Bangladesh support this basis for assistance. It is recommended that this project also be financed on highly concessional terms. Accordingly, the initial tranche of $16 million is proposed to be provided on AID's soft loan terms, and the balance of project funding is proposed to be on a grant basis.

B. Technical Feasibility

1. General

Given a total project area of 4,373 square miles, and the estimate of 2.5 miles of line per square mile for a complete system, the total 17 year construction requirement for the six feasibility areas will include approximately 11,000 miles of line. During this construction period, service is to be extended to 880,000 consumers with most load densities increasing to between 20 and 30KVA per square mile after the tenth year of operation. Therefore the technical requirements for this project include the provision of both an efficient initial operating system and a foundation for future expansion and construction needs. Accordingly, major components such as substations and main circuits have been designed and spaced for final load requirements. The major technical components of this project however will involve project concerns for initial primary branch circuit extensions to the bulk of potential consumers, and for the development of a solid institutional base to provide the necessary technical expertise for both current and future operations.

2. Institutions - Technical Responsibilities

The project will involve construction of a total of 24 substations, 4000 miles of new distribution line plus acquisition and rehabilitation of 300 miles of distribution line and five substations. To accomplish this in the six year project period it is anticipated that 12 local engineering and surveying firms, 12 substation contractors and 28 line construction contractors will be required. Each line contractor will be responsible for the construction, on an average, of 150 miles of distribution and sub-distribution power lines. As shown at Annex B.3 a sufficient number of qualified firms should be available in each category. In addition to local engineering and surveying firms and the Consultant, the project will also require the transfer from the PDB to REB of field inspectors by the end of the second year. In the same time the PDB divisions responsible for construction supervision will also be transferred to the REB.

Most contractors have few tools and equipment for the type of substation and power line construction proposed. Some of the necessary equipment and specialized tools will have to be supplied to the contractor. As discussed in Part I.C above, loan funds will be made available for this purpose, with repayments to be deducted from contractor invoices. Although some of the contractors will have former PDB superintendent and foremen personnel who are experienced and qualified, many will not. A strong initial emphasis on and attention to supervision and instruction will therefore be required. It will be necessary to establish and maintain an extensive and thorough construction management program. The work of the transferred PDB elements, assisted by the Consultant, will have the main role in this task.

Basic typical designs will be done by the Rural Electrification Feasibility Study Consultant under Phase II. See Annex B.7, Rural Electrification Feasibility Study Scope of Work. However actual "on-the-ground" design will be accomplished as the lines

are staked out on the ground. This will be done by local engineering and surveying firms under the supervision of the Consultant. As shown at Annex B. 3, there are sufficient qualified local engineering and surveying firms to accomplish this within the project term.

Under the new organization the PDB will be primarily responsible for generation and transmission of electric power while the REB will be concerned with rural distribution. In the project areas this will require transfer of all PDB distribution lines (11KV and smaller) and substations. During the first two years of the project, the PDB will be responsible for supervision and management of all construction. Throughout the project however the REB will set electrical and construction standards and specifications, assist in establishing the PBSs, act as a lending institution to the PBSs, set rates, establish training courses and systems for PBS as well as REB staff, and guide and direct the management of the PBSs. See Annex B. 5, for the institutional structure and staffing for the REB and the PBS.

The REB field inspection staff will inspect all construction, including initial PDB supervised and managed construction, to ensure compliance with REB standards and specifications. The inspection staff will also inspect consumer connections for adequacy and conformance to REB standards and specifications. At about the end of the second year as initial construction is completed, and the PDB divisions are transferred to REB, work on connections from the distribution line to the consumer will begin on the completed portions of the system. Consumer connections will be carried out by the line construction contractor for those consumers who want power at the outset. Subsequent connections will be made by the PBS line crews who for the first few years of operation should have a light maintenance workload. It is expected that each PBS will have a staff of 11 technical personnel-assistant linemen, linemen and foreman - for maintenance and for installation of consumer connections. As the consumer connection work load decreases, the requirement for maintenance of lines and substations should be expected to increase, both a function of the maturing of the system.

PBS technical personnel will be trained by the REB with the assistance of the Consultant who will work with the REB in establishing and carrying out the training program. By the completion of line and substation construction the local PBSs will be sufficiently trained and experienced to assume full operation and maintenance responsibility.

The PBS will purchase and take responsibility for bulk power at the substation. Although the PBSs will be locally operated and administered, they will be closely supervised and guided by the REB. In addition to REB financial and management overview, all consumer connections and system/facilities construction by the PBS will be to REB standards and specifications. The operation and maintenance of the 11KV distribution lines and substations will be the responsibility of the PBSs under the supervision and guidance of the REB.

PBS service will include a meter located on the consumer's building or pole and service will be free of connection or other capital charges. The wiring on the consumer's side of the meter and all interior wiring will be the responsibility of the consumer. This wiring will include a 15 ampere fused main disconnect switch and branch circuit(s) serving typically a ceiling light and a convenience outlet (a typical wiring plan is shown at Annex B.1). Although all wiring on the consumer's side of the meter will be his responsibility, prior to energization the PBS will inspect such wiring for conformance to standards and adequacy of installation. The PBS will also provide technical assistance and guidance to the consumers as needed. By the end of the second year, construction of 10 percent of the power lines will be complete,with the substations complete by the end of the following year.

The REB engineering contribution will be applied in the following areas:

- provide technical evaluation of feasibility studies
- develop general system design criteria
- develop construction standards
- develop general O & M guidelines
- evaluate and determine approved materials and methods
- provide technical evaluation of REB material purchases
- support REB technical training.

Local engineering and surveying firms will also provide services directly to the operating PBS as follows:

- provide systems planning necessary for REB loans
- prepare detailed line design (staking sheets)
- supervise ROW clearing
- provide construction inspection services
- certify as built construction for contractor payment
- prepare system maps
- provide general engineering consulting services.

3. Power System

The PDB is responsible for all power generation and transmission in Bangladesh. The total installed (rated) capacity of present PDB generating plants is 763 megawatts (MW). However, due to age, long-term major breakdowns, lack of spare parts, etc., available generating capacity is only 613 MW. This is supplied by the Karnafuli hydro-electric generating station (constructed under an AID loan and presently producing 92 MW), various natural gas powered generating plants (342 MW) and a number of oil and naptha powered plants (179). In addition, 190 MW of new generating capacity is under firm commitment from other donors and an additional 50 MW hydro-electric generating unit is now under construction at the Karnafuli generating station. This third Karnafuli unit is financed in part by a current AID loan, No. 388-T-007. Total generating capacity (presently available plus that under construction and firm commitment) by the end of 1982 will be approximately 853 MW. Generating capacity has however outstripped demand and will continue to do so in the near future. The peak load for 1976, for example, did not exceed 310 MW. Rural electrification under this project over the project life will add an additional 124 MW of demand. If a growth rate of 10 percent is assumed for the balance of the country, consumption by the end of 1982 would be 549 MW not including the rural electrification load under this project.

Generating capacity and loads are as follows:

TABLE 4

GENERATING CAPACITY AND LOAD DEMAND FORECAST

	Eastern Grid	Western Grid
Present available generating capacity	460 MW	153 MW
Available generating capacity by end of 1982	570 MW	283 MW
Peak load for 1976	240 MW	70 MW
Estimated load not including project by end of 1982	425 MW	124 MW
Project load by end of 1982	104 MW	20 MW

By the end of 1976 there were 3263 miles of 132KV, 66KV and 33KV main transmission line and 6394 miles of 11KV line in Bangladesh. In addition there are more than 300 miles of 132KV main transmission line presently under construction. The source of power supply for this project will be the PDB's 33KV transmission system. The 33KV power will be stepped down - at PBS owned and operated substations - and distributed to the rural areas through an 11KV distribution system also owned and operated by the local PBS. From there the supply will be further stepped down and distributed at 400 and 230 volts. The 11KV primary voltage level is adequate for long range rural electrification in Bangladesh. The projected development of the 33KV transmission system by the PDB is sufficiently extensive to permit reaching most of the rural areas of Bangladesh with 11KV feeders emanating from 33-11KV supply substations.

It is also appropriate in terms of maintaining uniformity among the distribution voltages in the country, and taking into account the 50 cycle system standard and the benefits of reduced feeder exposure. The possible benefits which might accrue from adopting a higher distribution level primary voltage would be offset by the additional investment costs, and is not required in view of the reach of the 33KV transmission supply system. Maps of Annex B.2 show the preliminary distribution system layouts for each of the six feasibility areas.

The establishment of new primary and secondary distribution facilities will be consolidated with existing PDB primary and secondary voltage distribution facilities in the project areas. In all project areas varying amounts of existing PDB distribution facilities exist - mostly located along major roads. Renovation will be required in some cases to achieve the reliability required of the new system, and rehabilitation of these facilities will permit them to be extended to serve areas presently not receiving service. A substantial portion of the existing PDB 11KV line in the project areas contains either secondary underbuild (400/230V 4-wire) or a below primary static wire. Most 11KV circuits without static or secondary appear to have sufficient pole height to add a below primary neutral and still maintain the minimum ground clearances recommended by the feasibility Consultant. If multi grounded primary systems are implemented, neutrals would be established on any existing 11KV lines integrated into the new systems. Steel static wires, where they exist, may have to be replaced to provide better current carrying capacity. The project cost estimates take into account the possibility of renovation work for the purpose. Static wires generally are used by the PDB only on steel pole lines as a public safety feature. In view of the quality of line construction and line maintenance, the static wire may have merit, however the PDB does not require it in all cases. In a recent large 11KV design effort by the PDB the static wire was eliminated in the interests of cost savings. In general, given the standard of construction and maintenance expected under this project, static wires should not be required except where existing line is rehabilitated and consolidated in the project systems. In those instances, the judgment as to the requirement will be on a case by case basis.

Also on the question of existing facilities, there are a number of existing distribution connections made directly to 33KV lines passing through the project areas. These consist of direct 33KV -- 400/230 volt distribution transformer connections as well as short 33KV branch lines which serve relatively small loads consisting of bazars and Thana headquarters. To reduce exposure to 33KV transmission, supply distribution from 33KV will be transferred to the maximum extent possible through the new substations to the new 11KV distribution.

Existing 33-11KV substations in the project areas and those now under construction will also in most cases be consolidated into the new system. The decision to consolidate 11KV supply substations will be made on the basis of spare capacity and condition of the facilities, which will be addressed in more detail in Phase II of the Feasibility Study. It is not expected, however, that substation consolidation will be undertaken unless all 11KV feeders emanating from the substation are the responsibility of the local PBS.

A profile of consumers and construction and other data for the six areas is shown in the Table following:

TABLE 5

POWER CONSUMERS AND CONSTRUCTION DATA

Project Area	Household	Bazar	Small Industries	Large Industries	Irrigation Pumps	Area Facilities To Be Acquired: Served Sq. Miles	Sub-stations	33KV Line	11KV Line	400 Volt Line	PROPOSED: 11KV 3P Line	6.35KV 1 P Line	400/230 V. Line	33-11KV Sub-Stan.
Chunarughat	154,254	26	121	4	212	865	5	6 Miles	17 Miles	2 Miles	440 Miles	256 Miles	106 Miles	5
Daudkandi	259,787	63	291	-	706	638	-	37 Miles	15 Miles	8 Miles	374 Miles	156 Miles	86 Miles	4
Jhikergacha	153,583	26	136	-	382	706	-	13 Miles	12 Miles	3 Miles	383 Miles	174 Miles	87 Miles	3
Kaliakair	161,025	47	173	-	1,542	595	-	9 Miles	55 Miles	13 Miles	325 Miles	130 Miles	74 Miles	5
Natore	153,659	53	134	-	524	765	-	1 Miles	60 Miles	6 Miles	365 Miles	195 Miles	93 Miles	3
Shahzadpur	205,677	49	160	-	61	804	-	7 Miles	30 Miles	6 Miles	401 Miles	206 Miles	98 Miles	4
TOTAL	1,087,985	264	1,015	4	3,427	4,373	5	73 Miles	189 Miles	38 Miles	2288 Miles	1117 Miles	544 Miles	24

Taking into account the reinforcement works currently under construction or approved for construction of PDB grid substations, sufficient 33KV capacity will be available to serve the rural electrification project through the six years of project operation, as well as to provide for other load growth within the project areas but not included in the project areas. The latter includes for example additional power requirements for jute mills, sugar mills, textile plants, tobacco plants, and other large scale industries which are under construction or planned for the project areas. The relative loads and substation capacities for the six areas are as follows:

TABLE 6

LOADS AND SUBSTATION CAPACITIES

(MVA)

Area	Exist/under construction 33KV source substation capacity	Existing demand on capacity	Estimated 1982 addl. demand on capacity	Estimated 1992 addl. demand on capacity	Grid system
Chunarughat	28	5.5	7.5	20	Eastern
Daudkandi	44	16	5.5	21	Eastern
Kaliakair	106	Not available	5.0	21	Eastern
Jhikergacha	30.1	12	3.5	16	Western
Natore	21	8	4.0	16	Western
Shahzadpur	14.5	5.7	4.5	19	Western

The capacity of the 33KV lines should therefore be adequate within a 13 percent volt drop range in all areas to supply both the rural electrification load and the growth of other loads throughout the five year term of the project. The feasibility Consultant has recommended a distribution feeder maximum voltdrop design of 7.5 percent primary circuit, 1.5 percent transformer and four percent secondary and service. This total voltdrop of 13 percent is high but has been recommended on the basis that the resulting ANSIC84.1 Range B service voltages are acceptable for Bangladesh and the economics of the higher voltdrop spread are preferred. Four percent of this

voltage has been allocated to secondaries and services to meet the extensive 230 volt secondary run requirements necessary for reaching households. Since residential loads are projected on the order of 4-6KW per mile of primary line, the four percent secondary service voltage provides a reasonable balance among the total amount of primary line extension required, the ability to load transformers, and the ability to reach into tree congested residential sites with secondary.

Again, on the question of 33KV line capacity, the service reliability of these lines is generally below desirable performance levels. Under current Bangladesh conditions, a 33KV line with 50 or less interruptions per year can be considered reliable. The number of recorded 33KV line interruptions is frequently greater than 100, and local line reliability therefore must be measured in this context. Except for the Kaliakair feasibility area, where interruptions on 33KV line exceed 250 each year, the lines selected to serve the 33-11KV substations in other project areas appear reasonably reliable. It is expected that the overall level of subtransmission system reliability will improve over the project life as PDB continues its current correctional program. This project will provide limited technical assistance and materials to the extent necessary to ensure the effectiveness of that program as it applies to the project areas.

In terms therefore of both generation and amount and location of main transmission line, the project is technically feasible without the construction of such additional capacity or line.

4. System Design

The routing of most main primary circuits will be 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. It is not expected however that lines will extend much further than five miles away from established roads or navigable water ways. See Annex B.2 for routing of main primary circuits. The precise location of branch circuits will be determined during implementation by local firms under supervision

of the Consultant. While sufficient roads and navigable rivers will permit bulk movement of materials to general construction depots, a great deal of material will necessarily be man or animal transported to the location of final installation. Routing will be established along existing communal pathways or future road alignments. Load requirements are the controlling factor, with physical obstacles, especially to vehicular accessibility, a secondary consideration. Substations however will be located only at sites accessible at all times of the year. Although a considerable portion of feeder lines will be installed across areas difficult of access, the location of automatic sectionalizing devices will be limited to the extent possible within acceptable operating practices to the main circuit or to other locations accessible by vehicle or boat. This will be necessary to ensure the effectiveness of routine line patrolling and troubleshooting.

All existing utility systems in Bangladesh operate at 50 cycle and supply power to consumers at three phase in either nominal 230 voltage or 400 voltage configuration depending upon usage. Although electric lighting and loads related to residential and general community use are not only significant but vital to the achievement of the purpose of the project, the greatest electric power demand will come from irrigation uses - deep and shallow tubewells and low-lift pumps - and agro-based and other small machine uses such as rice mills, flour mills, oil mills, welding shops, saw mills, etc.

Taking into consideration the relatively low load diversities and densities, and the extent to which these loads are expected to be distributed among residential, community and other commercial and agricultural usage, distribution will be a mixture of three phase and single phase extensions. The decision to develop a mixed system is based upon economic considerations developed by the feasibility Consultant which show that an exclusively three phase system would cost from five to seven percent more than a single phase system even taking into consideration the higher cost of single phase over three phase motors. Considering system plant investment only, an exclusively three phase system would be seven to 13 percent higher in cost than a single phase system depending upon the possible demand configurations. In areas of

predominantly residential and small commercial loading the use of the mixed three phase and single phase service would show significantly greater savings. For purposes of the assessment, an exclusively three phase system consists of a grounded neutral at the substation with a three-wire primary feeder system. This corresponds to the majority of the existing PDB 11KV system. The mixed system will have a four-wire three phase primary circuit and two-wire single phase circuit.

Three-phase main feeder lines will come out of the substations and extend to the center of the load area, then divide into single phase lines to reach the consumers. The consumer will not be handicapped because he can connect a 10 horsepower (HP) motor directly to the single phase service, and by using a converter can operate a 25 HP or even a 50 HP three phase motor from the single phase line. The single phase motor, or the three phase motor plus converter, will cost the consumer somewhat more than just a three phase motor of the same HP rating. However, in many cases it would cost the system perhaps $1000 or $10000 in extra construction costs for a three phase line to the consumer to save the consumer perhaps $100.00 on the cost of the motor. The energy consumed by the motor would be the same either way. For large industrial loads and concentrations of deep tubewell loads three phase service will be provided.

A balanced combined three phase/single phase system should meet the total needs of an area on the most economical basis. Households will constitute most of the service connections, and in fact more than one half of the total KW load on the systems. The cost of service to these households needs to be kept at the lowest possible level in order to put service within reach of as high a proportion as possible of the target group.

The distribution of the 15th year (17th year from inception of the project) loads projected for each of the feasibility areas is as follows:

TABLE 7

PROJECTED KW DEMANDS - 15TH YEAR OPERATION

Area	Residential	Commericial	Irrigation *DTW	Irrigation **STW	Irrigation ***LLP	Industrial
Chunarughat	11,078	496	279	1,337	1,008	,034
Daudkandi	11,953	1,315	1,476	1,136	1,850	3,185
Jhikergacha	7,752	1,060	2,088	1,957	735	1,792
Kaliakair	10,817	374	3,672	2,489	1,898	1,575
Natore	10,192	918	2,565	3,199	1,188	1,421
Shahzadpur	8,221	1,226	1,755	3,764	1,320	2,976
Total	60,013	5,389	11,835	13,882	7,999	15,983
						115,101
%Grand Total	52.1%	4.7%	10.3%	12.1%	6.9%	13.9%
						100.0%

* Deep Tubewells
** Shallow Tubewells
*** Low Lift Pumps

Note: The relative increase in the number of shallow over deep tubewells reflects preference for the smaller units as involving lower initial investment per cusec pumping capacity as well as reduced water management problems for farmer groups. This preference is expected to be more widely confirmed as the availability of electricity permits greater scope for individual farmer options.

More than 75 percent of all of the load indicated can be served adequately through single phase lines and transformers. Cost comparisons show that the per mile cost of a three phase 2-ACSR line is $6250 compared to a single phase line with the same size conductor at $4200, a per mile difference of $2050, or with 4-ACSR the respective per mile costs would be $4850 and $2950, a $1900 per mile difference in favor of single phase. Even where a three phase primary line may be available it would cost $1200 for a minimum (25KVA) three phase transformer installation as compared to $600 for a minimum (10KVA) single phase transformer installation. Comparable differences would also apply to secondaries and metering. Although actual field conditions may reduce these cost differentials, significant savings overall should be realized through the use of single phase.

In the project design essentially all loads requiring three phase service are income producing industrial types where the cost of power will be passed along to the product, while residential service is an end of the line cost that normally is not directly income producing and cannot be passed along. There is therefore a reasonable basis for requiring those who use three phase service to cover the extra cost in order to avoid charging single phase users costs for service they do not require or use.

The distribution system as built in the field will vary from the ideal layouts utilized in the feasibility Consultant's study. While main feeder line and main branch line will be installed initially, transformers and secondaries will only be installed where there is an identified need and a request for service. As the reality of electrification will be a new experience for most of the project areas, it is expected that many consumers will hold back in some skepticism until the system has been energized before requesting electric service. Many small branch extensions will then also be made. The savings of single phase versus three phase may prove on this point to be larger than now expected therefore due to the facility for expansion of a single phase system in smaller investment increments.

On the question of secondary underbuild, it is the feasibility Consultant's view that this will be required for the overwhelming proportion of the primary line, the requirement stemming from the dispersed character of rural household locations. Along stretches where primary line can however be run without underbuild, the single phase will adapt more efficiently than the three phase in view of the versatility and smaller size of the single phase transformer installations.

5. Poles

Only 10 to 20 percent of PDB's annual distribution pole requirements are currently met with wood poles. Most distribution lines are built with tubular steel poles or steel reinforced concrete poles fabricated on site. Although there are two extensive forest tracts

in Bangladesh, these contain few trees suitable for the poles of the 30 foot or greater length required for line construction. They do contain however a vast number of trees that would make poles of 25 foot or less length, and these would be suitable for above grade as "stub" poles over a concrete foundation and base. At least 50 percent of the total rural distribution pole requirements could be met with such a pole design. The concrete foundations would have sockets for ease of pole replacements. Also, where there would be a reasonable prospect of future three phase conversion, the pole size would be based on the range of possible higher loadings.

The specifications for wood poles adopted by the Bangladesh Standards Institute in 1973 are acceptable but are not being followed in practice. Improvement in timber forestry, seasoning and treating procedures is required. Although the development of a quality wood pole industry would result in significant cost reductions for rural electrification, such a program will take time to implement. Therefore, of the approximate 80,000 poles required for the project, the initial increment of some 70,000 will be procured through import. If at the time of the second procurement tranche, in the third year of the project, the local availability of suitable poles and treatment facilities has been confirmed, this second tranche may then be procured domestically.

6. Procurement

In addition to importing wood poles, the project will also require the importing of voltage regulators, reclosures, arresters, power fuses, cutouts, galvanized steel lattice towers, galvanized bolts, galvanized anchor rods and guy strand, and insulators and insulator hardware. These items are not presently manufactured in Bangladesh in acceptable quality or sufficient quantity to meet the needs of the project. Some local firms however have expressed a desire to manufacture such items and in context of this project, the Consultant with REB will explore the potential for such manufacture for possible future projects as well as for manufacture of spare and replacement materials. Even with the support of procurement contracts however these firms would not be able to contribute to the main materials need for this project. There are also presently no local sources of single phase distribution transformers and watt/hour meters and

these will also require import. In summary, all materials except for such items as cement, concrete aggregate, reinforcing steel, brick and some miscellaneous items will need to be imported. The details of these requirements are set forth at Annex B.4.

Procurement actions for one-third ($15 million) of the off-shore commodities are scheduled to be completed by the end of March 1978 with delivery in Bangladesh nine months thereafter - e.g., by end December 1978. Delivery to construction sites is estimated to take an additional three months. Procurement and delivery actions for the remaining two-thirds (28.7 million) will follow within two years. The magnitude and accelerated time schedule for procurement, acceptance, storage and movement of materials to project sites will impose greatly increased requirements on the capability of the PDB logistics staff and warehousing facilities. Assistance for logistics support therefore will be a main responsibility of the Consultant.

On the facilities side, additional PDB warehousing and storage facilities will be required at Chittagong and Khulna for receipt and distribution of materials. Present PDB facilities are not sufficient and additional warehouses and storage yards will need to be leased from private firms or acquired on a temporary basis from other Government agencies. Sufficient facilities are available at these two ports and leasing or temporary acquisition should not be a problem.

The storage and eventual trans-shipment of materials to the project sites will require storage and inventory controls and transport available on a timely basis. The storage and movement alone of the approximate 80,000 treated wood poles will require extensive storage space and transport for movement by water, highway and rail. Existing transport facilities are sufficient and flexible enough to meet this increased demand, provided the requirements are scheduled in advance and that emergency short term needs for foodgrain, fertilizer and other movement do not recur to an extent that interferes substantially with the space available for the materials for this project. Monitoring of space requirements and availability will be a continuing major responsibility of the PDB, and later of the REB, in both cases with the main assistance of the Consultant. The development of an efficient materials logistic support capability

will be a principal task of the Consultant during the initial project year. The movement control system needs to be in place and functioning by the time the first tranche materials begin to arrive in-country by the fourth quarter of CY 1978. The Consultant will also work with the PDB and the REB to develop port handling procedures for ensuring expeditious port clearance, including the development of procedures with Customs to provide for clearance at the PDB warehouses.

7. Source and Origin

In order to provide the greatest flexibility both with respect to obtaining lowest cost and delivery times, and to carry out the local procurement portion, it is recommended that this project be authorized for commodity procurement from AID Geographic Code 941, but including Bangladesh. Procurement of services however would be limited to the United States and Bangladesh.

8. General Plant

Establishment of PBSs in the rural areas will require construction of a physical infrastructure for administrating, maintaining and operating the rural electrification systems. In the 12 PBS areas there are at present no existing structures which can be acquired that would be adequate. Construction of new facilities is therefore required and this will be phased in accordance with the growth of

the systems. The facilities will include headquarters office space for general administration and billing, materials warehouses, repair garages and equipment yards, and residential facilities. Residential facilities, when complete, will accommodate about 40 employees including a house for the general manager, apartment style housing for department heads and supervisory types, and finally barracks style housing for other regular skilled employees. Common labor and temporary help are expected to be local people with their own housing.

Facilities design will be done by local engineering firms to customary standards. These are adequate for the project. Buildings will consist of load-bearing masonry walls with reinforced concrete slabs. Locally available materials will be used to greatest extent possible. By employing designs and materials with which local contractors are familiar, it is expected that the initial facilities required can be completed in the first construction season. In phasing of construction, emphasis will be placed on warehousing and critical residential structures as these units must be in place by the time the off-shore commodities reach the project sites. All local construction is to be a Government cost, including costs of residential furnishing to the extent not provided by residents themselves.

Except for locally available office furnishings, such as desks, chairs and cabinets, most office equipment will have to be imported. Transportation equipment, mostly jeep and pickup type, communications and specialized equipment and tools will also be imported. The equipment and tools will include those required for contractors. The communications equipment will consist of a base station two way unit for each PBS headquarters and mobile units in the utility vehicles. A small number of hand type portable units are also proposed. There will also be a base station at the REB office in Dacca for communication with the twelve PBSs. The Consultant, who will be located with the REB, will thereby have direct contact with the field advisors. All imported items will be an AID funded project cost. A list of the estimated imported materials and equipment and costs is shown at Part IV-B.

9. Consultant Assistance

The Consultant will provide training and technical and management assistance to the REB and to the PBSs. The Consultant will also work at the outset with the PDB units responsible for procurement and logistics, as well as with the divisions directly concerned with the initial construction. The most efficient and practical techniques will probably evolve from the contribution of the Consultant coupled with the experience of local conditions and application of local resources of the PDB and REB staff as well as of the local engineering firms. Apart from technical assistance responsibilities, the Consultant will also be tasked as the off-shore commodity purchasing agent for the PDB and the REB.

In general therefore the Consultant will perform the following services:

1. Assist the REB in training for system management, development, operations, construction and maintenance.

2. Advise the REB in technical management and financial operations.

3. Advise the REB and local engineering firms in proper site-specific design (general layout and typical designs are being done under Phase II of the Rural Electrification Feasibility Study), construction standards and techniques, and construction supervision and inspection.

4. Advise the local PBSs in management, operations and maintenance.

5. Advise and establish warehousing and inventory controls and procedures for the commodities purchased under the project.

6. Assist and advise on shipping, trans-shipping and port clearance requirements to ensure that commodities reach the project sites on schedule.

7. Assist and advise the REB in review of drawings prepared by the local engineering firms and the PDB.

8. Act as off-shore purchasing agent for the PDB/REB, including preparation for PDB/REB approval of detailed specifications for equipment and materials required and estimate of costs, drafting for PDB/REB approval of standard contract terms including for invitations for bid and other purchase forms, solicitation of bids, analysis and evaluation of proposals, recommendation of awards or actual awarding of contracts, expediting of purchases, review of invoices or bills submitted, making of payment with advice to PDB/REB, and arranging of shipment to Bangladesh. Procurement will be concentrated in the first 20 months of the project to minimize project delays due to late arrivals.

See outline scope of work for the Consultant at Annex B.6.

10. Conclusion

On the basis of the foregoing, it is concluded that the project is technically sound, includes a reasonably firm and accurate cost estimate, and reflects the necessary planning, both in selection of the type and timing of project components and in the plan for execution of the project. On this basis the project meets the requirements of the Foreign Assistance Act, Section 611(a).

Part IV - Financial Analysis and Plan

A. Financial Analysis

1. Financial Effect on Project Participants

As noted before, the rates for electric service have been set equal to or less than charges for alternate energy sources. For domestic users, survey data indicates that approximately 75 percent of the Bangladeshi households in the project areas spend at least Tk 9 ($0.60) per month on kerosene for domestic use. The minimum Tk 9 monthly service charge will therefore not only provide improved lighting without increasing household expenditure, but will make available a wide range of domestic activities which contribute to an improvement in standard of living.

Some of the 25 percent of households which currently spend less than Tk 9 per month for kerosene or other fuels for lighting will probably also connect. This would occur at some cost in terms of reducing expenditure on other items, a cost many people may be prepared to bear in return for the perceived increased benefit of better lighting. The cost difference for this group in most cases would have to be small in comparison to current expenditure for kerosene, i.e., Tk 1-2; otherwise they would not be able to afford the choice. For the lowest category in the 25 percent range, those who have no choice at all in terms of being able to afford the service, they will remain unaffected by charges for domestic service. However, the provision of electricity to rural areas, as a prerequisite for large-scale employment generation, should create a positive financial impact in terms of employment opportunities for these households, an impact which in the long term would allow them to afford the cost of service.

While the higher rate charged to commercial, industrial and agricultural consumers in effect provides a subsidy for domestic users, the financial returns from the use of electricity for production are more than adequate to justify the higher rates. These returns are favorable not only to the introduction of electrically driven machinery and equipment but also for conversion from diesel to electric power sourc as quantified in the benefit cost calculations (see Annex F).

2. Financial Viability

The REB will be receiving grant funds from both AID and the Government and in turn the REB will provide interest-free loans to the PBSs for system development. The financial viability of the project therefore depends on the ability of the local PBS systems to generate sufficient revenues to cover expenses for power, operations and maintenance, debt service and depreciation.

The two cost variables which greatly affect local system financial performance are the wholesale power cost and the consumer rates. In light of the Government's approval role in establishing both of these rates, it has been necessary not only to establish a rate structure which would initially provide a sound financial operation, but also to set forth the criteria upon which all future rates will be determined. For the wholesale power cost, it has been determined that power will be sold to the PBSs at the marginal rate of power production for PDB. On this basis the initial power cost for this project is estimated at 17 paisa ($0.0113) per KWH. The final rate will be based upon production costs at the time of PBS energization (end of second project year).

The primary criteria for the consumer rate structure are 1) that each local system be self-financing given interest free system construction loans; 2) that charges reflect an affordable tariff for all user classes; and 3) that domestic service in particular be provided at rates lower than rates for other user classes. On this basis, several alternative rate structures were considered for this project, with the following selected as the rates which most closely meet all three rate criteria:

Class	Rate per KWH
Residential	60 paisa ($0.04)
Small Commercial	75 paisa ($0.05)
Large Commercial and Industrial	75 paisa ($0.05)
Agricultural	75 paisa ($0.05)

Subject to the above criteria and to AID approval, these rates will be reviewed by the Government at the time of system energization (end of second project year) to reflect cost factors as further defined during final system design, consumer sign up, initial procurement and construction. Rates for the REB will then be established both for areas under this project as well as for existing rural electrified areas which by then have come under the REB.

The cash flow analysis presented at Annex G sets forth the projected financial status of the PBSs over the 17 year construction period given the above rates. The sources of funds include consumer sales, capital loans and membership fees. The applications of funds include purchase of power, operations and maintenance and capital costs. For the purpose of this analysis debt service was based on a seven year grace period from year three through year nine (the first two years of pre-operational loans also coming due in year 10) with a 20 year repayment period. While this debt retirement schedule may be used by the REB as a target, PBSs generating cash margins ahead of schedule should begin debt repayment accordingly.

The total cash flow for all six feasibility areas is represented in Table 8 . 15/ Sufficient revenue is generated by the six areas to cover all expenses, including debt service and depreciation, from beginning of operation onward. Individually the areas demonstrate varying degrees of financial self-sufficiency. The financial targets for operations have been set at generating sufficient revenue to pay for all operating costs by the fifth year of operation for each PBS, and to begin loan repayment by year ten. All six areas are projected to meet or exceed both of these targets.

15/ Each feasibility area includes two PBSs. Data for the PBSs separately is not available, either for this financial analysis or for the preceding economic analysis. For both purposes however the area based data provides a sufficient analysis of the economic and financial feasibility of its parts. See also Economic Feasibility Part III.A. above.

TABLE 8

SUMMARY CASH FLOW FOR ALL PBSs
($ 000)

YEAR	Gross Cash Flow Ex-Debt Service	Debt Service	Net Cash Flow after Debt Service	Depreciation	Accumulated Cash After Depreciation
1	-	-	-	6	(6)
2	-	-	-	91	(97)
3	904	-	904	384	423
4	724	-	724	610	537
5	893	-	893	708	722
6	1,020	-	1,020	790	952
7	1,356	-	1,356	856	1,452
8	1,679	-	1,679	922	2,209
9	2,015	-	2,015	985	3,239
10	2,345	1,329	1,016	1,060	3,195
11	2,721	2,086	635	1,122	2,708
12	3,087	2,441	646	1,190	2,164
13	3,519	2,720	799	1,254	1,709
14	3,942	2,949	993	1,317	1,385
15	4,413	3,171	1,242	1,381	1,246
16	4,859	3,396	1,463	1,448	1,261
17	5,296	3,645	1,651	1,512	1,400

Two of the six areas however will only partially cover depreciation through this 17 year construction period. Both areas show a poorer cash position because of the high percentage of residential connections, lowering the average KWH consumption per connection. While the average of the feasibility study low and high load forecasts was used for this analysis, the high load forecast was in fact applied in the Study analysis. If the connection forecast of the Study is assumed, these two areas would attain significantly higher sales revenues, thus making all six areas fully self-sufficient from the beginning of operation. If in fact this does not occur, the following are possible alternatives for these two areas; 1) extend the loan grace period to allow a greater initial cash build-up; 2) place additional power use personnel in these areas to encourage agricultural/small industrial use of electricity; 3) invest the excess cash earnings from other areas, depositing interest earned in a depreciation account for these two areas; 4) establish ceilings for margins earned in operations, with excess margins being distributed to less profitable operations; 5) require only partial repayment of expansion capital loans (after year five) as has been done in other initial rural electrification programs; and 6) adjust rates for some or all areas, either for all rate categories or for non-residential only.

In summary, all of the areas are projected to meet operating costs and debt service, with the total project investment showing a $1.4 million return after all expenses at the end of the construction term. While two of the areas will require greater financial control and perhaps alternate financing arrangements, the initial cash positions will allow considerable flexibility in determining appropriate measures for depreciation allowance. It is therefore concluded that all six areas meet the basic criteria for financial self-sufficiency and should be included in the project.

3. Budget Analysis of REB

Primary recurrent financial responsibilities of the REB and approximate annual budget requirements are listed below. In the event that other donors contribute toward start-up of additional sub-project systems and enlarged REB operations, the project will provide that as the system expands adequate steps will be taken proportionately to increase the annual REB budget.

ILLUSTRATIVE ANNUAL REB BUDGET [16]
(U.S. Dollar Equivalent)

Item	Budget
Office Staff (See Annex B. 5)	60,000
Field Staff (PBS Advisors)	95,000
Office Rent (Approx. 8000 sq. ft)	25,000
Office Expenses	20,000
Per Diem and Travel	55,000
Training (Operation of Central and Field Operations)	150,000
Local Construction Contractors	500,000
Loan Program Defaults (at 10%)	100,000
Operational Loans to PBSs	90,000
TOTAL	1,095,000

This annual recurrent budget requirement of approximately $1.1 million equivalent compares favorably with the current budget for the PDB Rural Electrification Division. Combining the distribution construction funds to be transferred from the PDB Rural Electrification Division to the REB (the exact percentage of transfer will be prescribed in the course of project implementation and is expected to increase gradually to 100 percent by project completion)

16/ This represents the necessary increase in budget commitment and does not include the budget for PDB divisions to be transferred. Current PDB funds for these divisions will be allocated to REB as transfers occur. Also, the REB staffing requirements are subject to change according to future project activity levels for which decisions are yet to be made by the Government and other donors.

and the additional budget to be approved upon establishment of the REB, this recurrent budget is well within the funding ability of the Government. The requirement for adequate budgetary support will be contained in the project agreement, both through conditions precedent and covenants.

Additional commitments to system development after this initial project are a non-recurrent budget item not reflected in this budget. In light of the large financial commitment required for expansion of the systems from years six through year seventeen, donor assistance will be required from years six through ten, at which time REB should be able to commence reinvestment of local system loan repayments. The Government has already proposed in addition to the REB recurrent budget, a continuing project budget sufficient to meet annual project contribution costs for this project, with the intention that this budget will expand considerably as more areas come under consideration for electrification. This budget will be adequate to cover the continuing contribution necessary for second stage development of these six project areas.

Effective REB financial support and assistance to the PBSs, as well as similar planning of REB's own financial resources, is essential to the implementation of this project as well as to the long term development of a Bangladesh rural electrification program. Technical assistance therefore will be provided for this purpose directly to the Member Finance of the REB. The structure of the REB financial section, procedures for budget development, allocations to PBSs, financial accountability and auditing, and the designation of auditors will all be subject to AID approval as a condition precedent under this project for second tranche funding.

B. Project Financial Plan

The total financing requirement for this project is $66.667 million equivalent, of which $50.0 million will be funded by AID in three tranches. No other donor will be providing financial assistance toward this initial project. The foreign exchange component of the AID funds

will total $45.170 million, with the $4.830 million balance applied to local currency expenditures. The foreign exchange component will finance U.S. and Code 941 procurement and shipment of line, transformer, line protection, services, street lighting, substation, office, household, training and construction equipment . All foreign exchange commodity costs have been calculated on the basis of U.S. current prices. If competitive and acceptable bids are received from other Geographic Code 941 countries, some of the requirements for ACSR conductor, transformers, meters and hardware may in fact be non-U.S. source. The AID funded local currency expenditures include local currency costs for line and the local cost expenses for consultant support. Experience in other projects has confirmed the advantage of total AID funding for consultant support in order to avoid delays and difficulties that consultants often experience in securing timely local funding through Government procedures. The contract however will be between the consultant and the REB.

AID funding obligations are scheduled at $16.0 million as a loan in FY 1977, $21 million as a grant in FY 1978 and $13 million as a grant in FY 1979.

The Government will provide $16.667 million equivalent in local currency which will finance 78 percent of all local expenditures and 25 percent of total project costs. Government funds will be disbursed in approximately equal amounts for each project year. The Government local currency expenditures are to include construction commodites, local contractors and REB staff, support commodites and housewiring and small industries loans. The Government's construction commodity local currency costs are estimated as a percentage of landed commodity cost: 7 percent for in-country handling, 10 percent for labor and erection (casual labor not included in line construction contractor estimates), and where applicable 7.5 percent for insurance and other direct construction costs to reflect construction in off-road areas.

Table 10 sets forth the Summary Cost Estimate and Financial Plan. Construction commodity quantities and costs from Table 10 are further detailed at Table 11, with all other costs detailed at Table 12. For a more complete breakdown of costs, see Annex B.4. Table 13 sets forth the annual disbursement of AID and Government funds, with estimates of project input/output values shown at Table 14.

TABLE 10

SUMMARY COST ESTIMATE AND FINANCIAL PLAN
($ 000)

ITEM	AID FUNDS FX	AID FUNDS LC	BDG FUNDS FX	BDG FUNDS LC	TOTAL COST
CONSTRUCTION COMMODITIES					
Lines	20,147	3,130	-	170	23,447
Line Rehabilitation	1,870	-	-	1,445	3,315
Transformers	2,934	-	-	247	3,181
Line Protection	249	-	-	26	275
Services	4,706	-	-	486	5,192
Street Lighting	34	-	-	5	39
Substations	2,235	-	-	470	2,705
Spares	400	-	-	-	400
General Plant	300	-	-	2,616	2,916
Inflation/Contingency	5,870	-	-	760	6,630
Sub Total	38,745	3,130	-	6,225	48,100
TECHNICAL ASSISTANCE					
Local Contractors	-	-	-	2,500	2,500
Consultant	4,000	1,000	-	-	5,000
REB Staff	-	-	-	1,000	1,000
Sub Total	4,000	1,000	-	3,500	8,500
SUPPORT COMMODITIES					
Consultant	30	700	-	-	730
REB Office	50	-	-	392	442
Vehicles	148	-	-	-	148
Vehicle Maintenance	-	-	-	240	240
Training Equipment	210	-	-	870	1,080
Inflation/Contingency	87	-	-	440	527
Sub Total	525	700	-	1,942	3,167
PROGRAM LOANS					
House wiring	-	-	-	2,500	2,500
Small Industries	-	-	-	2,500	2,500
Construction Equipment	1,900	-	-	-	1,900
Sub Total	1,900	-	-	5,000	6,900
TOTAL	45,170	4,830	-	16,667	66,667

TABLE 11

ESTIMATES OF CONSTRUCTION COMMODITY QUANTITIES AND COSTS

ITEM	UNIT	UNIT PRICE	QUANTITY	L.C. COST ($000)	FX COST ($000)	TOTAL COST ($000)
LINES						
11/6.35KV, 2/0 ACSR; 400/230V,2/0 ACSR Underbuild	Mile	13,604	9.6	18	111	129
11/6.35KV, 2/0 ACSR; 230V, 2 ACSR Underbuild	Mile	9,048	158.4	188	1,148	1,336
11/6.35KV, 2 ACSR; 400/230V, 2/0 ACSR Underbuild	Mile	11,161	45.9	69	417	486
11/6.35KV, 2 ACSR; 230V, 2 ACSR Underbuild	Mile	7,264	2,082.0	2,020	12,339	14,359
6.35KV, 2 ACSR; 230V, 2 ACSR Underbuild	Mile	5,119	1,115.1	749	4,567	5,316
400/230V, 2/0 ACSR	Mile	6,929	79.5	72	444	516
230V, 2 ACSR	Mile	2,946	465.0	184	1,121	1,305
				3,300	20,147	23,447
LINE REHABILITATION						
PDB 33KV, 11KV & 400 & 230V Lines	Mile	Lump sum	299.7	1,370	1,370	2,740
Additional Pole Height Flooded Areas	Percent	Lump sum	32.1	75	500	575
				1,445	1,870	3,315
TRANSFORMERS						
Three Phase Transformers	KVA	39.55	31,695	69	890	959
Single Phase Transformers	KVA	44.62	53,616	158	2,044	2,202
PDB Transformers Replacements	Each	100	235	20	--	20
				247	2,934	3,181
LINE PROTECTION	Lot	Lump sum	6	26	249	275
SERVICES						
Large Power, three phase	Each	410	45	2	16	18
Medium Power, three phase	Each	194	1003	20	159	179
Small Power & Large Commercial, Single phase	Each	60	219	2	10	12
Small Commercial, Single phase	Each	54	14042	67	659	726
Small Residential, Single phase	Each	18	83828	395	3,862	4,257
				486	4,706	5,192
STREET LIGHTING	Each	15.10	2,710	5	34	39
SUBSTATIONS, 33-11/6.35 KV, 5 MVA	Each	122,489	24	470	2,235	2,705

TABLE 12

LINE ITEM COST ESTIMATES

ITEM	COST COMPONENT
Spares	Four lots of substation spares at $100,000 per lot. Spares for line components are subsumed under line item estimates.
General Plant	Facilities for the 12 PBS organizations as follows:

	FX	LC
Headquarters Buildings (12)	-	$ 552,000
Warehouse Buildings (12)	-	312,000
Residential Buildings (72)	-	1,164,000
Guest Houses (12)	-	240,000
Land (12 sites)	-	96,000
Office Equipment	60,000	228,000
Tools	60,000	12,000
Communications Eqpmt.	180,000	12,000
Total	300,000	2,616,000

Local Contractors	Approximately 28 local line construction, 12 substation construction and 12 engineering (survey, staking and supervision) contractors, the cost being estimated as 5 percent of construction commodity cost.
Consultant	All foreign advisors' services, totalling 56 work years (see Part V). Cost estimated at $90,000 per work year.
REB Staff	Costs estimated at $200,000 per year based on current Government salaries. Breakdown of staffing set forth in Annex B.5.

TABLE 12 (Cont.)

ITEM	COST COMPONENT
Consultant Support	Local currency for housing estimated at $1050 per month for 672 work months; foreign exchange of $30,000 for 10 lots of appliances.
REB Office	Local currency for rental of 8,000 sq. ft. office space for the newly established REB at $128,000, for office furnishings at $44,000, for office expenses at $100,000, and for field housing at $120,000; $50,000 foreign exchange for office equipment.
Vehicles	Six vehicles for expatriate advisors at $6,000 each; Two vehicles for REB headquarters at $5,000 each; Twelve construction inspection vehicles for PBS at $7,000 each; Thirty-six motor bikes for PBS operations at $500 each.
Vehicle Maintenance	Local currency expenditure for 1200 vehicle months at $200 per month.
Training Equipment	Local currency at $870,000 for establishment of the central training station and for providing aids for field training; foreign exchange at $210,000 for equipment for central training station.
Inflation and Contingency	Cost allowance for inflation and contingency set at approximately 15 percent of commodity costs. While initial large procurement will not be subject to high inflation factor, commodities will be ordered before final staking/design layout is known. Contingency therefore allows for additional procurement requirements per final layout. Commodities purchased after FY 1979 obligation will be subject to higher inflation rates but less contingency.
Housewiring Loans	Provision of approximately 144,000 internal wiring loans at $17.35 per loan.

TABLE 12 (Contd.)

ITEM	COST COMPONENT
Small Industries Loans	Provision of 1200 electrical equipment and appliance loans to small non-farm production units, loans averaging approximately $2000 each.
Construction Equipment Loans	Provision of loans to construction contractors for purchase of required line distribution equipment. Foreign exchange costs include equipment for 28 line contractors at $50,000 each, 12 substation contractors at $20,000 each, and 12 engineering contractors at $21,500 each.

TABLE 13

ESTIMATED ANNUAL DISBURSEMENT OF PROJECT FUNDS
($ 000)

AID	FY 78	FY 79	FY 80	FY 81	FY 82	TOTAL
Construction Commodities	18,175	18,000	5,700	-	-	41,875
Technical Assistance	1,000	1,000	1,000	1,000	1,000	5,000
Support Commodities	825	100	100	100	100	1,225
Program Loans	-	900	1,000	-	-	1,900
TOTAL	20,175	20,000	7,800	1,100	1,100	50,000
BDG						
Construction	1,700	1,500	1,525	1,500	-	6,225
Commodities	100	950	950	1,000	500	3,500
Technical Assistance	950	248	248	248	248	1,942
Support Commodities	-	-	1,000	2,000	2,000	5,000
Program Loans						
TOTAL	2,750	2,698	3,723	4,748	2,748	16,667

TABLE 14
ESTIMATES OF INPUT/OUTPUT VALUES
($ 000)

Inputs	Outputs *					
	A	B	C	D	E	Total
Construction Commodities	38,000	5,000	1,000	3,500	600	48,100
Technical Assistance	3,500	250	1,000	3,500	250	8,500
Support Commodities	1,167	-	500	1,500	-	3,167
Program Loans	1,400	3,000	-	-	2,500	6,900
Total	44,067	8,250	2,500	8,500	3,350	66,667

* Outputs are as follows :

A. Construction of all projects line and substations.

B. Connection of 268,000 consumers.

C. PBS takeover of financial responsibility for local system.

D. Training of REB and PBS staffs, to be conducted by Bangladeshis by end of project.

E. Issuance of all small industries loans.

Part V - IMPLEMENTATION PLAN

A. Administrative Arrangements

1. Recipient - Management Capability

a. The REB

The effectiveness of the REB as implementing agency is crucial to the success of the project. As noted earlier therefore the establishment and initial staffing of this organization will be a condition precedent to initial disbursement,

Both AID and the Government will be providing grant financing for this project directly through the REB, and in turn it will extend interest free loans to the PBS associations. These loans will be secured by a loan contract and mortgage, the terms of which will specify program objectives, level of technical assistance, and policy and procedural requirements which the PBSs must maintain, and the recourse available to REB in the event of default. Loan security will be provided by requiring REB approval of local general manager appointments, adherance to a prescribed rural electric accounting system, monthly review of operations and financial reports, maintenance of a specified number of consumers reflecting targeted connections for this project, maintenance of standard insurance coverage and specified rates, implementation of proper billing and conduct of efficient personnel administration procedures. Funds will be advanced to the borrower PBSs only as required to meet system development costs.

The capability of the REB to manage this project will depend on four major factors: 1) staffing; 2) Government commitment; 3) organizational structure and procedures; and 4) budget.

Concerning staffing, the PDB currently has a total staff of 18,000 employees, with an excess of both trained professional and skilled workers. Much of the future REB staff will therefore be comprised of trained personnel from the PDB. The REB professional Board Members will also have either current or previous work experience in the power sector. Thus the initial

technical capability of the REB staff will equal or exceed that of other Government agencies. The Project Agreement will contain covenants with respect to the appointment of the professional Members of the REB Board.

The Government commitment to rural electrification and to the REB is best demonstrated by the scope and substance of actions now being taken to establish the REB and by the strong support the Government has given to this project from the outset of the Feasibility Study. The Government itself has previously accepted a policy of extending electrification to all rural areas, and all actions taken in support of this project have been further evidence of that commitment.

The third factor, organizational structure and procedure, is critical to the effectiveness of the REB. Assistance in developing the appropriate structure and procedures will be the primary input of the four Consultant advisors to the REB. In addition, there is much to be learned from the currently overstaffed PDB organization structure. One major lesson which has already been taken into account is the risk of building up a large central authority to meet the needs of an initial construction/development stage. Now that the PDB has levelled off its own construction activities, there is idle capacity within the organization. Therefore, the establishment of the REB will also serve to improve the use of PDB personnel through transfers and increased work load. The REB at the same time will rely on local PBS staff and contractors for construction activities so that PDB excess staffing is not replicated.

The budget for the REB will be approved through the standard Bangladesh Government Annual Development Plan (ADP). For the purpose of this project, a request for allocation is now being processed. In addition, the PDB rural electrification budget has been temporarily frozen so that funds can be transferred to the new REB upon its establishment. The Project Agreement through conditions and covenants will also act to ensure that Government funding is timely and adequate to project requirements.

Pursuant to the above, the REB should have both the necessary capability to manage the project and eventually to achieve the capacity to oversee the expansion of electric service to all rural areas.

b. The PBSs

The PBS associations will also have the benefit of strong Government support and Consultant and REB guidance on organizational structure and procedures. In addition, the PBSs will have a strengthened operational capacity resulting from first hand knowledge of the project area, its residents and needs. The PBSs will not however have a similar source of trained personnel. With the interim provided by the procurement delivery time, coupled with a strong initial training emphasis, the PBSs should have a core management capability by construction start-up time during the second project year. The increase in effectiveness of this capacity will correspond to the expansion of the project work itself as the PBSs are exposed to training on the job and given greater responsibility. In view of the importance to PBS capability at all stages of the general manager, the REB will approve all general manager appointments and assign management advisors as required.

With respect to technical capabilities, even with an 80 percent illiteracy rate, there are approximately 15 million literate persons in rural Bangladesh to serve as a pool of potential PBS office employees. Many rural people also possess the basic manual dexterity required for linework and for related skilled jobs for which they can then be trained.

The development funds for the PBSs will be provided by the REB on a repayment schedule beginning in the 10th year with 20 years for repayment (see Part IV.A. above). Early operational budgets will also require loans from the REB, with these loans to be repaid as soon as cash margins are generated. These operational loan requirements are to be taken into consideration for the recurrent REB budget, so that both the REB and PBS systems will be financially sound given realistic projections of costs and revenues.

c. Target Group

Given the reach of electrification in terms of general welfare, community services and employment, the rate structure criteria and the minimum consumer levels proposed for this project, the rural poor should have reasonable access to a share in the benefits of the project.

2. AID

Implementation of this project will require the services of one AID direct hire electrical engineer for twelve work months per year during the life of the project. These services will consist of monitoring service contracts and project progress, reviewing bids, awards and technical analyses, field inspections, and determining project modifications as necessary. This Mission staff position has already been established and filled. Local hire engineering assistance for an equal term will also be required and this position will be recruited as soon as the project has been approved. In addition to electrical engineering there will be large Mission direct hire demand on a project development officer and initially also on the commodity logistics officer. Current and proposed staff levels should be sufficient to meet these requirements, as well as those of the evaluation officer and the collateral responsibilities of the other Mission project committee members.

Disbursement for all commodity procurement will be through direct AID letters of commitment, direct reimbursement or letters of credit. These payment procedures are to be determined through consultation with the REB and the Government, and will depend upon a finding as to the most expeditious method of financing for each project component, e.g., Consultant services, local expenses and off-shore procurement. As indicated in Part III.B, AID Geographic Code 941 source origin is recommended for commodity procurement for this project, also including Bangladesh.

B. Implementation Plan

As discussed above, the REB will be established and staffed as a condition precedent to initial disbursement under this grant. For the purpose of administering the grant, the Secretary, External Resources Division, Ministry of Planning, will be the principal Government representative, but it is expected that the Member Finance of the REB will be delegated implementing responsibility. All project actions concerning the local PBS associations will be subject to approval of the REB which will also be responsible for all financial and operational aspects of PBS activities.

The Project Performance Tracking (PPT) Schedule is set forth in Table 15. The PPT network diagram is at Annex D.

1. Monitoring

For the Government, monitoring of project progress will be the responsibility of the REB Board, which will be assisted by the Consultant. The Chairman and Member Administration of the REB and the four Consultant advisors to the REB will have primary monitoring responsibility for institutional development. The Member Engineering, the six Consultant PBS construction advisors and their six counterparts will assume the principal monitoring responsibility for the technical aspects of the project. The Chiefs of the PDB Procurement, Material and Equipment Section and of the Clearance and Movement Section and the Consultant logistics advisor will fill the monitoring role for procurement and logistics. All significant recommendations resulting from project monitoring will be reported to the REB Board for action, provided that any action changing the design of the project will require AID approval.

On the AID side, monitoring of the institutional development aspects of the project will principally be the responsibility of the project development officer who will be assigned as the project officer. Similarly, the electrical engineer will have the

TABLE 15

PROJECT PERFORMANCE TRACKING SCHEDULE

Country:	Project No.	Project Title:	Date:	/X/ Original	Approved:
BANGLADESH	388-0021	RURAL ELECTRIFICATION	July 11, 1977	/_/ Revision	

1.	Feb. 28, 1978	Consultant
2.	March 31, 1978	Training of REB & PBS staffs begins
3.	March 31, 1978	Contract(s) with local contractors signed
4.	June 30, 1978	Procurement actions for purchase of first tranche of off-shore commodities completed.
5.	Sept. 30, 1978	System design completed & approved.
6.	Sept. 30, 1978	Construction of PBS facilities begins.
7.	Dec. 31, 1978	PBS statute effective.
8.	March 31, 1979	Construction of initial PBS facilities completed
9.	March 31, 1979	ROW procurement in progress.
10.	March 31, 1979	ROW staking in progress.
11.	March 31, 1979	Distribution system contractor begins construction.
12.	May 31, 1979	Collection completed of additional baseline & control data for final evaluation
13.	Sept. 30, 1979	Transfer of construction divisions from PDB to REB.
14.	Sept. 30, 1979	Evaluation of REB & PBSs.
15.	Feb. 28, 1980	Consumer connections begin on completed line sections.
16.	Sept. 30, 1980	PBSs assume operation and maintenance of completed sections.
17.	Sept. 30, 1980	Begin final inspection & energization of completed sections.
18.	Sept. 30, 1980	Evaluation of PBS consumer profiles.
19.	Sept. 30, 1980	Consumer connections target achieved.
20.	Sept. 30, 1981	All system construction completed.
21.	Sept. 30, 1982	All sections energized and consumer connections completed.
22.	Sept. 30, 1982	Training of REB and PBS staff completed.
23.	Sept. 30, 1982	Final project evaluation.

main monitoring role for the technical work of the project, with the commodity logistics officer following the procurement and logistics aspects. The full project committee, which will also include the Mission legal advisor and controller and an agricultural development and program evaluation officer, will together discharge the Mission responsibility for coverage of the total project.

2. Logistics

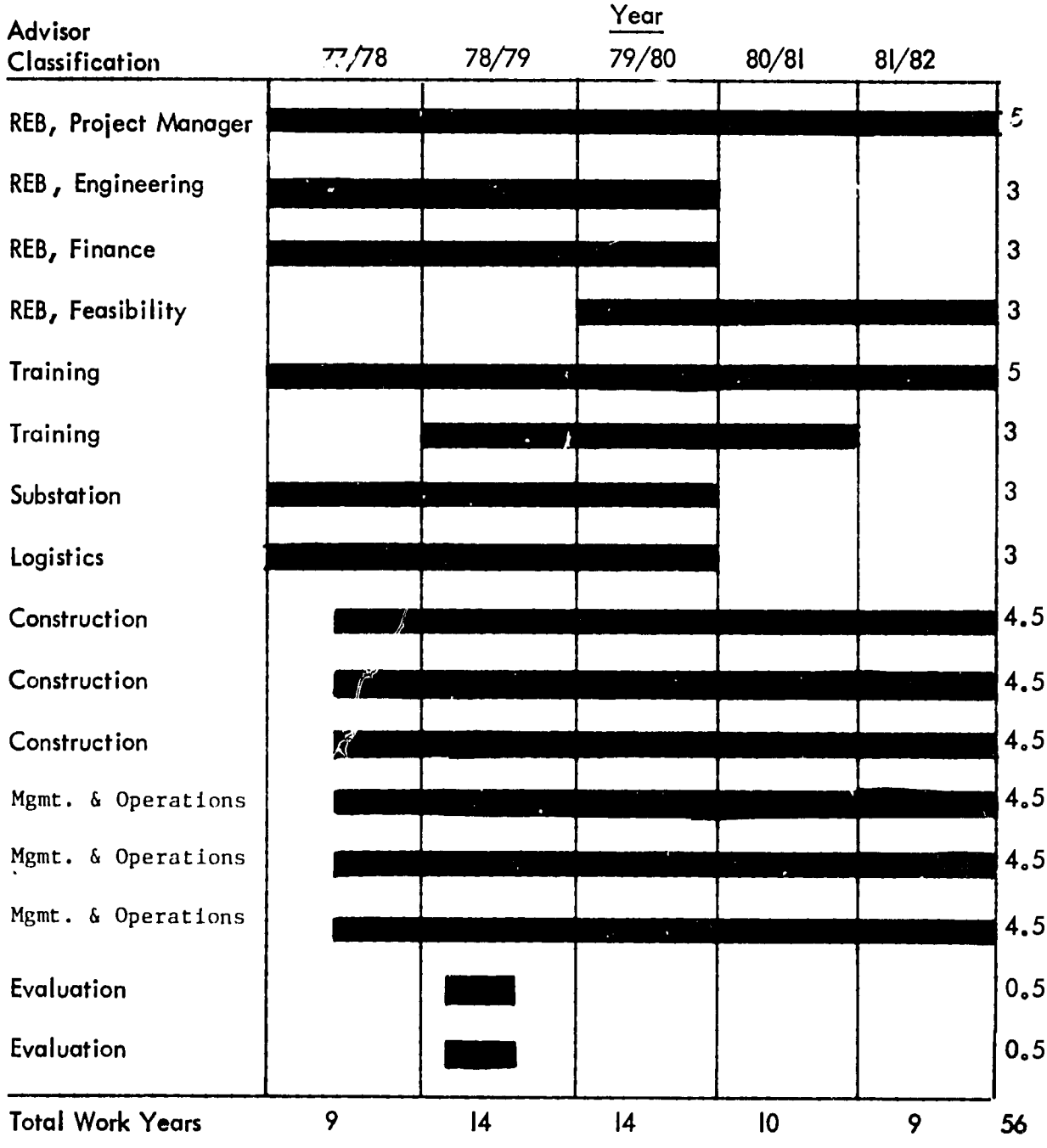
The logistics requirements for project commodites will involve import and warehousing of materials at Chittagong and Khulna, and rail, water and road transport of commodities to project sites and warehouses (see Part III. B., Technical Feasibility). The Consultant logistics advisor will work with PDB and succeeding REB staffs to install an expeditious and effective control system to ensure that project commodities will be delivered to on-site storage facilities on a timely basis. Effective logistics control, movement, storage and despatch of project commodities and materials will be critical to implementation of the project.

The logistics advisor will also work with the PBS associations as their capabilities expand to develop an inventory control system for project materials to be the responsibility of the PBSs. This logistics advisory role will be a continuing responsibility throughout the term of the project. Counterpart personnel will be assigned each by PDB, the REB and the PBSs and the training component will emphasize the development of a strong continuing logistical control capability. For the purpose of personnel logistics, the basic vehicle requirements for REB, the Consultant and the PBSs are to be financed under the grant. Project equipment will also be provided through REB for the PDB construction divisions and will remain directly under REB once these divisions have been transferred.

3. Consultant Services

There will be one host country services contract awarded for all Consultant technical assistance under this project. The contract will be funded on a cost reimbursable fixed fee basis and will cover the five year life of project. The chart below indicates the timing and yearly personnel levels proposed for the expatriate contract staff:

TABLE 16
PROPOSED ADVISORS



The above staffing represents an average of 11.2 persons in-country per year.

4. Remaining Feasibility Study Work

The major actions required prior to signing of the Project Agreement are to be performed in Phase II of the Rural Electrification Feasibility Study. These actions are now in progress and include preparation of:

1) design criteria and technical specifications for project systems;
2) rights-of-way clearance requirements and procedures;
3) final quantity and cost estimates for equipment materials, engineering, procurement and erection;
4) detailed work schedules for each project area; and
5) tender documents for construction and local and off-shore procurement.

It is particularly important to avoid project delays that off-shore materials procurement documentation is completed in time to proceed to procurement immediately upon signing of the Project Agreement. See Part III. B., Technical Feasibility for procurement arrangements and inventory control. See also Annex B. 7 for Phase II, Scope of Services.

C. Conditions, Covenants, and Negotiating Status

1. Conditions Precedent to Initial Disbursement

a) Government legal opinion as to binding character of the Project Agreement.

b) Designation of Government representatives authorized to act with respect to the Project Agreement.

c) Legal establishment of the REB, appointment of the REB Members, and subsequent establishment of an initial rate structure.

d) Evidence of Government approval of the project, including the funding arrangements and levels therefor, and of the establishment by the Government of a budget for the first year (1977/78) of the project.

e) Evidence that the REB has made arrangements to obtain the services of the Consultant for the project.

f) Assignment to REB work of the PDB personnel, organizational units and logistics support necessary to initial implementation of the project.

g) Selection by the respective Thana Parishad of the initial PBS board members in each sub-project area.

h) Establishment of procedures to ensure the expeditious Customs clearance of all commodities imported for the project.

2. Conditions Precedent to Disbursement Under FY 1979 Grant

a) Completion of the transfer of PDB construction divisions, and inspection and other staff from PDB to the REB.

b) Establishment of the rate structure for the project areas, such structure to reflect the following criteria:

1) all PBSs are to be financially self-sufficient subject to the condition that REB funding is provided to the PBSs on an interest free loan basis; and

2) domestic service will be provided at rates lower than rates for other uses classes.

c) Installation of the financial management system developed for the REB.

d) Legal establishment of the PBS organizations. This action should take place well in advance of the second funding cycle.

e) Assignment of one BSCIC and one BADC staff person to each PBS for the purpose of administering the small industries and agricultural power use programs respectively.

f) Completion of the initial evaluation carried out under the project and agreement on the implementation of recommendations which may derive therefrom. (See Part VI below.)

3. Covenants

a) The Government 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.

b) The Government 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.

c) The Government shall ensure that the REB both establishes sound financial and operational criteria and adheres to the minimum consumer levels in determining the eligibility of individual PBS organizations for loans.

d) The Government shall cause the PDB to supply electric power to the PBS systems as demand requires and at a rate equal to the national average marginal cost for production of electricity.

e) The Government 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 while at the same time maintaining maximum feasible service to low income domestic users.

f) The Government shall cause REB promptly to disburse sufficient funds to the PBS organizations for the purpose of meeting normal and usual operating costs incurred during the project which cannot be met by PBS generated revenues.

g) The Government shall cause all Government 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.

h) The Government shall cause the REB and PBSs to administer house-wiring and small industries loans in a sound financial manner and on the condition that such loans are to be extended only to potential electric consumers who without such a loan could not otherwise afford electric service.

i) The Government and AID shall cooperate fully to ensure that the project will be accomplished and to this end shall from time to time, at the request of either party, exchange views through their representatives with regard to the project.

j) The Government shall cause REB to carry out the project in accordance with plans, design standards, specifications, work schedules and construction methods acceptable to AID, and shall cause REB promptly to furnish AID such plans, design standards, specifications and work schedules, and any material modifications made thereon, in such detail as AID shall reasonably request.

4. <u>Terminal Dates for Conditions Precedent and Disbursement</u>

a) Conditions precedent to initial disbursement shall be met within one month from the date of signing of the Project Agreement.

b) Conditions precedent to disbursement under the FY 1979 funding shall be met within one month from the date of signing of the amendment to the Project Agreement providing for such funding.

c) Requests for issuance of letters of commitment or other funding documents under the initial loan must be made within 36 months from the date of signing of the Project Agreement.

d) Requests for issuance of letters of commitment or other funding documents under the FY 1979 grant must be made within 18 months from the date of signing of the amendment to the Project Agreement.

e) The terminal date for disbursements under the initial loan will be 48 months from the date of signing of the Project Agreement.

f) The terminal date for disbursements under the FY 1979 grant will be 36 months from the date of signing of the amendment to the Project Agreement.

5. Status of Negotiations

The provisions of this project essentially reflect the joint view of the AID Mission and the Government with respect both to the recommendations of the Feasibility Consultant set forth in the Feasibility Study Phase I report and the project requirements as perceived in the development context of Bangladesh. While all aspects of the project provisions have been reviewed and in many cases proposed by the Government, the following points are subject to further review:

a) Further details concerning the administration and use of the small industries loans must be decided with BSCIC. These will need to be defined prior to signing of the Project Agreement.

b) Specific conditions to be set forth under the proposed statute for establishment of the PBS organizations have not yet been determined. The determination of these conditions should wait until the initial PBS boards are in place to express their views concerning the appropriate organizational structure.

In summary, the Government has taken a leading role in the development of the rural electrification project and has both contributed initiatives and provided strong support. The result is a sound and agreed project.

Part VI - Evaluation Plan

A. Baseline Data

Adequate baseline data is essential if the evaluation is to demonstrate the qualitative and quantitative impact of electrification and indicate actions to maximize project effectiveness. As an initial step in data collection, a 5000 household survey was conducted by NRECA/CAI in 12 initial target Thanas. Of these 12 Thanas, six now represent "core" or geographic center Thanas of the six feasibility areas. Therefore approximately 2500 of the households surveyed are representative of the final project areas. Data is also available from unstructured interviews subsequently carried out in all Thanas of the six selected feasibility areas.

Data from the initial survey provide an adequate evaluation base for incomes, kerosene expenditure, crop production and patterns, migration, small industries, commercial and irrigation units and land tenure. The land tenure category also required considerable additional data and clarification derived from the preliminary findings of the Land Occupancy Study (see Part II. A, Social Analysis). While all of this initial data provided an adequate starting point in terms of formulating the project, there is a definite need for further baseline data collection for the following purposes:

1) to reflect conditions immediately prior to energization, which will not actually commence in project areas until September 1979;

2) to provide additional data from non-core Thana areas not included in the initial core Thana survey;

3) to revalidate findings of the initial survey, particularly in terms of income, which is very difficult to measure in Bangladesh;

4) to compile data which was absent or weak in the initial survey, these areas primarily relating to health and education, credit, population growth, communications facilities, crime, and the role of women; and

5) to collect comparable control baseline data in the Comilla Kotwali rural electrification area.

As a means of preparing a survey format consistent with the above needs, it is proposed that the Mission, with assistance from or through AID/W, be responsible for actual design and field testing of the survey questionnaires. Program Development and Support (PDS) funds would be used for this purpose to the extent required. Probably up to three work months of TDY assistance would be required. Design and testing of the questionnaires should be completed by October 1978, so that actual data collection could begin in the following months. Data collection is to be performed by two advisors to be funded under the project. These advisors are to be sociologists with specific prior experience in rural electrification evaluation/analysis. The duration of the survey is to be seven months, the two advisors spending one month in each of the six feasibility areas and one month in the Comilla Kotwali control area. The evaluation advisors will then return to the United States to complete analysis of the data per the recommendations of AID as established prior to the survey. The total estimated advisor time should be about 24 work months. It is currently envisaged that these advisors would work under a subcontract with the Consultant.

B. Evaluation

Three formal evaluation periods are recommended during the life of the project. The first will be in mid-1979. At this time the REB should have a basic operational staff, the PDB will be preparing to transfer construction divisions to REB, and the PBSs will have been legally established and also have initial operating staffs. The primary focus of this first evaluation will therefore concern REB and PBS institutional development, including financial and operating procedures, local participation, success of consumer sign-up, training progress, administration of housewiring loans, and general institutional effectiveness. In addition, particular attention will be centered on logistics and any problems which may have arisen in connection with commodity movement and storage. Recommendations from this evaluation should be available prior to obligation of the FY 1979 funds.

The second formal evaluation will occur during mid-1980. By this time approximately 25 to 50 percent of construction will have been completed and connections will have commenced. The primary area of emphasis for this evaluation will therefore be review of the PBS consumer profiles to ensure that connections actually

reflect the agricultural, small industry, and rural poor domestic consumers forecast for the project. To facilitate this analysis, all consumer sign-ups will be registered on a simple form indicating name, address, consumer category, current expenditure on kerosene or other fuels, income and employment. This evaluation should include a spot check survey on the relative accuracy of reported income data versus site visit estimates of income in view of the tendency of people to understate income for official survey purposes. An additional evaluation item during this period will be a review of line and substation construction procedures and the observed level of workmanship. Results and recommendations of this evaluation will be made available to all PBSs and the REB.

By mid-1982 the final evaluation should begin. This evaluation will concentrate on project performance in terms of end of project status. In addition, an assessment will be required concerning the ability of REB to conduct feasibility studies and subsequently to administer a full-scale rural electrification program. This evaluation will recommend as to the appropriate scope and rate of program expansion as justified by initial experience.

C. Ex Post Facto Evaluation

In view of the 17 year construction term for these initial project areas and the resulting long-term benefit stream period, there will be a need for post-project evaluation. There is also however a strong likelihood that AID and other donors will be providing assistance toward the second construction stage in these project areas. Post-project evaluation requirements will therefore be determined in conjunction with second phase construction plans.

D. Conduct of Evaluations

All three project evaluations will be conducted jointly by the Government and AID. The Government will assist in the design of evaluations, and will assign personnel as necessary to assist in field work. The REB and the Division of Power and Natural Resources, Planning Commission, will share this responsibility. Since the AID Mission will not have the staffing for these evaluations, TDY assistance will be requested for this purpose, utilizing AID/W evaluation specialists, Bureau of Census personnel on PASA contracts, or other contract personnel.

AID/W PRP APPROVAL MESSAGE

SUBJECT: FY 77 RURAL ELECTRIFICATION

SUMMARY: BASED ON APPROVAL BY ASIA PROJECT ADVISORY COMMITTEE OF PRP ON NOVEMBER 25, MISSION AUTHORIZED PROCEED WITH FEASIBILITY STUDY AND PREPARATION OF PROJECT PAPER (PP). IN ADDITION TO ISSUES CONTAINED IN PRP, REVIEW DISCLOSED FURTHER POINTS LISTED BELOW WHICH FEASIBILITY STUDY AND PP SHOULD ADDRESS. END SUMMARY.

1. FEASIBILITY STUDY: IT IS NOTED IN PRP THAT A FEASIBILITY STUDY IS A PRECONDITION TO THE PP.

2. ORGANIZATION: TO GIVE APPROPRIATE ATTENTION TO RURAL ELECTRIFICATION AID/W CONSIDERS SOME FORM OF SPECIALIZED INSTITUTION TO THE EFFECTIVE AGENT FOR IMPLEMENTATION OF THIS PROJECT AND OF CONTINUING BDG RURAL ELECTRIFICATION PROGRAM GENERALLY. IN ANY EVENT ORGANIZATION AND RELATIONSHIP OF RURAL ELECTRIFICATION ACTIVITIES TO BANGLADESH POWER DEVELOPMENT BOARD, ROLE OF COOPERATIVES (IF ANY), MEANS FOR LOCAL PARTICIPATION IN SUBPROJECT SELECTION, DESIGN AND IMPLEMENTATION, ETC., SHOULD BE WORKED OUT WITH BDG IN COURSE OF PROJECT DESIGN. THERE IS NO INTENTION AT THIS POINT TO IMPOSE A PARTICULAR METHOD OF RESOLVING THIS ORGANIZATIONAL REQUIREMENT, BUT THE QUESTION REPRESENTS MAJOR ISSUE AND MUST BE ADDRESSED IN VERY FIRST STAGE OF FEASIBILITY STUDY AND BY MISSION IN DISCUSSIONS WITH BDG.

3. SCOPE FOR AID FINANCING: PROJECT DESIGN SHOULD IDENTIFY WHICH PROJECT COMPONENT WILL BE AID-FINANCED. WE ASSUME THAT EXCEPT IN CASES WHERE THERE IS CLEAR ECONOMIC IMPERATIVE FOR DOING SO, AID FUNDING WILL NOT COVER TRANSMISSION LINES BUT WILL BE LIMITED TO DISTRIBUTION NETWORKS. WE ASSUME THERE IS SUFFICIENT DEMAND FOR AT LEAST FIRST TRANCHE OF LOAN TO CONFINE ELECTRIFICATION TO DISTRIBUTION FROM EXISTING 11 KV LINES. FURTHER TO THIS POINT, WHILE PRP STRESSED ENERGIZING PUMPS AS PRINCIPAL OBJECTIVE OF THIS PROJECT, USAID PRESENTATION AT APAC OFFERED SOMEWHAT DIFFERENT EMPHASIS, STATING THAT BASIC OBJECTIVE OF RURAL ELECTRIFICATION MUST BE TO PROVIDE EMPLOYMENT (AND, THEREFORE, INCOME) TO RURAL POOR. USAID PRESENTATION FURTHER EQUATED THIS OBJECTIVE WITH MARKET TOWN OR "CLUSTER" DEVELOPMENT FOSTERING COMMERCIAL AND LIGHT INDUSTRIAL ACTIVITY MADE POSSIBLE BY ELECTRIFICATION AND IMPLIED THAT USAID WAS IN DIALOGUE WITH BDG

TO WIDEN ITS PERSPECTIVE BEYOND A CONCENTRATION ON ELECTRIFICATION OF PUMP IRRIGATION. IN VIEW APPARENT PRESENT SYNONYMITY OF LARGER, MORE PROSPEROUS FARMERS WITH PUMP USERS, AID/W WOULD ENDORSE A PROJECT GOAL BETTER ORIENTED TO THE DESIRED TARGET GROUP WHICH MIGHT (IN THE FACE OF LIMITATIONS OF FUNDS) MEAN A TRADE-OFF BETWEEN PUMPS AND MORE MARKET TOWN DEVELOPMENT.

4. SCOPE OF PROJECT: PROJECT DESIGN SHOULD IDENTIFY AND QUANTIFY THE ACTUAL DISTRIBUTION SYSTEMS AND ELECTRIFIED AREAS TO BE INCLUDED WITHIN THE PROJECT: I.E., THE SCOPE SHOULD NOT BE OPEN-ENDED IN LISTING SIMPLY THE CRITERIA TO BE APPLIED IN SELECTION OF SUCH AREAS.

5. TARGET GROUP: PROJECT DESIGN SHOULD CLEARLY OUTLINE THE PROFILE OF THE TARGET GROUP TO BE AFFECTED BY THE PROJECT, AND THIS SHOULD BE REFLECTED IN SELECTION OF THE AREA TO BE ELECTRIFIED. PRINCIPAL EMPHASIS SHOULD BE DIRECTED TO PROSPECTS FOR PRODUCTIVE USE, EQUITY CONSIDERATIONS, AND MEANS OF ENSURING THAT PROJECT BENEFITS REACH SUCH GROUPS AS WOMEN, LANDLESS LABORERS AND SMALL FARMERS; AND TO ACHIEVEMENT OF SOCIAL AND HUMAN RIGHTS IMPACT. IMPACT ON MARKET TOWNS NEEDS TO BE PARTICULARLY ADDRESSED UNDER THIS HEADING.

6. ALTERNATIVE SELECTIONS: FACTORS REVIEWED IN PARAGRAPHS 4 AND 5 ABOVE SHOULD BE REFLECTED IN BASIC EVALUATION OF ALTERNATIVE AREAS AND CLEARLY SHOW THE BASIS ON WHICH ONE SITE OR SET OF SITES OF NEAR SIMILAR CHARACTER IS SELECTED OVER ANOTHER. OTHER FACTORS BEING EQUAL, "TIE BREAKERS" SUCH AS AREA DEVELOPMENT POTENTIAL OR OTHER DEVELOPMENT ACTIVITIES SHOULD BE CONSIDERED.

7. DATA BASE: SELECTION CRITERIA (PARA 4, 5 AND 6 ABOVE) SHOULD REFLECT FINDINGS FROM INITIAL DATA COLLECTION IN POTENTIAL AREAS, TOGETHER WITH EVALUATION OF ALREADY ELECTRIFIED CENTERS. THIS SHOULD BE EARLY STEP UNDERTAKEN BY MISSION WITH LOCAL NATIONAL CONTRACT ASSISTANCE AS REQUIRED. AS NOTED IN PRP, SUCH DATA WILL BE ESSENTIAL TO EXPEDITIOUS SCHEDULING OF FEASIBILITY STUDY TARGETS AND TO EFFECTIVE PROJECT DESIGN

8. SUBSIDY: FINANCIAL RESPONSIBILITIES, SHARING OF COSTS, ROLE OF SUBSIDY, RATES, ECONOMIC PAYMENTS, ETC., ALL NEED COMPLETE DETAILING AS NOTED IN PRP. ECONOMIC AND FINANCIAL RELATIONSHIPS ALSO SHOULD BE DESCRIBED IN DETAIL. SUBSIDY ANALYSIS SHOULD INDICATE SPREAD OF BENEFITS BY CLASSES OF USERS (E.G., INDUSTRIES, COMMERCIAL ESTABLISHMENTS, LARGE FARMERS AND SMALL FARMERS). YOU MAY ALSO WISH TO EXPLORE HIGHER SUBSIDIES FOR RURAL AS OPPOSED TO URBAN CONSUMERS AS BOTH A SOCIAL ECONOMIC INCOME DISTRIBUTIVE MECHANISM AND AS A MEANS OF STEMMING RURAL TO URBAN MIGRATION.

9. AS NOTED IN PRP, THE PP SHOULD INCLUDE APPROPRIATE ENVIRONMENTAL ASSESSMENT INCLUDING EFFECTS ON ECOLOGY RESULTING FROM THE PROJECT.

10. PP SHOULD INCLUDE AN APPROPRIATE EVALUATION PLAN WITH DETAILED AND SPECIFIC CRITERIA FOR EVALUATION.

11. LOGICAL FRAMEWORK. REVIEW AND DISCUSSION OF PRP SUGGESTS THAT PROJECT GOAL AND PURPOSE AS DEFINED IN LOGFRAME SHOULD BE RESTATED IN TERMS OF PROJECT DESIGN REFLECTED IN TEXT OF PRP. PRELIMINARY DISCUSSION, FOR EXAMPLE, INDICATES THAT GOAL MIGHT BE BETTER EXPRESSED AS "IMPROVEMENT OF RURAL ELECTRIFICATION AGENCY WITH THE CAPABILITY EFFECTIVELY TO PLAN, IMPLEMENT, MAINTAIN, EVALUATE AND EXPAND RURAL ELECTRIFICATION SYSTEMS".

LOGFRAME WOULD BE RESTATED IN ITS OTHER PARTS TO REFLECT ANTICIPATED INCREASES IN RURAL PRODUCTIVITY, SUCH AS AGRICULTURE AND RURAL INDUSTRIES.

12. OTHER DONORS: PRP MENTIONS POSSIBILITY OF OTHER DONOR PARTICIPATION IN MEETING BDG ELECTRIFICATION GOALS. IN VIEW OF POTENTIALLY LARGE DEMAND FOR SUCH INFRASTRUCTURE IN RURAL BANGLADESH WHICH AID ALONE WILL OBVIOUSLY NOT BE ABLE TO SATISFY, EFFORT SHOULD BE MADE AT EARLY STAGE TO ENLIST MORE SERIOUS EXPRESSIONS OF OTHER DONOR INTEREST AND INTENT PERHAPS AS WELL AS PARTICIPATION IN STRATEGIES, INTER ALIA, FOR INSTITUTIONAL DEVELOPMENT. SUCH INFORMATION WILL ALSO BE USEFUL IN HELPING AID DETERMINE IF IT IS PROGRAMMING THE RIGHT MAGNITUDE OF RESOURCES FOR THE OVERALL PROGRAM.

13. INTERIM REPORT: REQUEST INTERIM REPORT AT COMPLETION "FIRST PHASE" OF FEASIBILITY STUDY/PROJECT DESIGN BUT IN ANY CASE NOT LATER THAN NOVEMBER 1, 1976, COVERING MINIMUM OF FOLLOWING ISSUES: (A) NEGOTIATED BDG/USAID STATEMENT ON PROGRAM'S ULTIMATE OBJECTIVES, WITH SPECIAL REFERENCE TO FOCUS ON PUMP ENERGIZING VIS-A-VIS EMPLOYMENT AND INCOME GENERATION FOR POOR TARGET GROUP: (B) UNAMBIGUOUS QUANTITATIVE AND QUALITATIVE FIX ON ANTICIPATED BENEFICIARIES; (C) NEGOTIATED ORGANIZATIONAL AND OWNERSHIP SOLUTION; AND (D) OUTLINE OF SUBSIDY POLICY.

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BASIC SYSTEM DESIGN CRITERIA

Operating Frequency

All existing electric utility systems in Bangladesh operate at 50 hertz (cycles). The rural electrification systems will interconnect with and obtain power from the existing transmission network and therefore will also 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

The most commonly used distribution system voltage in use by U.S. rural electric systems is 12.5Y/7.2kv, although there are a considerable number of systems using 24.9Y/14.4kv lines, especially in sparsely populated areas.

In Bangladesh the present 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 the 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 the proposed areas, it is recommended that the proposed new distribution systems be operated at 11Y/6.3Kv while using 12.5Y/7.2Kv levels of insulation and general design standards. Note the following examples of possible feeder area layouts.

Assuming an 11Y/6.35Kv 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 - 2/0 ACSR R-0.708/mile Y=0.686/mile.
Branch conductor - 2 ACSR R=1.410/mile X=0.704/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 2/0 ACSR main feeder	-	5.37
435	% Volt drop to end of 2 ACSR branch	-	2.23
	Total % drop	-	7.60

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 2/0 ACSR main feeder	-	5.38
330	% Volt drop to end of 2 ACRS Branch	-	2.01
	Total % drop	-	7.39

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 2/0 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 2/0 AGSR main feeder	-	4.86
480	% Volt drop to end of 2 AGSR branch	-	2.86
	Total % drop	-	7.72

The total drop is just slightly over the 7.5 percent recommended for the primary. This can be compensated for by limiting the amount of secondary installed along the end of this branch. The feeder area served would extend approximately 5.5 miles from the substation (4.5 miles of 2/0 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.

4. 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 2/0 ACSR main feeder	-	5.89
160	% Volt drop to end of 2 ACSR branch	-	0.96
	Total % drop	-	6.85

With 10 KVA/square mile of load, the feeder area served would extend approximately 10 miles from the substation (nine miles of 2/0 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 2/0 ACSR main feeder	=	6.36
	% Volt drop to end of 2 ACSR Branch	=	1.46
	Total % drop	=	7.72%

With 15 KVA/square mile of load, the feeder area served would extend approximately 8.5 miles from the substation (7.5 miles of 2/0 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 substations 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 12.5Y/7.2 kv have been in service and proven for many years, and it is recommended that the system should be designed to meet these insulation parameters. 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. Contaminated 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 leakage 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 $10\frac{1}{2} + \frac{1}{2}$ inch.
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	34 kv.

(e) Secondary and service system will be designed using material and equipment for less than 300 voltsphase 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 (XLP) 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) specifies standard voltage levels at the service entrance point and point of utilization.

ANSI Standard Voltage Range

Nominal voltage	Maximum voltage	Range A		Range B	
		Minimum service voltage	Minimum utilization voltage	Minimum service voltage	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 rural electrification program for this project anticipates that a substantial part of the electrification effort will be to provide lighting in rural households. Because of the low income levels of a large portion of the prospective rural household customers, the cost of a light bulb will be a substantial customer expenditure. It is imperative, therefore, that the level of service voltage be established at a value which will prevent excessive lamp burn out. Maintaining a maximum voltage of 105 percent of the predominant lamp rating will achieve this. 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 is recommended for this project.

A nominal 230 volt service voltage level is presently established in Bangladesh. The 230 volt base level is also being considered by the IES as the standard base voltage to replace existing IES 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 and is recommended for this project.

Recommended 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 volt-drop (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 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 25 KVA and above, providing 25 KVA or more of individual motors, 15 hp minimum, or other three phase equipment are 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. At 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 AAC)	Circuit	KW-Feet (80% P.F) 3% Voltdrop	At 50 KVA/mile maximum secondary length(feet)	At 130 KVA/mile maximum secondary length(feet)
2 AWG	3 wire	8100	1460	910
2/0 AWG	3 wire	13200	1860	1160
2/AWG	4 wire	12200	1800	1110
2/0 AWG	4 wire	20000	2300	1420

The 2 AWG conductor size provides adequate secondary reach and is recommended for narmal 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 centres be established with 2 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)
2 AWG ACSR	2 wire	1350	1625

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 phase loads, but this will be undertaken only with careful consideration of maintaining 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 $1\frac{1}{4}$ 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/6.35Kv 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 a power factor of 0.9. One of the most important benefits of shunt capacitor 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 fault conditions. The system to be protected in this instance is a solidly grounded 11.0Y/6.35Kv, four wire multi-grounded 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 a 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.

On overhead transformer installations, the arrester should be connected to the transformer source. The ground wire lead should be connected to the arrester and interconnected to the transformer tank and secondary neutral.

Feeder Sectionalizing and Switching

In the interest of reducing cost and dependency on a large quantity of apparatus requiring regular maintenance for dependable operation, the broad initial use of hydraulic sectionalizing devices on feeder circuits is not being recommended. One three phase automatic oil circuit recloser is proposed to be installed on each feeder main circuit. Both oil reclosers or sectionalizers on branch circuits will be used only when operational experience shows that they are necessary.

Each primary branch circuit, three phase or single phase, which is tapped from the main curcuit will normally be sectionalized with fused cutouts. These branch circuit fuses will protect the main circuit from trouble on the branch circuits. Branch circuit fuses will be sized with the largest possible fuse size that can sense minimum current fault conditions occurring on the branch circuit. Larger fuse sizes will reduce the frequency on fuse failure due to lightning surges. NEMAT type 50 ampere fuses will be the preferred minimum fuse size on any initial installation.

Normally, it is not recommended that any automatic sectionalizing devices be installed on branch on tap circuits beyond the branch source fuse in order that detection of branch circuit outages can be confined to the vicinity of the main feeder. Additional fusing, however, may be required where it is believed abnormally hazardous conditions exist.

The location of reclosers or fuses should be easily accessible whenever possible.

Exhibit C presents a typical feeder protection scheme proposed for the project.

Fused cutouts will be open dropout type containing explosion type fuses. Cutouts will be rated 100 amperes 15 kv, 95 kv BIL, 700 ampere interrupting capacity. All fused cutouts will be provided with hooks permitting the operation of portable load break tools.

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 one fast and three 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" x 8'-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 on 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 two conductor sizes, 2/0 ACSR AWG and 2 ACSR AWG, 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	2/0	2
Branch Circuit - Primary	3	2	2
Top Circuit - Primary	1	2	2
Main Circuits - Secondary	3	2/0 or 2	2
Main Circuits - Secondary	1-3 wire	2/0 or 2	2
Main Circuits - Secondary	1-2 wire	2/0 or 2	2
Branch Circuits - Secondary	1	2	2

The following service conductor sizes are recommended:

Size, AWG	Type
# 16 CU	Local Two-Core Cable (for low usage residential)
# 6 AL	Duplex
# 2 AL	Duplex
# 2 AL	Triplex
# 2 AL	Quadruplex
# 4/0 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 of uniform design consisting of a single incoming supply line, a primary insulating 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 exits, 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 reclosers 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 portions 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 at least six percent impedance. 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 proposed 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 proposed below for this project.

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'	-
Pedestrian 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.

Mechnical Line Design Considerations

Where appropriate, structural line design should be in accordance with REA Bulletin 160-7, "Distribution Line Design (Mechanical)". Design factors should however be 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 33 kv subtransmission system.

(2) Stepdown substations which transform voltage from 33 kv 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 troubleshooting the location of automatic sectionalizing devices will be restricted, inasmuch as possible within acceptable operating practices, to the main circuit or other locations assessible by vehicles or boats.

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

Distribution System

A primary distribution voltage of 11/6.35 kv which is recommended is consistent with the 11 kv, 50 hertz primary voltage presently in use throughout Bangladesh. New feeder systems will be designed with multiple grounded 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 feeders branching from 33-11 kv supply substations. The 11 kv primary voltage therefore should be adequate. 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 recommended 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 coverage 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

Load projections which have been prepared indicate that the majority of feasibility 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. In the system design proposed for the project, substations have been located according to spacings adequate to meet 15 year load projections, and these substations are proposed to be installed during the initial project. Consequently, no

foreseeable main circuit reinforcement is considered necessary. Primary branch circuit extensions away from main 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 coventional 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 grounded neutral primary system.

(5) Three phase main circuits and principal branch 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

Per discussion above, it is proposed that automatic sectionalizing be 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 navigable 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.

The portionsof the project areas estimated to be flood-prone are shown below:

Area	Area in square miles	Percent flooded
Chunarughat	865	7
Daudkandi	638	99
Jhikergacha	706	6
Kaliakair	595	51
Natore	765	13
Shahzadpur	804	16

Most project 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 10 to 15 feet. There are also a few cases where sustained flooding in excess of six feet will be encountered in the project areas, but available information suggests these to be the exception.

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 depth.	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 sway 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 avoided with the use of duplex type cable for secondary circuits. Primary lines, on the other hand, when required to cross wooded tracts, must have sufficient right of way, and subsequent clearing maintained, to keep trees effectively away from the lines.

Substations

Substations of basically uniform design are proposed. All substation voltage transformation will be 33 kv to 11/6.35 kv. Substations will supply two 11/6.35 kv feeders through either a 5 MVA or 2.5 MVA three phase transformer, and substation capacity initially installed should be sufficient to meet the 15 year load forecast.

Three phase transformers are proposed in all substations with an above average level of protective device. Three phase units built by major manufacturers have proven reliable, and use of three phase units also offers some basic initial price advantage over single phase transformers.

Further study however is being conducted addressing the following considerations: (1) on the basis of one spare substation transformer for every four operating stations, the cost advantage of a single phase spare would just about offset the price advantage of the three phase units in the initial installation; and (2) the availability of equipment expeditiously to move a 36,000 pound three phase unit in and out of a rural station as compared to a 14,000 pound single phase unit, if or when that may be required.

As discussed above, single phase automatic voltage regulation of the 11 kv supply bus will be necessary in view of 33 kv voltage fluctuations. Although voltage regulators are a sophisticated mechanical device, acceptable distribution system voltages cannot be ensured without them. In the interests of minimum cost, three phase oil circuit reclosers are proposed for substation feeder breakers. See details above, page 18 of this Annex.

A strong emphasis during project implementation will be placed on training and routine practice of recloser and regulator maintenance.

Supply Reliability

Design of the systems will provide adequate protection, sectionalize faults within reasonably small areas, and at the same time prevent disruption back through the substation into the PDB subtransmission circuits.

Information available to date from 33 kv line outage records indicates that failures are frequent but generally of short durations. This indicates a need for more precise settings or coordination of relays, or the elimination of conditions leading to temporary faults, such as interfering trees, flopping jumpers, cracked insulators, faulty lightning arresters, etc. In Bangladesh, 33 kv line with 50 or less interruptions per year can be considered reliable, where the number of recorded 33 kv line interruptions is frequently greater than 100. Except for the Kaliakair area, where interruptions on 33 kv lines from Tongi substation to Sabhar and Tangail exceed 250 each year, those lines serving the 33-11 kv substations in the other areas appear reasonably reliable. Overall improvement in 33 kv subtransmission reliability is expected to take place as the PDB carries out a program to correct current system defects.

Consolidation of Area Distribution Facilities

In all project areas, varying amounts of existing PDB distribution facilities exist, mostly located along major roads. In general, existing PDB 11 kv lines will be incorporated into the project system and the load presently being supplied at 11 kv or 400 or 230 volts turned over to the new systems along with the associated facilities. It is expected that in several instances the existing PDB facilities will require renovation work to raise reliability to an acceptable level. The detailed requirements for this renovation work will be addressed in Phase II of the Rural Electrification Feasibility Study, although the costs of this work have been reflected in the Phase I estimates.

In addition, in the project areas there are also a considerable number of distribution connections to the 33 kv lines which pass through the areas. These consist of direct 33000-400/230 volt distribution transformer connections as well as short 33 kv branch line extensions

which serve relatively small loads. In the interest of removing all possible exposure to the 33 kv subtransmission supply system, distribution from 33 kv will be transferred to the new 11 kv distribution system.

Existing and under construction 33-11 kv substations in the project areas may also be consolidated into the new system. The decision to do so will be made on the basis of spare capacity and condition of the facilities, and will be addressed in more detail in Phase II of the Rural Electrification Feasibility Study. It is not expected however that substation consolidation will be undertaken unless all 11 kv feeders extending from the substation are to be the responsibility of one of the operating PBSs.

Areas of present and under construction PDB electrification of pumps and irrigation projects have been identified and recorded on the layout maps. In the Phase II detailed design, the project lines will be routed to coordinate with proposed as well as existing PDB 11 kv lines to avoid conflict in these areas. Also in Phase II the proposed substation locations will be reviewed in terms of PDB substation planning for pumps and irrigation projects to ensure compatibility between the two systems.

Subtransmission Supply Capacity

It is difficult to obtain accurate information as to actual loading and reliability of PDB facilities because a large portion of substation meters are inoperable and log books, maps and diagrams often are often not available. However, through a combination of field observations and review of data from PDB offices, a reasonably confident picture has emerged concerning the bulk power supply capability for the six project areas over the initial five years of system operation.

Particular attention has been given to 33 kv system capability, including the stepdown transformer capacity at grid substations (supplying 33 kv from the 132 kv or 66 kv network). Taking into account reinforcement works under construction or approved at PDB grid substations, sufficient 33 kv capacity should be in place to serve adequately both the project growth and growth of existing load through the initial five years of operation in five of the six project areas. These relative loads and substation capacities are as follows:

Area	Estimated 33 kv source substation capacity (MVA)	Existing demand on capacity (MVA)	Estimated 1984 demand on capacity (MVA)
Chunarughat	28	6	20
Daudkandi	44	16	40
Jhikergacha	20	12	29
Kaliakair	106	18	44
Natore	21	8	20
Shahzadpur	6	1	6

In the Jhikergacha area, PDB will be required to provide additional grid substation capacity soon after 1980.

The capacity of 33 kv lines appears adequate within a 10 percent voltdrop range in all areas to supply for the initial five years the project loads along wit growth of existing load in the same areas. In several areas 33 kv lines which are under construction have been considered as available supply sources for new substations proposed for the project.

Household Services and Wiring

From the Rural Electrification Feasibility Study survey data it is estimated that each family "bari" consists of approximately three households, with one kitchen often shared among all three households. It was therefore determined that one service and meter could adequately serve an average of three households. It is recommended that the PBSs own and install the service wiring to and including the meter, providing a minimum capacity of 15 amperes. The meter would be installed on the consumer's main house or on a riser or yard pole furnished and installed by the owner of the premises.

Individual households within a bari would pay for the wiring installation from the meter to and within their respective house. This wiring should include a 15 ampere fused switch adjacent to the meter and connected to the load side, a minimum of two 15 ampere cutouts, one ceiling light fixture with a wall switch and one convenience receptable.

Based on a service to a bari consisting of three households with three houses and a kitchen to be electrified, an estimate has been prepared for the material and labor required for the premises as follows:

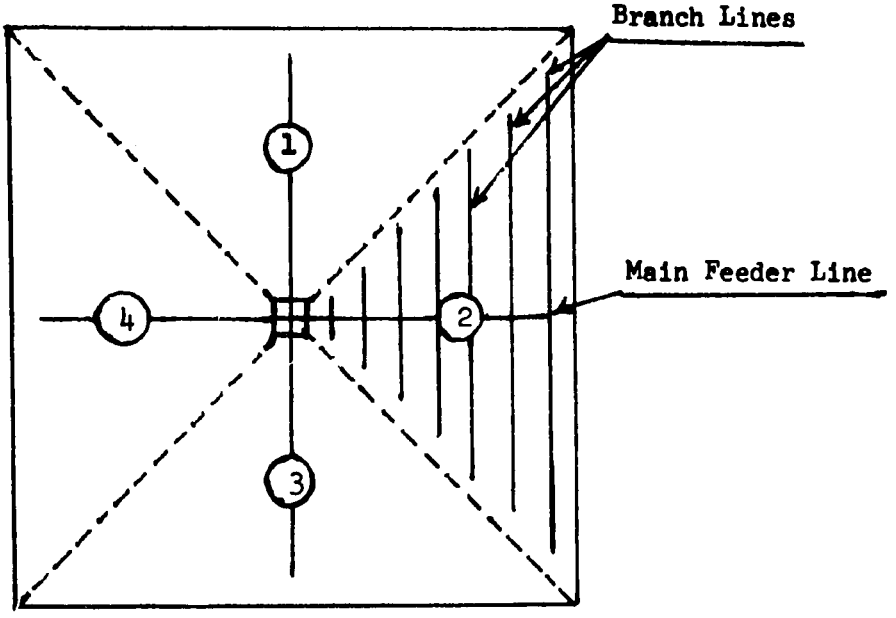
Quantity	Item		Total Cost (Taka)
3	Bamboo Poles		45
1	Wooden Encloser for Meter and Main Switch		15
1	Loop Earthing Ground No.12 SWG		24
1	15 Amp Double Pole Switch		95
100 Ft	No. 10 CE Messenger Wire		25
100 Ft	Twin Core U.P. Wire 3/0 029		165
8	15 Amp Cutouts on a Board		60
4	S&F Ceiling Light and Bulb		21
4	S&F Amp. 3 Pin Plug Socket		60
4	5 Amp Light Switch		20
60 Ft	Surface Wiring with 2-3/.029 Conductor		120
	Contingency		59
	Labor and Overhead		71
	Total Cost/Three Households	Tk	781
	Cost/Household	Tk	260

A suggested wiring plan for a typical three household bari is shown at Exhibit E.

EXHIBIT A

SUBSTATION FEEDER ARRANGEMENTS
INVESTIGATED

FOUR FEEDER AREA



TWO FEEDER AREA

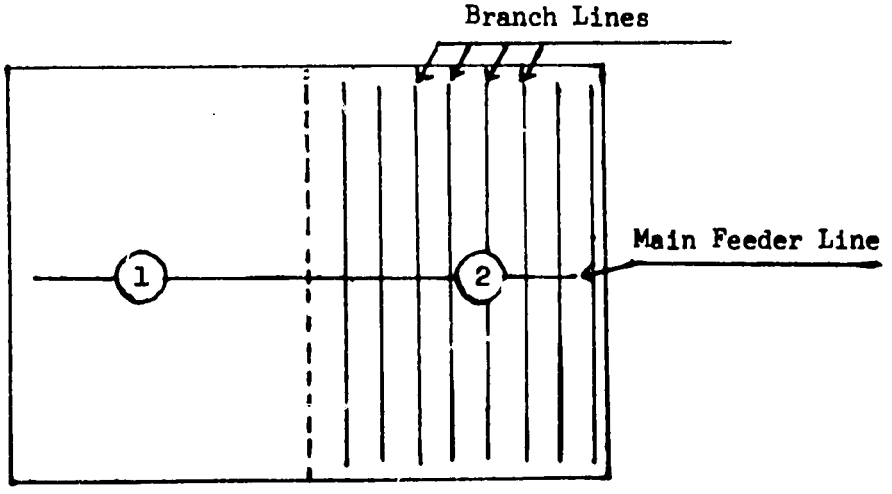


EXHIBIT B

TYPICAL SUBSTATION SUPPLY AREAS

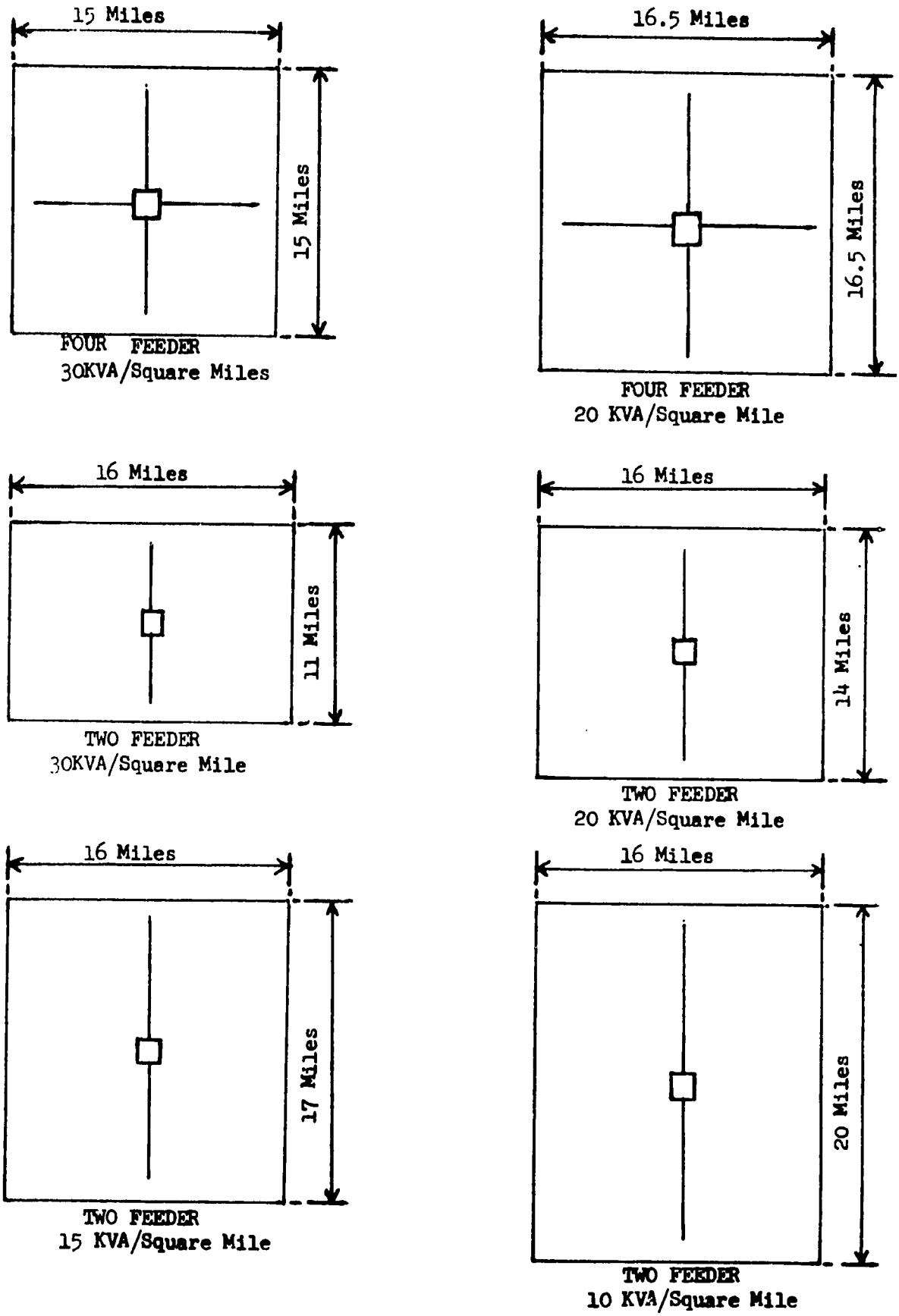
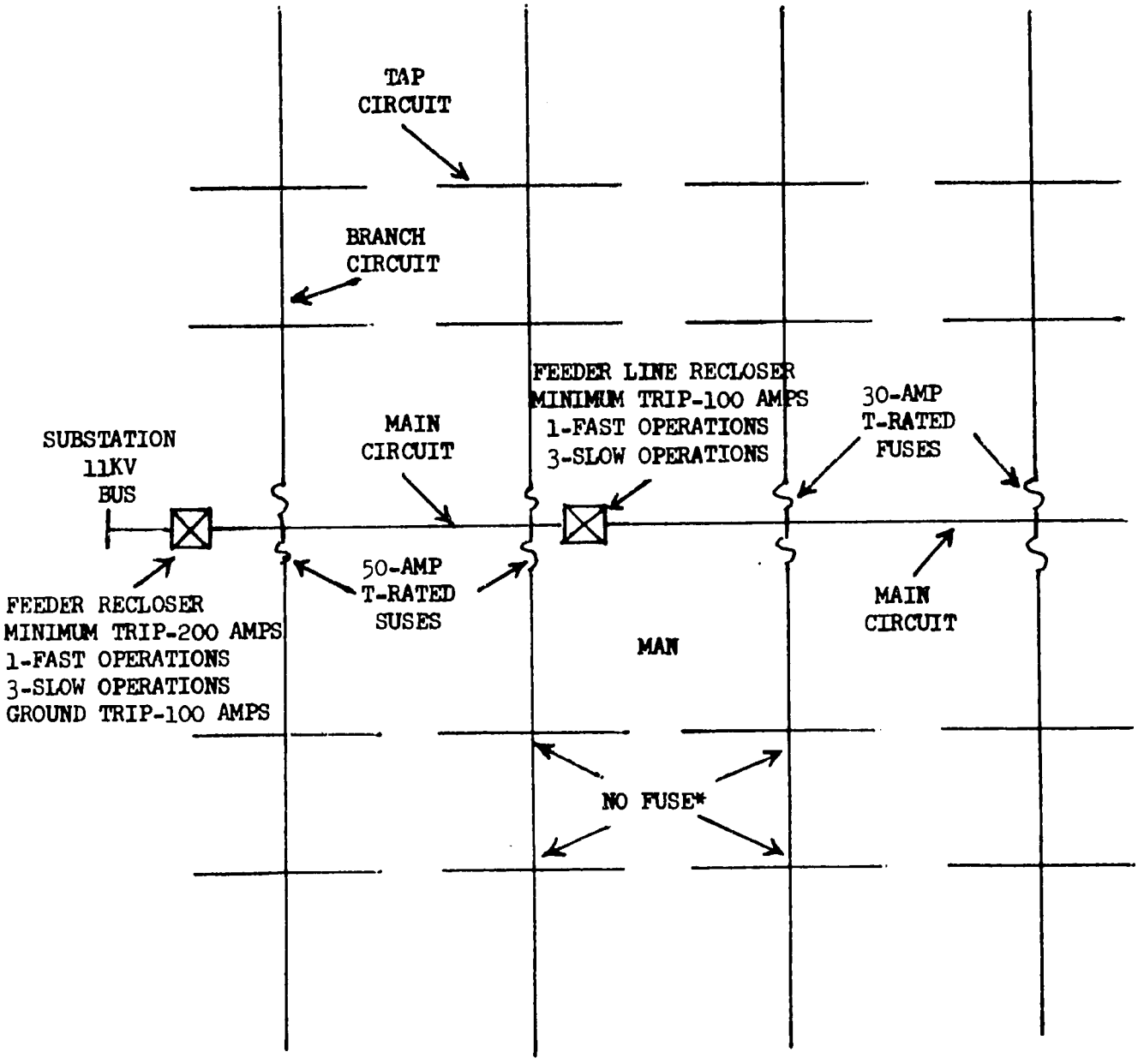


EXHIBIT C

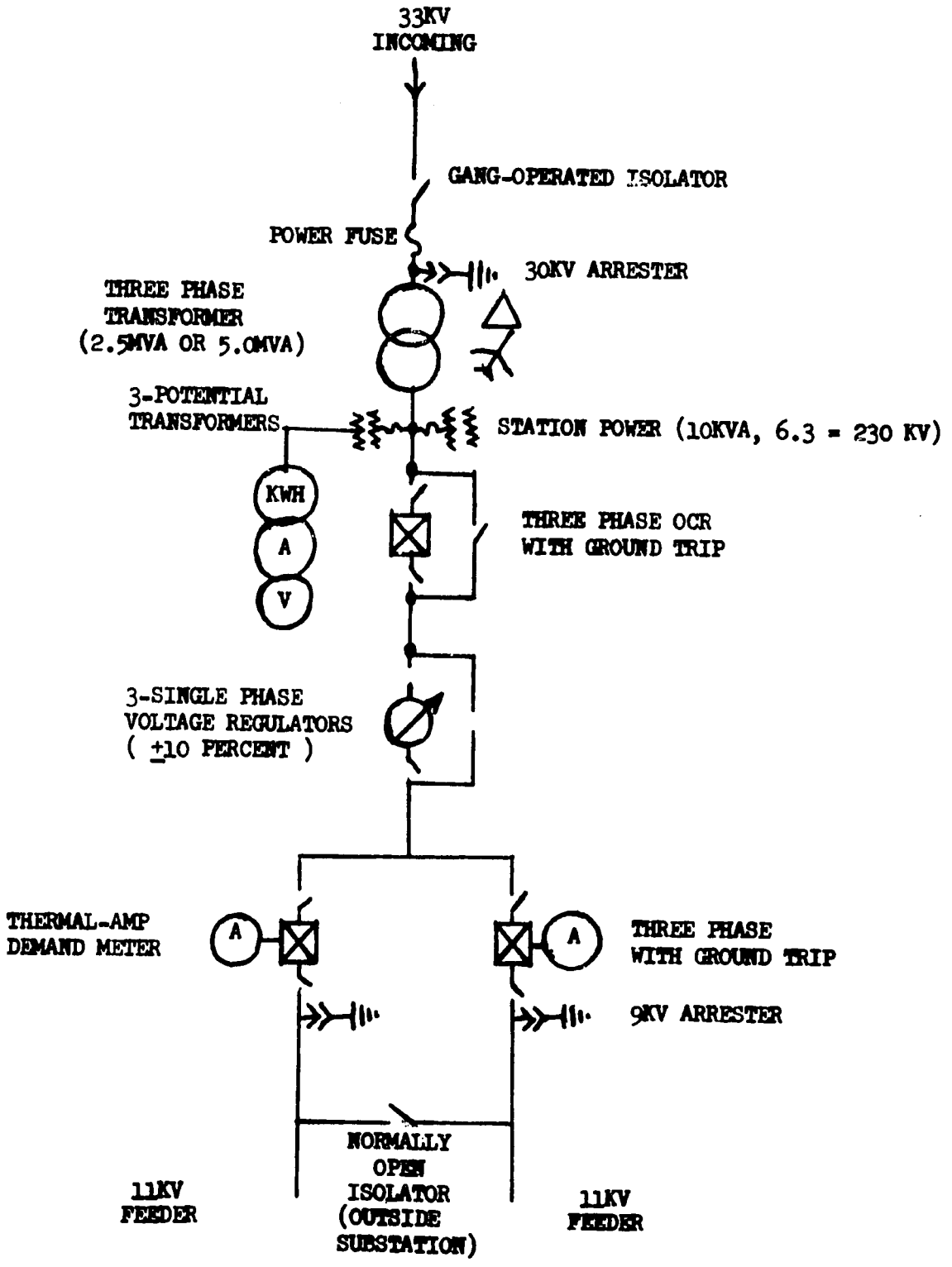
TYPICAL FEEDER
PROTECTION SCHEME



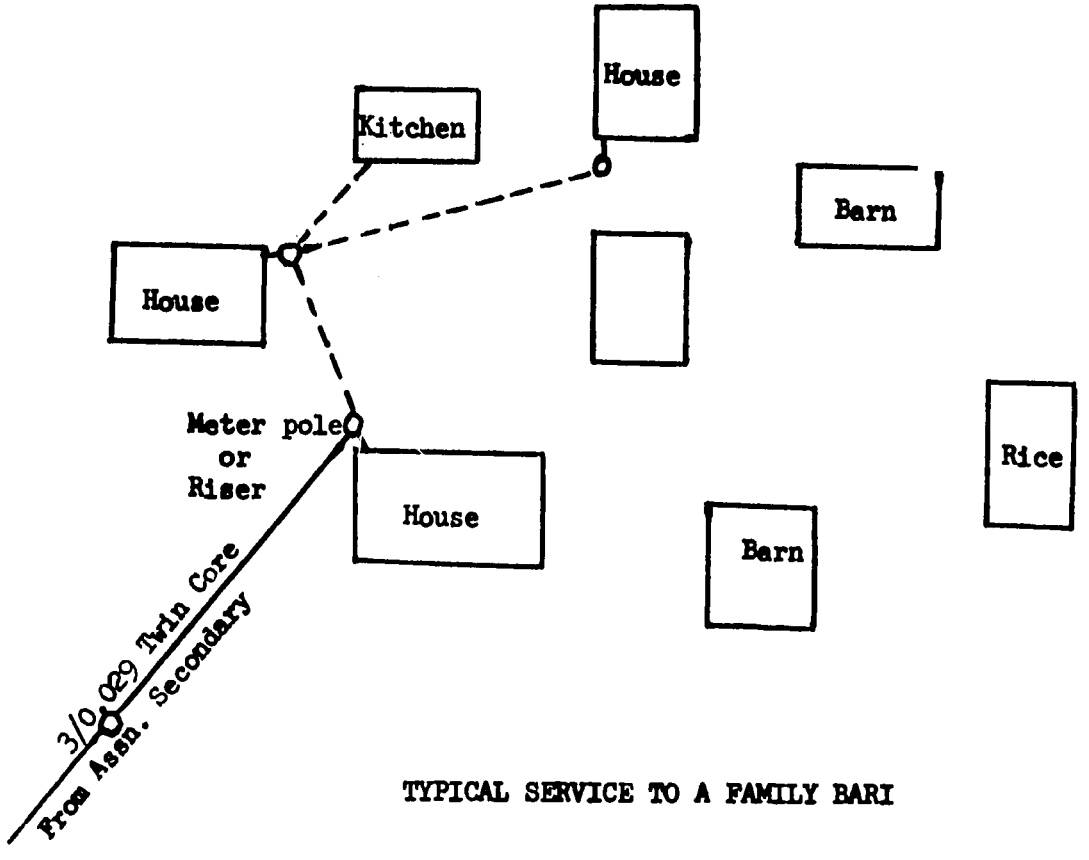
*TAP CIRCUITS NORMALLY NOT FUSED UNLESS ABNORMALLY
HAZARDOUS CONDITIONS WARRANT

EXHIBIT D

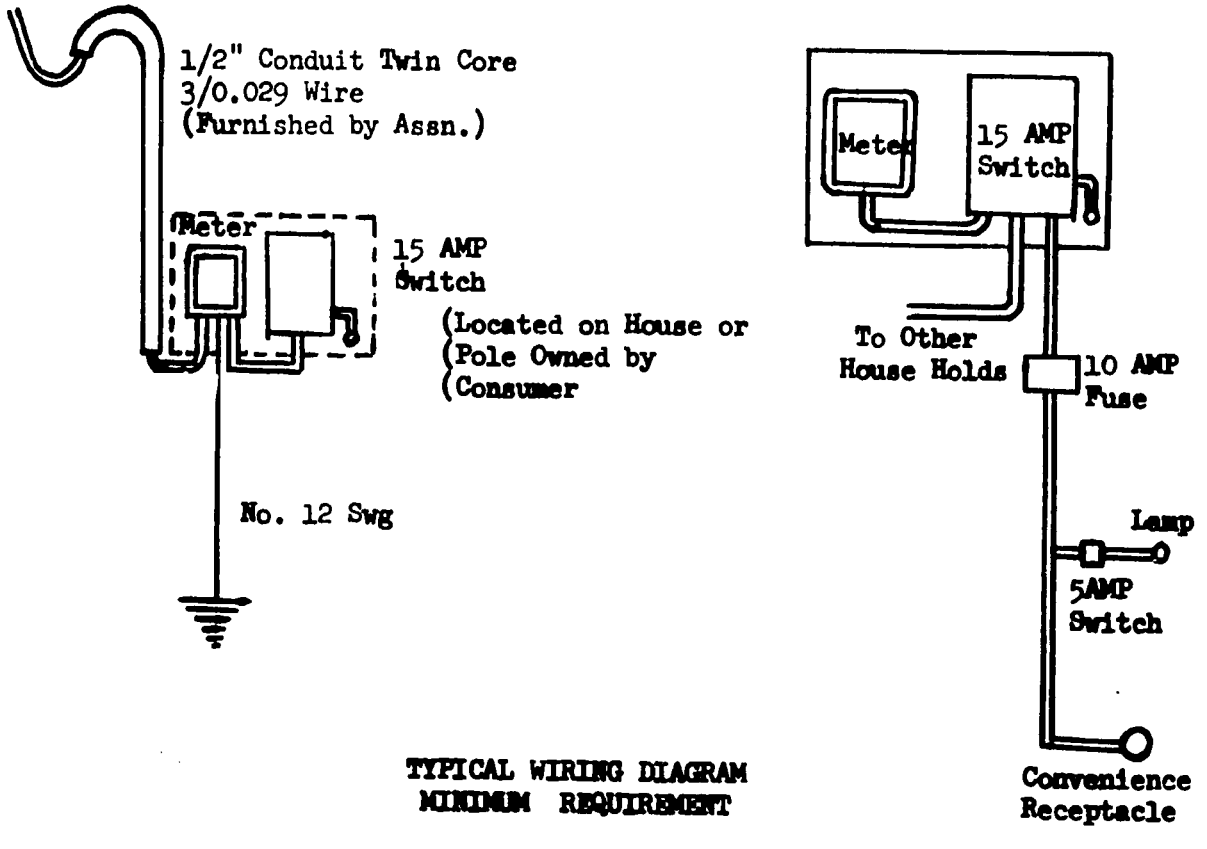
PROPOSED STANDARD SUBSTATION



STANDARD HOUSEWIRING PLAN



TYPICAL SERVICE TO A FAMILY BARI



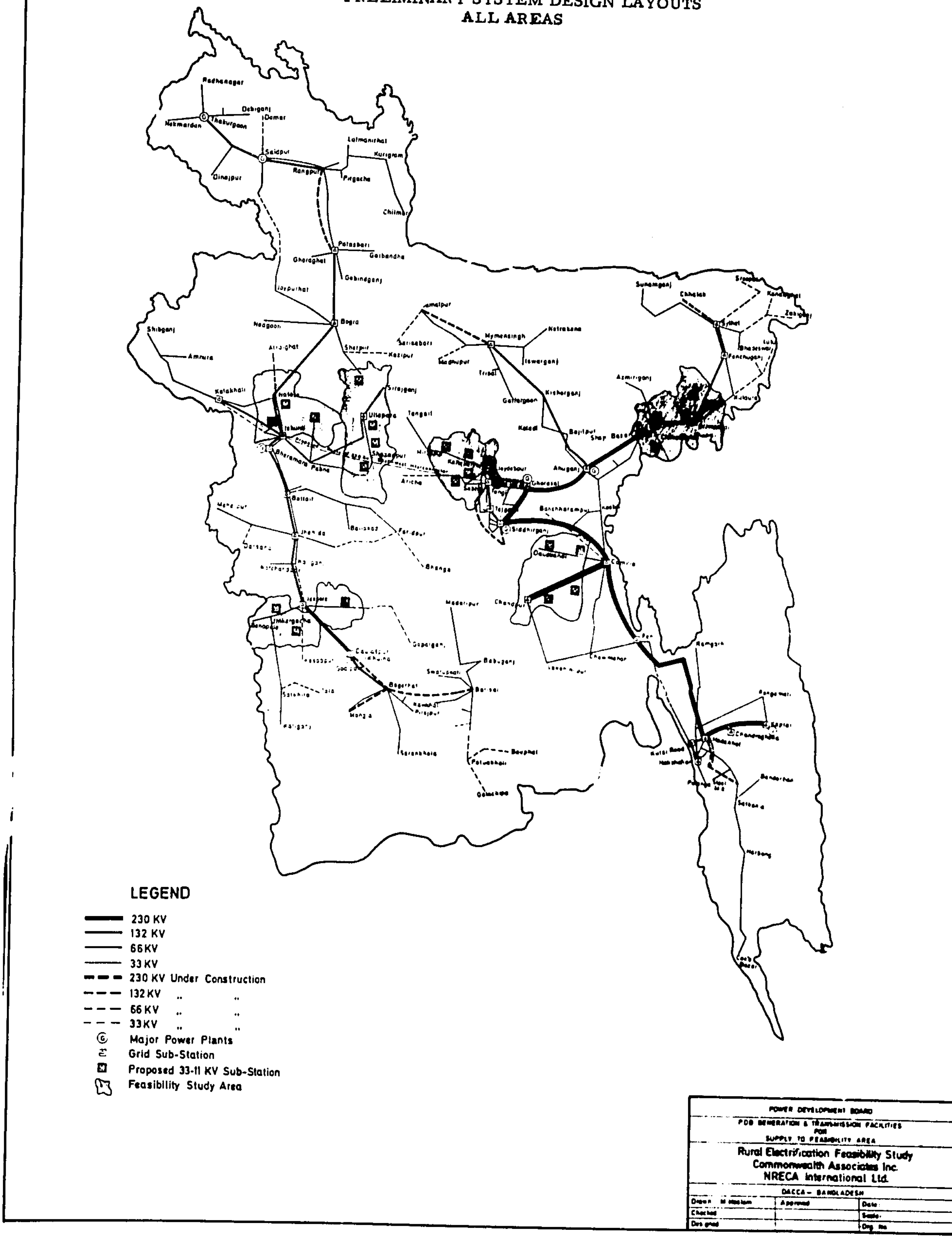
TYPICAL WIRING DIAGRAM
MINIMUM REQUIREMENT

PRELIMINARY SYSTEM DESIGN LAYOUTS

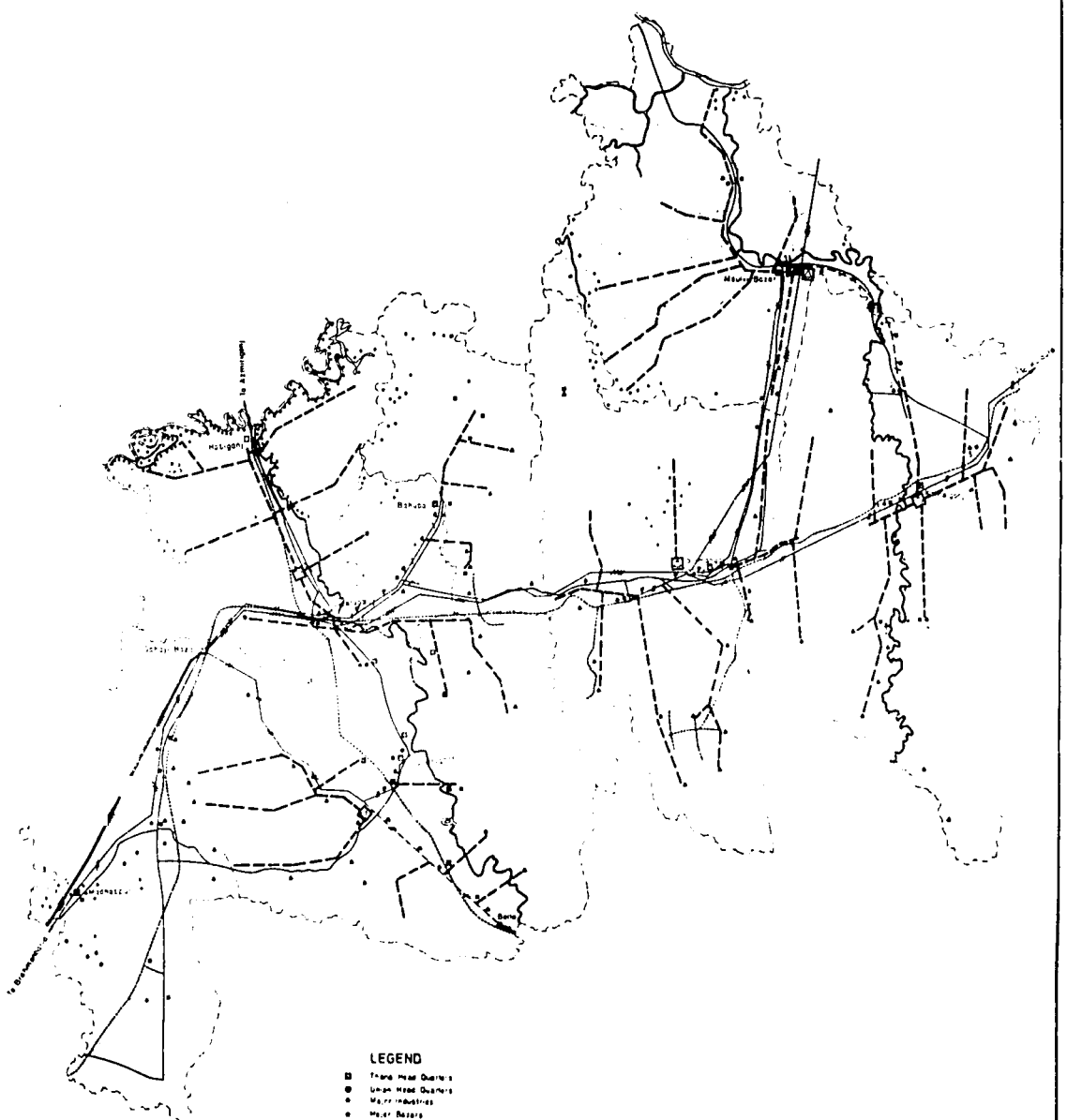
Maps showing the preliminary system design layouts of the project areas are included in the following order:

Area	Page
All Areas	2
Chunarughat	3
Daudkandi	4
Jhikergacha	5
Kaliakair	6
Natore	7
Shahzadpur	8

PRELIMINARY SYSTEM DESIGN LAYOUTS
ALL AREAS



PRELIMINARY SYSTEM DESIGN LAYOUTS
CHUNARUGHAT



LEGEND

- Thana Head Quarters
- Union Head Quarters
- Major Industries
- Major Bazars
- Deep Tube Wells
- Shallow Tube Wells
- Low Lift Pumps
- Road Pucca (All weather Road)
- Road Kaccha (Seasonal Road)
- Existing PDB Lines
  - 132 kv
  - 66 kv
  - 33 kv
  - 11 kv
- Planned PDB Lines
  - 132 kv
  - 66 kv
  - 33 kv
  - 11 kv
- Proposed RE Lines
- New 11 kv Lines
- Acquired PDB Lines
- 11 kv Sub-Station
- Telephone Line
- Thana Boundary
- River

POWER DEVELOPMENT BOARD

CHUNARUGHAT FEASIBILITY AREA
PRELIMINARY DISTRIBUTION SYSTEM LAYOUT

Rural Electrification Feasibility Study
Commonwealth Associates Inc.
NRECA International Ltd.

DACCA — BANGLADESH

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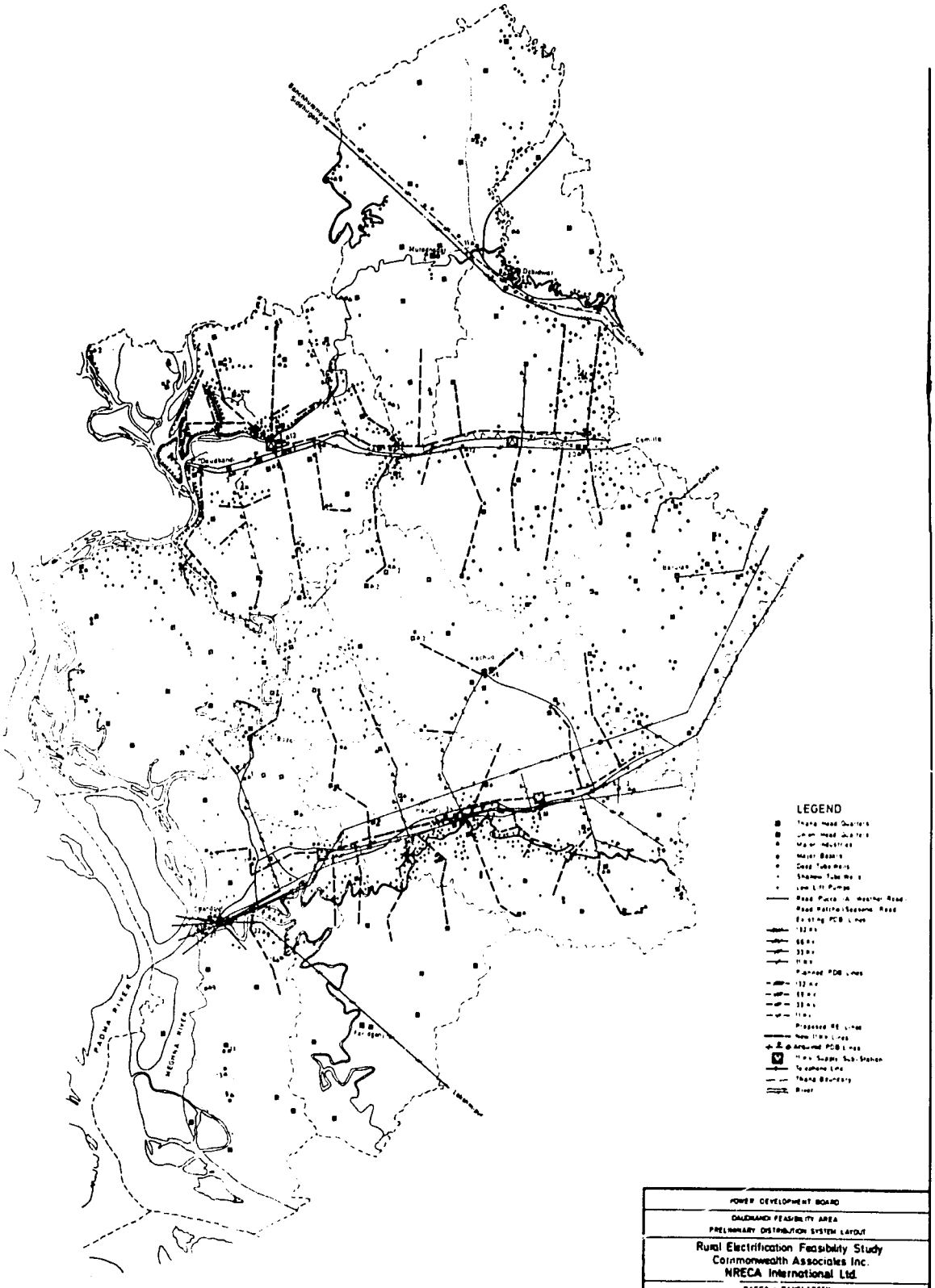
Designed		Drg. No


LEGEND
Thana Head Quarters
Union Head Quarters
Major Industries
Major Bazars
Deep Tube Wells
Shallow Tube Wells
Low Lift Pumps
Road Pucca (All Weather Road)
Road Katcha (Seasonal Road)
Existing PDB Lines
132 kV
66 kV
33 kV
11 kV
Planned PDB Lines
132 kV
66 kV
33 kV
11 kV
Proposed REB Lines
New 11kV Lines
Anticipated PDB Lines
11 kV Supply Sub-Station
Telephone Line
Thana Boundary
River
PADMA RIVER
MEGHNA RIVER
POWER DEVELOPMENT BOARD
DAUDKANDI FEASIBILITY AREA
PRELIMINARY DISTRIBUTION SYSTEM LAYOUT
Rural Electrification Feasibility Study
Commonwealth Associates Inc.
NRECA International Ltd.
DACCA - BANGLADESH
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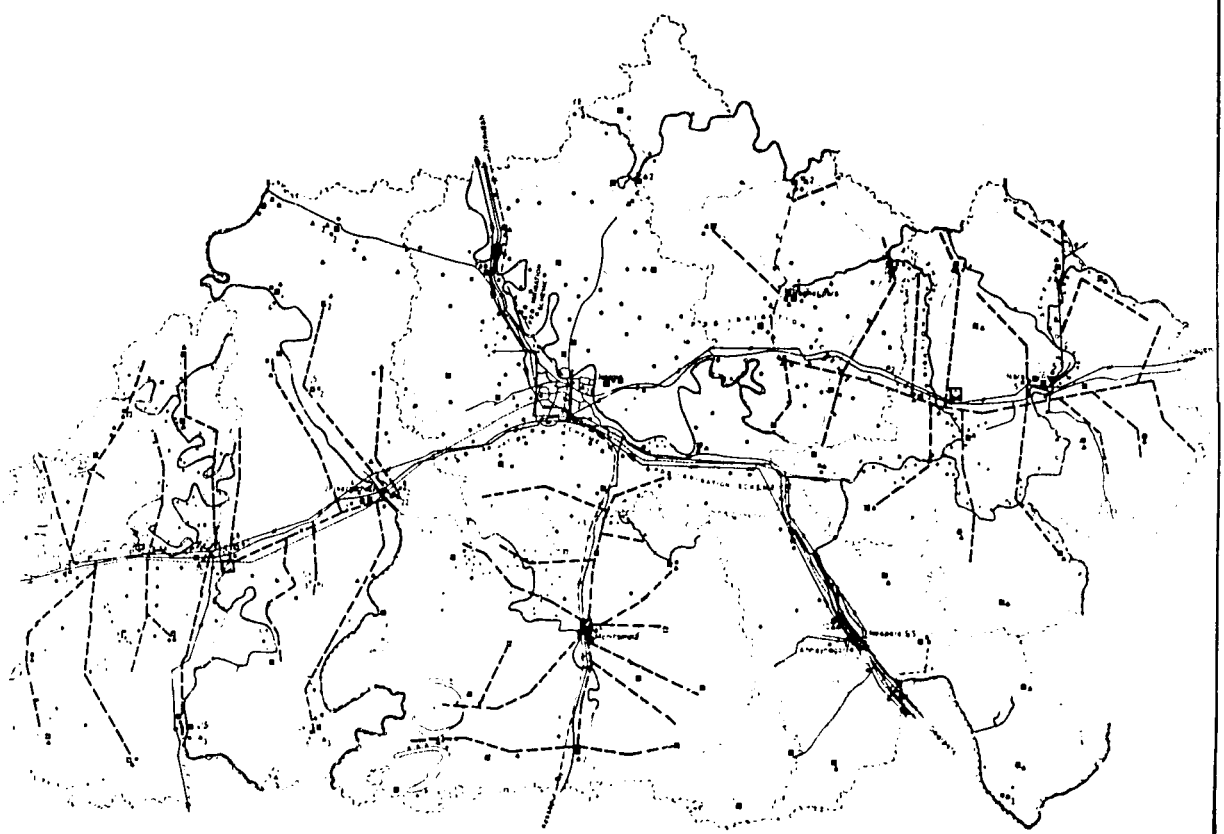
PRELIMINARY SYSTEM DESIGN LAYOUTS
JHIKERGACHA



LEGEND

- Thana Head Quarters
- Union Head Quarters
- Major Industries
- Major Bazars
- Deep Tube wells
- Shallow Tube Wells
- Low Lift Pumps
- Road Pucca (All weather Road)
- Road Kacha Seasonal Road
- Existing PDB Lines
  - 132 K.V.
  - 66 K.V.
  - 33 K.V.
  - 11 K.V.
- Planned PDB Lines
  - 132 K.V.
  - 66 K.V.
  - 33 K.V.
  - K.V.
- Proposed REL Lines
- New 11 K.V. Lines
- Acquired PDB Lines
- 11 K.V. Supply Sub-Station
- Telephone Line
- Thana Boundary
- River

POWER DEVELOPMENT BOARD		
JHIKERGACHA FEASIBILITY AREA PRELIMINARY DISTRIBUTION SYSTEM LAYOUT		
Rural Electrification Feasibility Study Commonwealth Associates Inc. NRECA International Ltd.		
DACCA - BANGLADESH		
Drawn M Hossain	Approved	Date
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PRELIMINARY SYSTEM DESIGN LAYOUTS
KALIAKAIR

LEGEND

- Thana Head Quarters
- Union Head Quarters
- Major Industries
- Major Bazaars
- Deep Tube Wells
- Shallow Tube Wells
- Low Lift Pumps
- Road Pucca (All Weather Road)
- Road Kacha (Seasonal Road)
- Existing PDB Lines
  - 132 KV
  - 66 KV
  - 33 KV
  - 11 KV
- Planned PDB Lines
  - 132 KV
  - 66 KV
  - 33 KV
  - 11 KV
- Proposed RE Lines
- New 11 KV Lines
- Acquired PDB Lines
- 11 KV Supply Sub-Station
- Telephone Line
- Thana Boundary
- River

POWER DEVELOPMENT BOARD

KALIAKAIR FEASIBILITY AREA

PRELIMINARY DISTRIBUTION SYSTEM LAYOUT

Rural Electrification Feasibility Study
Commonwealth Associates Inc.
NRECA INTERNATIONAL LTD.

DACCA — BANGLADESH

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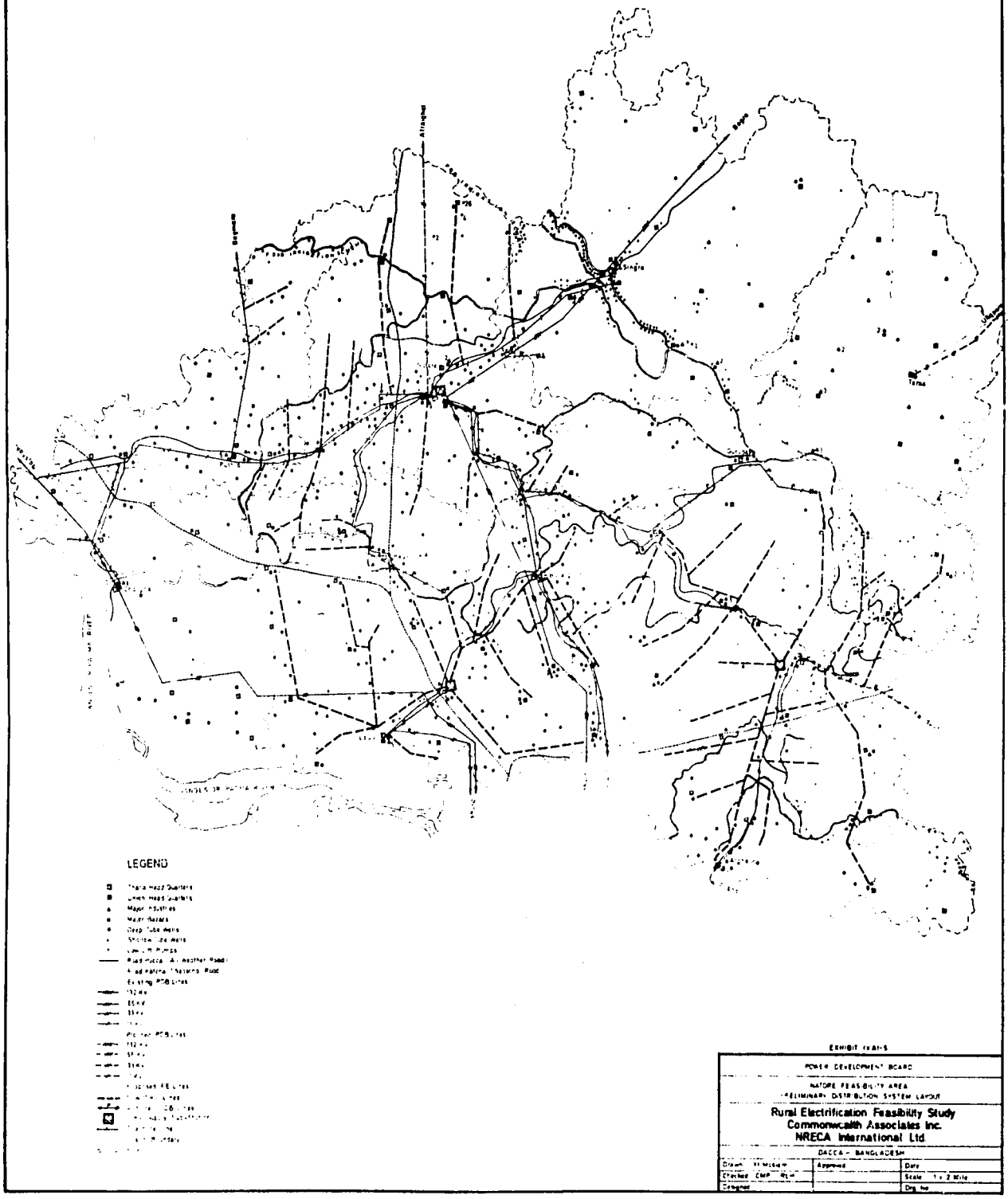
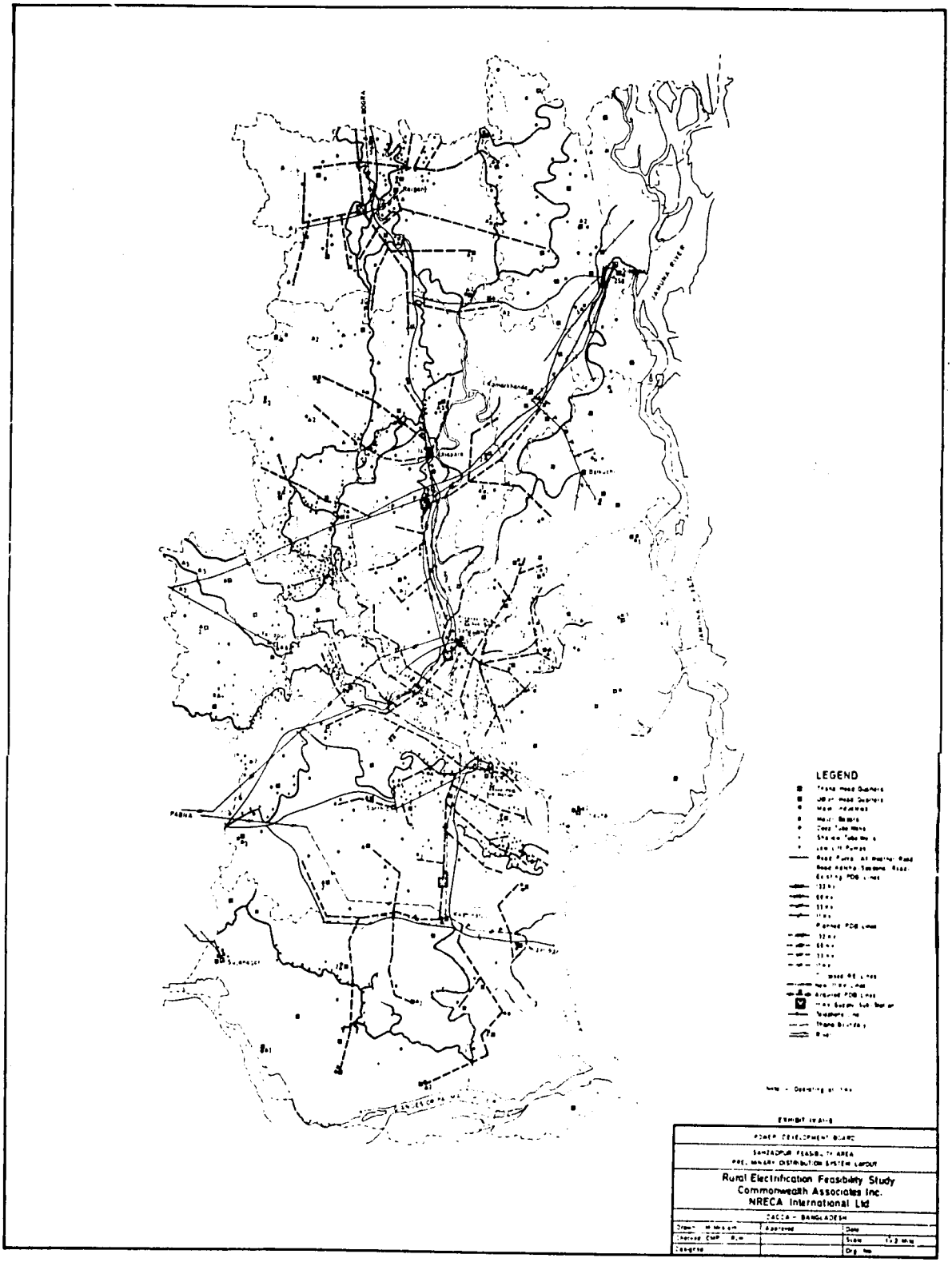
PRELIMINARY SYSTEM DESIGN LAYOUTS
NATORE




BOGRA
JAMUNA RIVER
PABNA
LEGEND
Rural Electrification Feasibility Study
Commonwealth Associates Inc.
NRECA International Ltd

LIST OF CONSULTING ENGINEERS & ARCHITECTS

1. M/S Bangladesh Consultants Ltd.
   48, Dilkusha C/A, Dacca -Phone 252792
   Managing Director: Mr. Habibur Rahman

2. M/S Nabajug Prokoushali
   159 Dhanmondi R/A
   Road #13/2, Dacca -Phone 317949
   Mr. Kabiruddin Ahmed, Director

3. M/S Sarm Associates Ltd.
   125-A Motijheel C/A, Dacca
   Director: Mr.Fazlul Majid, Phone 246330

4. M/A Bangladesh National Consultants
   64 Motijheel C/A,Dacca. Phone 246039
   Director: Mr. Mansur.

5. M/S Consultants Bangladesh Ltd.
   56-57 Motijheel C/A
   Dacca. Phone 283184
   M/Director Mr. M.M. Haq

6. M/S Bureau of Consulting Engineers Ltd.
   60 Motijheel C/A, Dacca. Phone 253536
   Director: Dr. Hatem Ali Khan

7. M/S Associate Technical Enterprise
   Bangladesh School Text Book Board Bldg.
   69/70 Motijheel C/A, Dacca
   Mr. Moinul Haq, Tel. 251952

8. M/S Associated Consulting Engrs. Ltd.
   Institute of Engineers Building
   Ramna, Dacca-2

9. M/S Concrete International Ltd.
   131 Motijheel C/A,Dacca-2, Tel.250291

10. M/S Development Design Consultant
    13/2 Toyenbee Circular Road
    Motijheel, Dacca-2, Tel. 252408

11. M/S National Consulting Engineers
    9-A Toyenbee Circular Road
    1st Floor, Motijheel, Dacca

12. Associated Architect & Engrs. Ltd.
    9-D Motijheel C/A
    Dacca, Tel. 281666

13. Brixton & Brixton Ltd.
    823 Dhanmondi R/A.

14. Projanani Shangshad Ltd.
    500 Dhanmondi R/A
    Road #7, Dacca-5, Tele: 315948

15. Prokoushali Sangsad Ltd.
    101 Motijheel C/A, Dacca-2
    Dir Alimulla Khan, Tel.256223 &250078

16. Consociates International Ltd.
    Salateen House,
    131 Motijheel C/A,Dacca, Tel.250291

17. Rahman & Associates
    24-25 Dilkusha C/A
    Dacca-5. Tel. 256865 & 255022

18. Bastu Shilpi Ltd.
    Corner Court
    29 Toyenbee Circular Road
    Motijheel C/A, Dacca, Tel. 257653

19. M/S E.C.A. Ltd.
    51 Dhanmondi R/A, Road No. 2
    Dacca.

20. M/S Shaheedullah & Associates Ltd.
    167 Dhanmondi R/A, Road #13/3
    Dacca-5

21. Sthapati Sangsad Ltd.
    122 Dhanmondi R/A, Road #3
    Dacca-5

22. M/S Thariany & Co.
    135-C Dhanmondi R/A, Road #5
    Dacca-5

23. M/S Planners & Builders
    House No. Road No. 27
    Dhanmondi R/A, Dacca-5

24. M/S Prokaushali Sangshad Ltd.
    Salateen House
    131, Motijheel C/A, Dacca-2

25. M/S M.S. Jafar
    Architects & Engineers
    65 Gulistan Avenue,Dacca-2

26. Electro-Mechanical Engineers
    M/S Technological Services Ltd.
    399 Dhanmondi R/A,Road #28,Dacca-5

LIST OF PDB "A" CLASS CONTRACTORS - CIVIL AND/OR ELECTRICAL WORKS

1. M/S Tarang
2. M/S Barnali Corp
3. M/S Eastern Associates
4. M/S Friends Co.
5. M/S I.B. Traders
6. M/S Shoma Prokoushali
7. M/S Eastland Engineers Ltd.
8. M/S Bangladesh Trading & Const. Co. Ltd.
9. M/S Aftab Engineers & Co.
10. M/S Better Builders
11. M/S Md. Nurul Huda
12. M/S Bangladesh Erectors Ltd.
13. M/S Jeccon International
14. M/S International Engineers Ltd.
15. M/S Seva Prokoushali
16. M/S Emek Engineers
17. M/S Asia Electric
18. Emico International
19. M/S Sigma Engineers
20. M/S Techno Consultant
21. M/S Sayed Ahmed
22. M/S Bangladesh Technical of Comilla
23. M/S Fency Electrical Co.
24. M/S Engineering Associates
25. M/S M.I. Chowdhury
26. M/S M.A. Halim
27. M/S Md. Omar Farooque
28. M/S Shah Prokoushali
29. M/S Associated Engineering Construction
30. M/S Maniruzzaman
31. M/S Md. Mobarok Hossain
32. M/S Jai Engrg. & Construction
33. M/S Topo Surveyers & Engineers
34. M/S Eastern Construction Engineering
35. M/S Mumtazuddin Ahmed
36. M/S S.R. Traders
37. M/S A. Awal
38. M/S Shunipun Engineers
39. M/S A.K. Electric & Eng. Works
40. M/S Md. Abu Baker
41. M/S Goodluck Engrs.
42. M/S Prokoushali Parishad
43. M/S Associated Electrical Corp.
44. M/S Serajul Islam
45. M/S The Builders Corp. Ltd.
46. M/S Surma Corporation
47. M/S Engineering Services
48. M/S Engineers Enterprise Ltd.

49. M/S Globe Construction
50. M/S Ishan Traders
51. M/S Bangladesh Development Corp.
52. M/S Kazi & Brothers.
53. M/S Oriental Engineers
54. M/S Yaduddin Ahmed
55. M/S Munir Traders
56. M/S Bangladesh Builders Syndicate
57. M/S M.S. Huq & Co.
58. M/S Abul Kalam Mandal
59. M/S Meghna Electrics
60. M/S Huque & Sons
61. M/S Zenith Engineers
62. M/S Hashem Electric Co.
63. M/S The National Agency
64. M/S Abdul Hannan Chowdhury
65. M/S Azizullah
66. M/S Nirmman
67. M/S Jamal Ahmed
68. M/S Bananja (International)
69. M/S Pana Engineering Corp.
70. M/S Bangladesh Electrical & Construction Co. Ltd.
71. M/S Shuvan Bros.
72. M/S The Engineers & Consultants Ltd.
73. M/S Md. Jafarullah Khan Chowdhur
74. M/S Shapla Electrics
75. M/S Bangladesh Prokoushali
76. M/S Hussain Trading Corp.
77. M/S M. Hussain & Co.
78. M/S S. Huq & Co.
79. M/S Rukshana Builders
80. M/S Deep Jele Jai
81. M/S Friends Union Syndicate
82. M/S United Builders Corp.
83. M/S Darbar Electrical Works
84. M/S Md. Ansar Ali
85. M/S R.A. Construction
86. M/S KCG Construction
87. M/S Ashraf Electric Co.
88. M/S Bengal Builders
89. M/S Modern Electrical Enterprise.
90. M/S Northern Enterprise
91. M/S Rahamania Electrical Stores
92. M/S Saidur Rahman
93. M/S Sigma Construction
94. M/S R.N. Electric & Motor Works
95. M/S Kakoli Traders
96. M/S United Technologies

97. M/S Nishat Electrical Works
98. M/S Build Well Engineering & Co.
99. M/S North Bengal Electric Works
100. M/S Liliar Engineering
101. M/S Unique Engrg. Service
102. M/S Shamsuddin Engrg. Works
103. M/S Rahman Associates
104. M/S Packs Engineers
105. M/S S.A. Matin & Co.
106. M/S M.N. Zaman
107. M/S Jai Engineering
108. M/S Razi & Co.
109. M/S Meka Engineering
110. M/S Alfa Engineering
111. M/S Karko
112. M/S Binimai Traders
113. M/S A & K Traders
114. M/S Bangladesh Industrial & Commercial Enterprise.
115. M/S Mirza Abu Baker
116. M/S The Sun Beam Enterprise
117. M/S Friends Electric Stores
118. M/S Delta Bangladesh Engrg.Divn.
119. M/S Popular Enterprise
120. M/S M.A. Khan & Co.
121. M/S Uttara Prokoushali & Co.
122. M/S Aloukmai Electrical Co.
123. M/S Nirman Prokoushali
124. M/S Amzad Hussain & Bros.
125. M/S Bangla Electric Co.
126. M/S The Associated Engineers & Ot
127. M/S M.A. Khaleq
128. M/S Sthapan Bid.
129. M/S Motaleb Bhai
130. M/S Techno
131. M/S Shafiq Electronics
132. M/S Associated Construction Co.
133. M/S Mala Chowdhury
134. M/S Saudagar Agency
135. M/S Suman Engineers
136. M/S Electric Traders
137. M/S Tropical Techno Services
138. M/S Delwar Hossain
139. M/S Safiruddin Ahmed
140. M/S Star Delta Engineering Works.
141. M/S Nila Enterprise
142. M/S Md. Abu Baker
143. M/S Bengal Construction
144. M/S A. Kausar & Co.

145. M/S Emal Builders
146. M/S N.B. Electric Motor Works.
147. M/S Electric Enterprise
148. M/S Habibullah Bahar
149. M/S Popular Engineers
150. M/S Emark Engineers
151. M/S National Electric Co.
152. M/S Jalalabad Electric House
153. M/S Nurun-Nabi
154. M/S M.R. Sikder
155. M/S Karotoa Construction
156. M/S Abdur Rahman
157. M/S Z.S. & Associates
158. M/S Desh Construction
159. M/S Jahangir Alam
160. M/S Serajul Islam
161. M/S The Bengal Electric
162. M/S Eastern Construction
163. M/S Khulna Shipright & Tractor Co.
164. M/S Eastern Electric Traders
165. M/S Shawkot Ali & Sons
166. M/S Electrical Construction Co.
167. M/S Zaman & Co.
168. M/S Md. Yunus Ali & Bros.
169. M/S Khanam Electrical & Mechanical Works
170. M/S Bazlur Rahman
171. M/S Pragati Karigar Ltd.
172. M/S Zamal & Co.
173. M/S Con-Ak
174. M/S Manikganj Prokoushali
175. M/S Easter Engineering Corp.
176. M/S Delta Engineering Co.
177. M/S Molla & Sons
178. M/S Momataz Builders & Traders
179. M/S Amir Hussain
180. M/S Habib Engineering Works.

COST ESTIMATE-11Y/6.35KV THREE PHASE PRIMARY LINE-STANDARD MILE
CONDUCTOR: #2/0 ACSR PRIMARY: #2 ACSR NEUTRAL

Description	Quantity	Unit	Unit Cost (U.S.$)	Total Cost (U.S.$)
Pole Imported, 30' Class-7	10	Each	79	790
" 35' Class-5	4	"	122	488
" 40' Class-5	2	"	156	312
Pole Top Unit:				
C1 (Tangent)	8	"	53	424
C2 (5°-30° Angle)	2	"	98	196
C8-3 (30°-60° Angle)	1	"	202	202
C7-1 (60°-90° Angle)	1	"	224	224
C1 plus A5-2 (1-Ø Tap)	2	"	91	182
C1 plus C7 (3-Ø Tap)	2	"	193	386
Conductor, #2/0 ACSR	16.63	1000 Feet	128	2129
" #2 ACSR	5.54	"	64	355
Guy & Anchor	8	Each	43	344
Pole Ground	16	"	21	336
Total Material				6368
Labour Cost (@10% of material)				637
Insurance & other construction cost (@7.5% of material)				478
			Total	7483

COST ESTIMATE-11Y/6.35KV THREE PHASE PRIMARY LINE-STANDARD MILE
CONDUCTOR: #2 ACSR BOTH PRIMARY & NEUTRAL

Description	Quantity	Unit	Unit Cost (U.S.$)	Total Cost (U.S.$)
Pole Imported, 30' Class-7	10	Each	79	790
" 35' Class-5	4	"	122	488
" 40' Class-5	2	"	156	312
Pole Top Unit:				
C1 (Tangent)	8	"	53	424
C-2 (5°-30° Angle)	2	"	98	196
C8 (30°-60° Angle)	1	"	202	202
C7-1 (60°-90° Angle)	1	"	224	224
C1 plus A5-2 (1-Ø Tap)	2	"	91	182
C1 plus C7 (3-Ø Tap)	2	"	193	386
Conductor, #2 ACSR	22.18	1000 Feet	64	1419
Guy & Anchor	8	Each	43	344
Pole Ground	16	"	21	336
Total Material				5303
Labour Cost (@10% of material)				530
Insurance & other Construction Cost (@7.5% of material)				398
			Total	6231

COST ESTIMATE-6.35KV, SINGLE PHASE PRIMARY LINE-STANDARD MILE
CONDUCTOR: #2 ACSR BOTH PRIMARY & NEUTRAL

Description	Quantity	Unit	Unit Cost (U.S.$)	Total Cost (U.S.$)
Pole Imported, 30' Class-7	10	Each	79	790
" 35' Class-5	4	"	122	488
" 40' Class-5	2	"	156	312
Pole Top Unit:				
A1 (Tangent)	7	"	21	147
A2 (5°-30° Angle)	2	"	36	72
A3 (30°-60° Angle)	1	"	32	32
A4 (60°-90° Angle)	3	"	57	171
A1 plus A5-1 (1-Ø Tap)	3	"	54	162
Conductor, #2 ACSR	11.09	1000 Feet	64	710
Guy & Anchor	8	Each	43	344
Pole Ground	16	"	21	336
Total Material				3564
Labour Cost (@10% of material)				356
Insurance & other Construction cost (@7.5% of material)				267
			Total	4187

COST ESTIMATE-11Y/6.35KV THREE PHASE PRIMARY LINE WITH 400V/230V THREE PHASE SECONDARY UNDERBUILD - STANDARD MILE
CONDUCTOR: #2/0 ACSR PRIMARY; #2 ACSR NEUTRAL
#2/0 ACSR SECONDARY

Description	Quantity	Unit	Unit Cost (U.S.$)	Total Cost (U.S.$)
Pole Imported, 30' Class-7	10	Each	79	790
" 35' Class-5	9	"	122	1098
" 40' Class-5	6	"	156	936
Pole Top Unit:				
C1 (Tangent)	17	"	53	901
C2 (5°-30° Angle)	2	"	98	196
C8 (30°-60° Angle)	1	"	202	202
C7-1 (60°-90° Angle)	1	"	224	224
C1 plus A5-2 (1-Ø Tap)	2	"	91	182
C1 plus C7 (3-Ø Tap)	2	"	193	386
J5 (Tangent)	48	"	9	432
J10 (5°-60° Angle)	9	"	9	81
J6 (Deadend)	36	"	9	324
Conductor, #2/0 ACSR	33.26	1000 Feet	128	4258
" #2 ACSR	5.54	"	64	355
Guy & Anchor	16	Each	43	688
Pole Ground	25	"	21	525
Total Material				11578
Labour Cost (@10% of material)				1158
Insurance & other Construction Cost (@7.5% of material)				868
			Total	13604

COST ESTIMATE-11Y/6.35KV THREE PHASE PRIMARY LINE WITH 400V/230V THREE PHASE SECONDARY UNDERBUILD - STANDARD MILE CONDUCTOR: #2 ACSR PRIMARY; AND NEUTRAL AND #2/0 ACSR SECONDARY

Description	Quantity	Unit	Unit Cost (U.S.$)	Total Cost (U.S.$)
Pole Imported, 30' Class-7	10	Each	79	790
" 35' Class-5	7	"	122	854
" 40' Class-5	4	"	156	624
Pole Top Unit:				
C1 (Tangent)	13	"	53	689
C2 (5°-30° Angle)	2	"	98	196
C8 (30°-60° Angle)	1	"	202	202
C7-1 (60°-90° Angle)	1	"	224	224
C1 plus A5-2 (1-Ø Tap)	2	"	91	182
C1 plus C7 (3-Ø Tap)	2	"	193	386
J5 (Tangent)	36	"	9	324
J10 (5°-60° Angle)	9	"	9	81
J6 (Deadend)	30	"	9	270
Conductor, #2/0 ACSR	16.63	1000 Feet	128	2129
" #2 ACSR	22.18	"	64	1419
Guy & Anchor	16	Each	43	688
Pole Ground	21	"	21	441
Total Material				9499
Labour Cost (@10% of material)				950
Insurance & other Construction Cost (@7.5% of material)				712
			Total	11161

COST ESTIMATE-11Y/6.35KV THREE PHASE PRIMARY LINE WITH 230V SINGLE PHASE SECONDARY UNDERBUILD-STANDARD MILE
CONDUCTOR: #2/0 ACSR PRIMARY; SECONDARY AND NEUTRAL

6666 Description	Quantity	Unit	Unit Cost (U.S.$)	Total Cost (U.S.$)
Pole Imported, 30' Class-7	10	Each	79	790
" 35' Class-5	6	"	122	732
" 40' Class-5	3	"	156	468
Pole Top Unit:				
C1 (Tangent)	11	"	53	583
C2 (5°-30° Angle)	2	"	98	196
C8-3 (30°-60° Angle)	1	"	202	202
C7-1 (60°-90° Angle)	1	"	224	224
C1 plus A5-2 (1-Ø Tap)	2	"	91	182
C1 plus C7 (3-Ø Tap)	2	"	193	386
J5 (Tangent)	11	"	9	99
J10 (5°-60° Angle)	3	"	9	27
J6 (Deadend)	10	"	9	90
Conductor, #2/0 ACSR	27.72	1000 Feet	122	3548
Guy & Anchor	16	Each	43	688
Pole Ground	19	"	21	399
Total Material				8614
Labour Cost (@10% of material)				861
Insurance & other Construction Cost (@7.5% of material)				646
			Total	10121

COST ESTIMATE-11Y/6.35KV THREE PHASE PRIMARY LINE WITH 230V SINGLE PHASE SECONDARY UNDERBUILD-STANDARD MILE
CONDUCTOR: #2/0 ACSR PRIMARY AND #2 ACSR BOTH NEUTRAL AND SECONDARY

Description	Quantity	Unit	Unit Cost (U.S.$)	Total Cost (U.S.$)
Pole Imported, 30' Class-7	10	Each	79	790
" 35' Class-5	5	"	122	610
" 40' Class-5	3	"	156	468
Pole Top Unit:				
C1 (Tangent)	10	"	53	530
C2 (5°-30° Angle)	2	"	98	196
C8-3 (30°-60° Angle)	1	"	202	202
C7-1 (60°-90° Angle)	1	"	224	224
C1 plus A5-2 (1-Ø Tap)	2	"	91	182
C1 plus C7 (3-Ø Tap)	2	"	193	386
J5 (Tangent)	10	"	9	90
J10 (5°-60° Angle)	3	"	9	27
J6 (Deadend)	10	"	9	90
Conductor, #2/0 ACSR	16.63	1000 Feet	128	2129
" #2 ACSR	11.09	"	64	710
Guy & Anchor	16	Each	43	688
Pole Ground	18	"	21	378
Total Material				7700
Labour Cost (@10% of material)				770
Insurance & other Construction Cost (@7.5% of material)				578
			Total	9048

COST ESTIMATE-11Y/6.35KV THREE PHASE PRIMARY LINE WITH 230V SINGLE PHASE SECONDARY UNDERBUILD-STANDARD MILE
CONDUCTOR: #2 ACSR PRIMARY; NEUTRAL AND SECONDARY

Description	Quantity	Unit	Unit Cost (U.S.$)	Total Cost (U.S.$)
Pole Imported, 30' Class-7	10	Each	79	790
" 35' Class-5	4	"	122	488
" 40' Class-5	2	"	156	312
Pole Top Unit:				
C1 (Tangent)	8	"	53	424
C2 (5°-30° Angle)	2	"	98	196
C8-3 (30°-60° Angle)	1	"	202	202
C7-1 (60°-90° Angle)	1	"	224	224
C1 plus A5-2 (1-Ø Tap)	2	"	91	182
C1 plus C7 (3-Ø Tap)	2	"	193	386
J5 (Tangent)	9	"	9	81
J10 (5°-60° Angle)	3	"	9	27
J6 (Deadend)	8	"	9	72
Conductor, #2 ACSR	27.72	1000 Feet	64	1774
Guy & Anchor	16	Each	43	688
Pole Ground	16	"	21	336
Total Material				6182
Labour Cost (@10% of material)				618
Insurance & other Construction Cost (@7.5% of material)				464
			Total	7264

COST ESTIMATE-6.35KV SINGLE PHASE PRIMARY LINE WITH 230V SINGLE PHASE SECONDARY UNDERBUILD-STANDARD MILE
CONDUCTOR: #2 ACSR FOR PRIMARY; SECONDARY AND NEUTRAL

Description	Quantity	Unit	Unit Cost (U.S.$)	Total Cost (U.S.$)
Pole Imported, 30' Class-7	10	Each	79	790
" 35' Class-5	4	"	122	488
" 40' Class-5	2	"	156	312
Pole Top Unit:				
A1 (Tangent)	7	"	21	147
A2 (5°-30° Angle)	2	"	36	72
A3 (30°-60° Angle)	1	"	32	32
A4 (60°-90° Angle)	3	"	57	171
A1 plus A5-1 (1-Ø Tap)	3	"	54	162
J5 (Tangent)	9	"	9	81
J10 (5°-60° Angle)	3	"	9	27
J6 (Deadend)	8	"	9	72
Conductor, #2 ACSR	16.63	1000 Feet	64	1064
Guy & Anchor	14	Each	43	602
Pole Ground	16	"	21	336
Total Material				4356
Labour Cost (@10% of material)				436
Insurance & other Construction Cost (@7.5% of materials)				327
			Total	5119

COST ESTIMATE-400V/230V THREE PHASE SECONDARY LINE-STANDARD MILE
CONDUCTOR: #2/0 ACSR, PHASE AND #2 ACSR, NEUTRAL

Description	Quantity	Unit	Unit Cost (U.S.$)	Total Cost (U.S.$)
Pole Imported, 30' Class-7	20	Each	79	1580
" 35' Class-5	3	Each	122	366
Pole Top Unit:				
J5 (Tangent)	60	"	9	540
J6 (Deadend)	64	"	9	576
Conductor, #2/0 ACSR	16.63	1000 Feet	128	2129
" #2 ACSR	5.54	"	64	355
Guy & Anchor	8	Each	43	344
Total Material				5860
Labour Cost (@10% of material)				586
Insurance & other Construction Cost (@7.5% of material)				483
			Total	6929

COST ESTIMATE-400V/230V THREE PHASE SECONDARY LINE-STANDARD MILE
CONDUCTOR: #4 ACSR BOTH PHASE AND NEUTRAL

Description	Quantity	Unit	Unit Cost (US $)	Total Cost (U.S.$)
Pole Imported, 30' Class-7	20	Each	79	1580
" 35' Class-5	2	"	122	244
Pole Top Unit:				
J5 (Tangent)	56	"	9	504
J6 (Deadend)	60	"	9	540
Conductor, #4 ACSR	22.18	1000 Feet	40	887
Guy & Anchor	8	Each	43	344
Total Material				4099
Labour Cost (@10% of material)				410
Insurance & other Construction Cost (@7.5% of material)				338
			Total	4847

COST ESTIMATE-230V SINGLE PHASE SECONDARY LINE-STANDARD MILE
CONDUCTOR: #2 ACSR PHASE AND NEUTRAL

Description	Quantity	Unit	Unit Cost (U.S.$)	Total Cost (U.S.$)
Pole Imported, 30' Class-7	14	Each	79	1106
" 35' Class-5	2	"	122	244
Pole Top Unit:				
J5 (Tangent)	10	"	9	90
J6 (Deadend)	11	"	9	99
Conductor, #2 ACSR	11.09	1000 Feet	64	710
Guy & Anchor	6	Each	43	258
Total Material				2507
Labour Cost (@10% of material)				251
Insurance & other Construction Cost (@7.5% of material)				188
			Total	2946

COST ESTIMATES
SUBSTATIONS

Description	Unit	Quantity	5000 KVA Cost (U.S. $)	2500 KVA Cost (U.S. $)
MATERIAL COST				
Power Transformer, Three Phase 33-11/6.35KV, 50Hz, Off Load Taps				
5000 KVA	Each	1	56,545	
2500 KVA	"	1		41,266
Voltage Regulator, Single Phase 15 KV, 240 Amp, 95 BKIL, ± 10%	"	3	14,824	14,824
Oil Circuit Reclosers, Three Phase 15KV, 400 Amp Cont, 6000 Amp Int., Ground Trip Meters				
Bank Recloser	"	1	6,222	6,222
Feeder Recloser	"	2	12,152	12,152
Gang Operated Air Break Switch, 35KV	"	1	2,173	2,173
Outdoor Power Fuse, 200 Amp, 35KV	"	3	1,331	1,331
Regulator Bypass Switch, 15KV, 600 Amp	"	3	1,205	1,205
Disconnect Switch, 15KV, 600 Amp	"	21	2,289	2,289
Fuse Cutout, 15KV, 100 Amp	"	4	220	220
Gang Operated Tie Switch, 15KV, 400 Amp	"	1	1,408	1,408
Potential Transformer, 110BIL	"	3	1,466	1,466
Station Transformer, 10 KVA	"	1	454	454
Structural Steel	Tons	6	5,400	5,400
Bus Insulators, Grd. Mat & Misc.	Lot	1	2,500	2,500
Wall, Brick	Feet	400	2,000	2,000
Attendant Quarters	Sq.Ft.	450	3,000	3,000
Land	Acre	.5	800	800
Labour			8,500	8,500
TOTAL			122,489	107,210

COST ESTIMATES
MISCELLANEOUS ITEMS

Prices Per Unit (U.S.$)

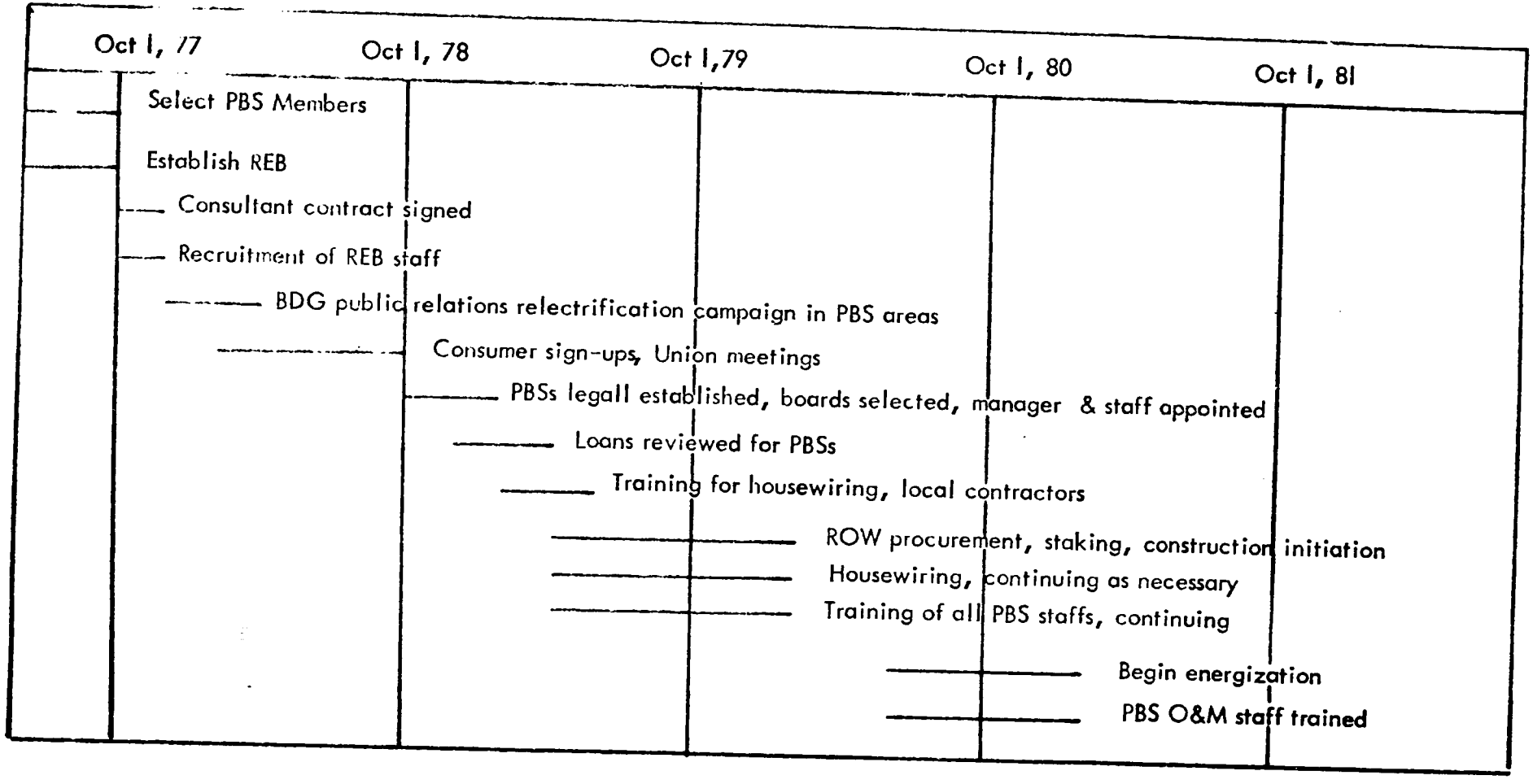
Description	Unit	Material	Labor	Other Construction Cost	Total Cost
Oil Circuit Recloser, Three Phase 15KV, 100Amp Cont, 2000Amp Int.	Each	1,999	21	150	2,170
Fuse Cutout, 15KV, 100 Amp	"	46	5	4	55
Gang Operated Feeder Tie Switch, 15KV 3-Pole, 400 Amp	"	1,408			
Street Light, Local Mfg Luminaire, Incandescent Lamp, Individually switched -	"	13.10	1.20	.80	15.10
Services					
Three Phase, 4-Wire, 400/230V 300Amp with C.T.S., 4-Wire Meter and 55 ft. - #4/0 AWG					
Alluminium Quadplex Wire	"	383	15	12	410
Three Phase, 4-Wire, 400/230V 60 Amp with 4-Wire meter and 80 ft. - #4 AWG					
Alluminium Quadplex Wire	"	182	6	5	194
Single Phase, 2-Wire, 230V 60Amp with 2-Wire Meter and 55 Ft. - #4 AWG					
Alluminium Duplex Wire	"	60	3	1	64
Single Phase, 2-Wire, 230V 10Amp with 2-Wire Meter, Bamboo Service Pole, 85 ft. - #12 AWG Copper 2 Core Cable & Steel Messanger, mast and 2-Wire Meter	"	49	4	1	54
DISTRIBUTION TRANSFORMERS					
Single Phase, Pole Mounted 6350-240/480V, 50Hz, 95KVBIL CSP Type					
10 KVA	"	448	6	-	454
15 KVA	"	518	6	-	524
50 KVA	"	949	9	-	958
100 KVA	"	1594	9	-	1603
Three Phase Bank, Cluster Mounted, 6, 350-240/480V, 50Hz, 95KVBIL					
3 x 10 KVA	"	1398	21	-	1419
3 x 15 KVA	"	1590	21	-	1611
3 x 50 KVA	"	2911	25	-	2936
3 x 100 KVA	"	4846	25	-	4871

INSTITUTIONAL STRUCTURE

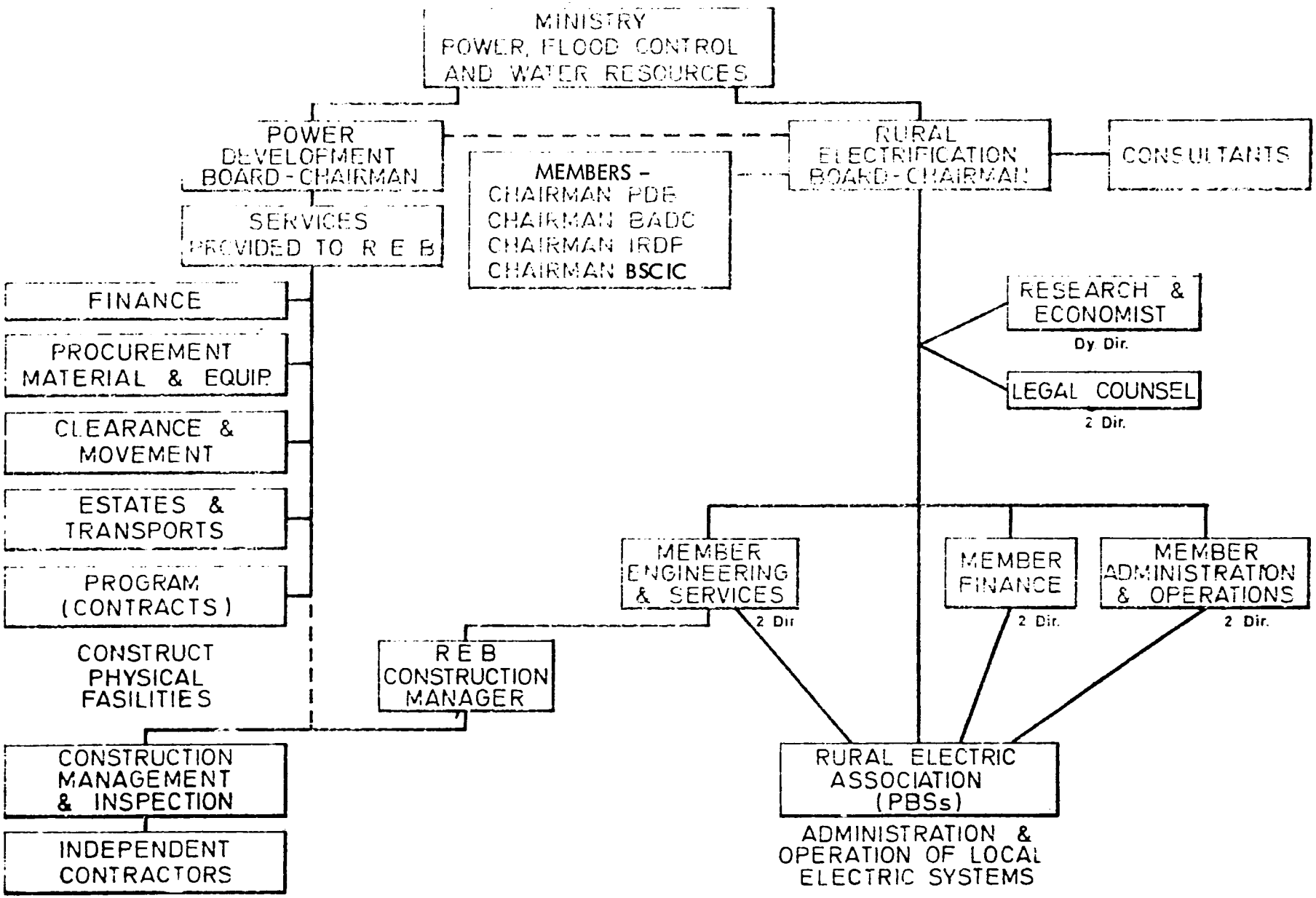
The following charts and lists are presented to describe the staffing, structure and timing of the institutions required for this project.

	Page
Institutional Implementation Schedule	2
Organization Chart - PDB, REB & PBS	3
REB Organization Charts	
Member-Engineering & Services	4
Member-Finance	5
Member-Administration & Operation	6
REB Final Staffing	7
PBS Initial and Intermediate Staff	8
PBS Final Staffing	9
PBS Organization Chart (Final)	10
Training Requirements	11

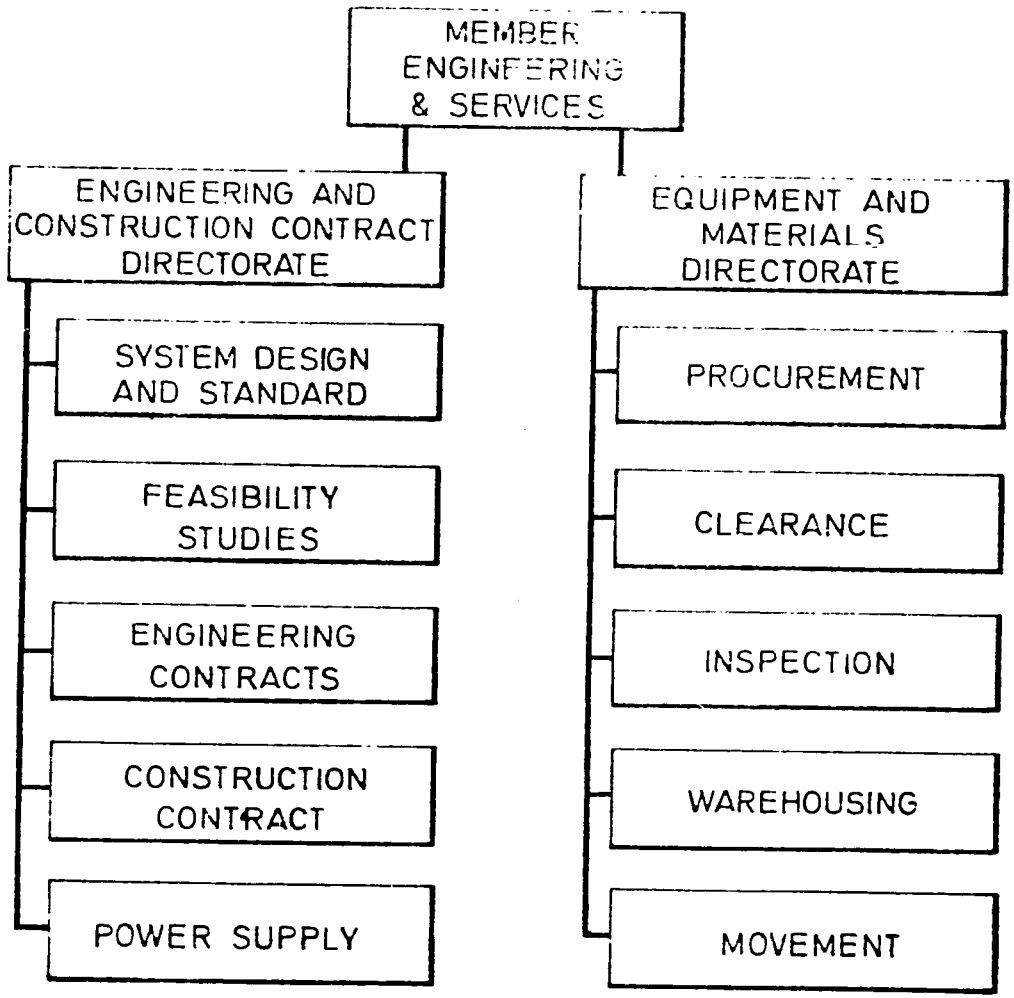
INSTITUTIONAL IMPLEMENTATION



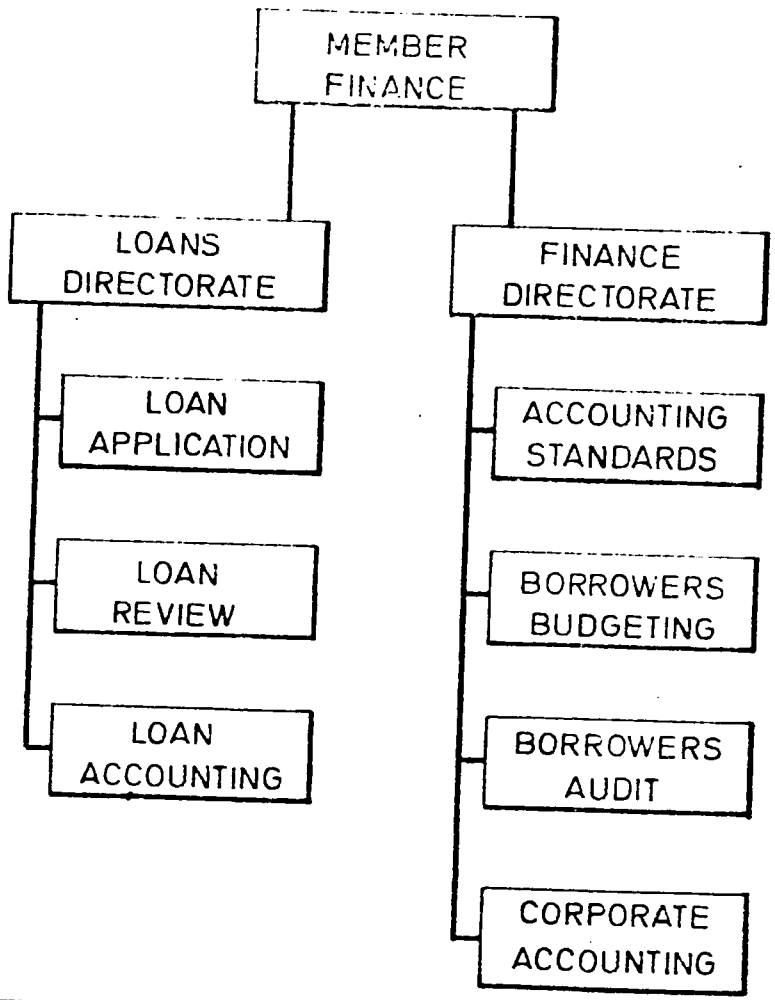
BANGLADESH RURAL ELECTRIFICATION BOARD WITH LOCALLY ORGANIZED PBSs



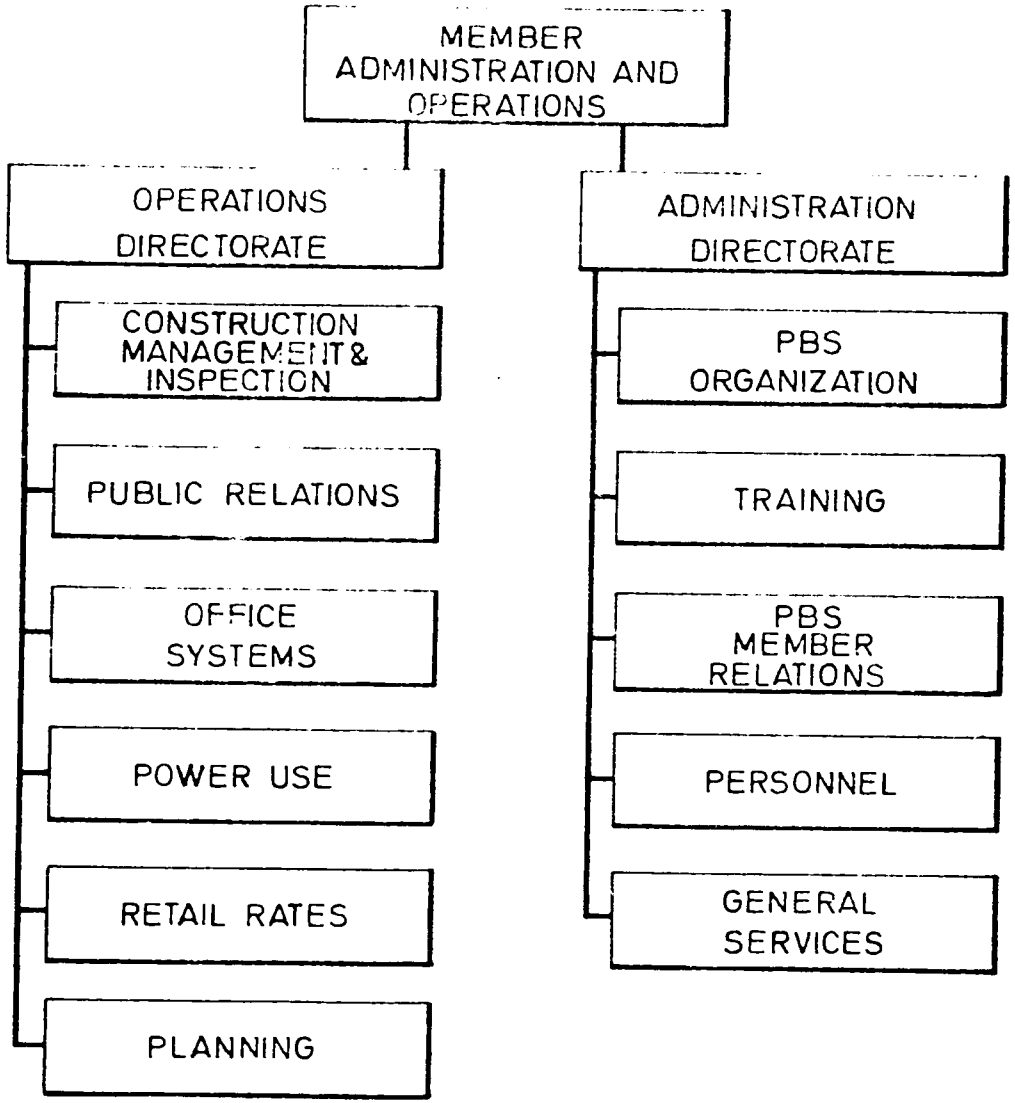
REB ORGANIZATION CHART



REB ORGANIZATION CHART



REB ORGANIZATION CHART



BANGLADESH RURAL ELECTRIFICATION BOARD
FINAL STAFFING (5TH YEAR)

Position	No. Employees	Salary Taka	Benefits Taka	Monthly Taka	Annual Taka
Chairman	1	2,000	800	2,800	33,600
Member	3	2,000	800	8,400	100,800
Director	6	1,550	620	13,020	136,240
Deputy Director	3	750	300	3,150	37,800
Development Specialist	6	500	200	4,200	50,400
Accountant	6	500	200	4,200	50,400
Engineer	6	500	200	4,200	50,400
Organization & Mgt. Spec.	6	500	200	4,200	50,400
Lawyer	2	1,550	620	4,340	52,080
Stenographic and Clerical	20	310	124	8,680	104,160
Non Technical Staff Support	10	250	100	3,500	42,000
Total REB	69			Tk 50,670	Tk 678,140

Note: This does not include twelve field divisions to be transferred from PDB to REB in second project year. These field divisions include the REB construction supervision personnel.

LOCAL RURAL ELECTRIC ASSOCIATION (PBS)
INITIAL MEMBERS (1ST YEAR)

3 Farmers
- a) one landless
- b) one owning less than 2.4 acres of land
- c) one "at large" representative

1 Teacher

1 Businessman or Businesswoman

1 Artisan

1 IRDP or other cooperative representive

1 Representative of National Woman's Organization or Family Planning Clinic

Note: At least two of the above eight members are to be women.

INTERMEDIATE STAFFING (2ND YEAR)

1 Manager

1 Member Service Representative

2 Accountants

2 Billing Clerks

1 Row Chief

2 Storekeepers

2 Typists

6 Linemen

2 Laborers

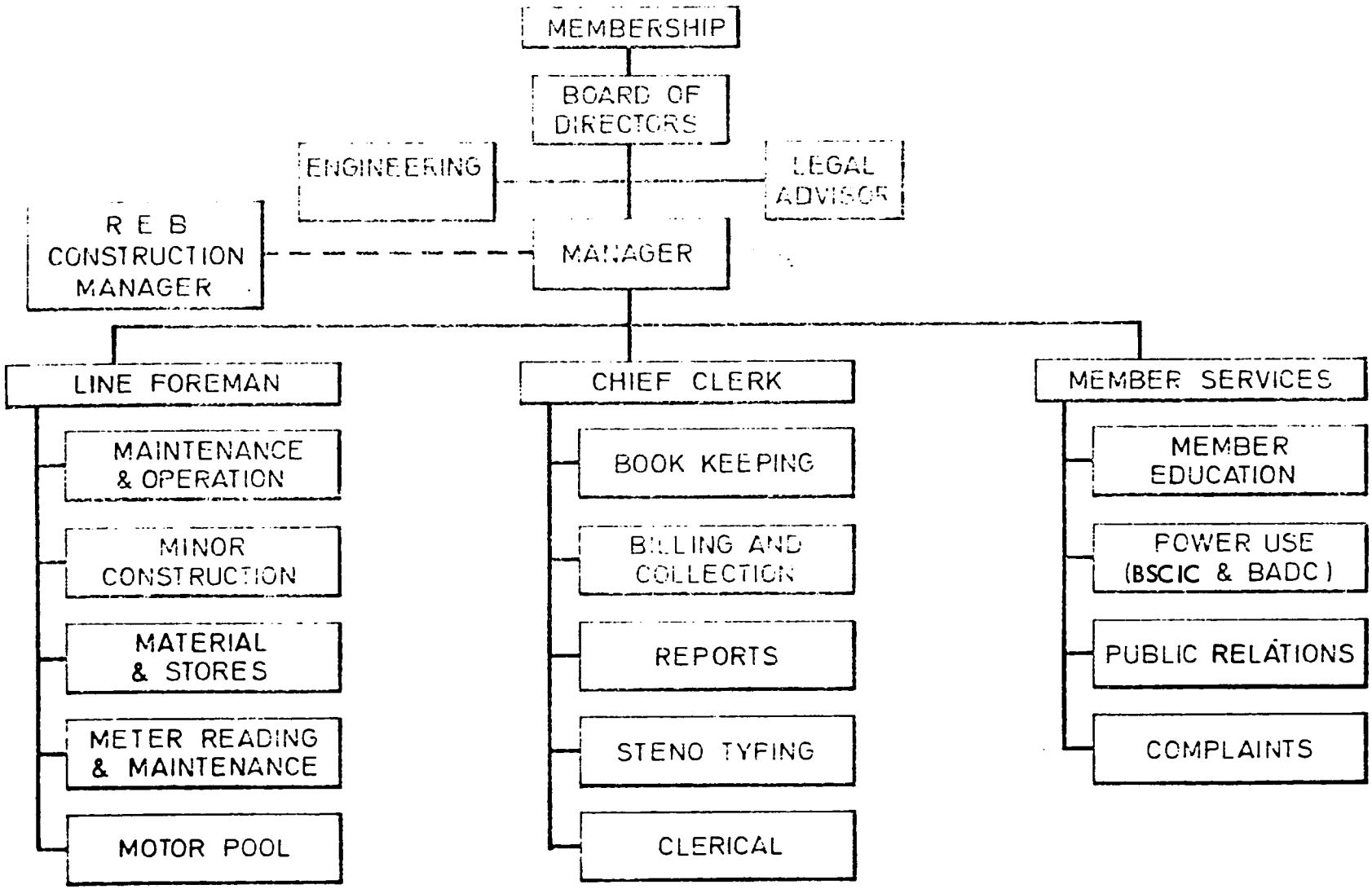
[illegible] Drivers

LOCAL RURAL ELECTRIC ASSOCIATION (PBS)
FINAL OPERATING STAFF (5TH YEAR OR AFTER)

Position	No. Employees	Salary Taka	Benefits Taka	Monthly Taka	Annual Taka
Manager	1	1,550	620	2,170	26,040
Member Service Representative	2	500	200	1,400	16,800
Accountant	2	375	150	1,050	12,600
Cashier	2	200	80	560	6,720
Billing Clerk	4	240	96	1,344	16,128
Clerk-general	1	240	96	336	4,032
Work Order Clerk	1	250	100	350	4,200
Row Chief	1	500	200	700	8,400
Store Keeper	1	300	120	420	5,040
Store Helper	1	250	100	350	5,400
Stenographer-Typist	2	250	100	700	8,400
Line Foreman	1	550	220	770	9,240
Lineman	5	500	200	3,500	42,000
Asstt. Lineman	5	250	100	1,750	21,000
Driver	2	250	100	700	8,400
Chowkider	1	250	100	350	4,200
Laborers	2	150	60	420	5,040
Total	35			Tk 17,200	Tk 2,06,040

LOCAL RURAL ELECTRIC ASSOCIATION (PBS)

FINAL OPERATING SYSTEM (5th YEAR)



TRAINING REQUIREMENTS

Sample types of courses that will be developed under the project:

I. For Rural Electric Association (PBS) Personnel

A. Organization, Management and Office Operations

1. Management Course
2. General Managers Conference
3. Conference for Board Directors and Managers
4. Annual Conference for Presidents and Managers
5. Conference-Workshop on Work Plan Development
6. Accounting Course
7. Warehouse Operations and Management Course
8. Workshop on Work Order Procedure
9. Seminar on the Administration of Construction by Force Account
10. Meter Reading, Billing and Collection Course
11. Office Management Course
12. Workshop for Member Service Director
13. Seminar on Retail Rate Structure
14. Seminar on Newsletter Writing

B. Electrical

1. Linemen Course
2. Electricians Course
3. Seminar on Secondary Line Staking
4. Seminar on Pole Preservation, Testing and Inspection
5. Hot Line Course

C. Safety

1. Industrial Safety Seminar
2. Safety Training Course
3. Safety Trainers Course
4. Electrical Appliance Safety Seminar
5. Safety Training
6. Distribution Lines Safe Maintenance Course

II. In-Service Training Courses for REB Personnel

A. Supervisory

1. Supervisor Training Course
2. Seminar on Rural Electrification Program for Middle Management Personnel

B. Engineering

1. Seminar on the Review of Engineering and Construction Methods
2. Inspectors Orientation Course
3. Seminary on Feasibility Study Preparations
4. Inspectors Orientation Course on Pole Preservative Processing

C. Trainers

1. Linemen-Electrician Trainers Course
2. First Aid Instructors Course
3. Training Staff Planning Conference
4. Course on Effective Communication

D. Clerical and Secretarial

1. Clerks Skills Training Course
2. Course on Secretarial Proficiency
3. Lecture, Seminar on Records Management

E. Support Group

1. Skills Training for Drivers
2. Skills Training for Janitors and Messengers

RURAL ELECTRIFICATION CONSULTANT
Outline Scope of Work

The Consultant is the principal source of expert assistance for implementation of the Rural Electrification Project. The duties of the Consultant will include the following:

1. General advice to the Bangladesh Rural Electrification Board (REB) on all questions concerned with project implementation including institutional development, technical requirements and standards, financial management and training.

2. Advice and assistance to the REB specifically on technical and engineering requirements. This will include development of design, operational and construction standards, inspection procedures, maintenance, etc., the entire range of technical concerns related to project implementation.

3. Advice and assistance to the REB on all matters related to financial management, including development of financial procedures and plans and completion of a financial management system. This responsibility will also include development of procedures for administering REB loans to the subproject associations (Rural Electric Societies), as well as for financial inspection and auditing of subproject association financial activities.

4. Advice and assistance to the REB in development of an REB capability for conduct of surveys and feasibility studies for expansion of the rural electrification program, including a capability for assessment of the economic, technical, social and other factors relevant to such studies.

5. Assistance in development of a central REB training program and facilities with the purpose of providing a continuing capability in REB to carry out training of REB and local association staff in all aspects of system operation and administration. This responsibility will include training of trainers, development of training materials, guidelines, standards and criteria for evaluation of training effectiveness.

6. Advice and assistance to the Rural Electric Societies on the institutional, technical and financial requirements for effective operation, maintenance and management of rural electric system.

7. Advice and assistance to the REB on all project logistics requirements, including receipt and despatch, warehousing, inventory control, transport, etc. This will include training of counterpart personnel responsible for these duties.

8. Supervision of construction of both substations and distribution line for all of the Rural Electric Society subprojects. This will include review and supervision of work done by local engineering firms and contractors, training of construction inspectors, and advice to the local Rural Electric Societies and local engineering firms on site-specific design, construction standards and techniques, etc.

9. Act as offshore purchasing agent for the REB and Power Development Board for this project, including preparation of detailed materials lists and cost estimates, preparation of standard bid and contract documents, solicitation of bids, analysis and evaluation of proposals, recommendations for or award of contracts, review of invoices, making of payments and arranging of shipment. This will also include training of counterpart personnel with respect to each of these tasks.

10. Development of baseline data for performance of project evaluations.

The services above are estimated to require approximately 56 work years of consultant personnel services.

Conduct of the Consultant services will reflect the basic project principle that successful implementation of the project depends upon the initiative and effectiveness of counterpart personnel, and that the services to be provided by the Consultant accordingly will be directed to the institutional development of REB and Rural Electric Society capability.

SCOPE OF SERVICES

The purpose of this study is to develop the technical, economic, financial and social analysis and organizational requirements for a rural electrification program in Bangladesh.

The study will be carried out in collaboration with the Bangladesh Power Development Board (Power Development Board) in two phases, as follows:

Phase I - Survey, Feasibility and Organization and Rate Analysis

Phase I shall consist of a review of available information concerning Bangladesh development, including particularly that relating to rural development, selection of project study areas, the preparation of feasibility studies for the selected study areas, establishment of rank order priority listing of areas studied, analysis and recommendations on organization, staffing and training requirements, and an analysis of rate structures and pricing policies for the rural electrification program. An estimated period of eight (8) months will be required to complete Phase I.

1. The Consultant shall conduct a review of available information concerning Bangladesh, particularly that relating to rural development, including field confirmation as necessary, to determine areas most favorable to the development of rural electric systems in close proximity to existing or proposed transmission and distribution facilities and taking into account any Bangladesh Government development plans as well as potential rural industries including agro-industries, irrigation, commerce, and education, health and social institutions for the areas.

2. Prior to undertaking the review, the Consultant shall familiarize himself with the existing plans and studies for rural electrification of Bangladesh as prepared by the Power Development Board and shall review existing generation, transmission and distribution systems and expansion plans to identify most suitable power sources for rural electrification in the areas identified under paragraph I above.

3. The Consultant shall develop a preliminary economic and social profile of the most favorable areas identified under I above. The economic and social profile shall include description of the state of development of the agricultural sector within the study area, description of major Bangladesh Government agricultural programs within the area such as irrigation, introduction and utilization of high yielding varieties of rice, credit programs, etc. Using

available information and sample field surveys, the profile shall describe large, medium and small scale rural industries, family owned and operated repair and manufacturing shops, and agroindustrial firms in terms of capital investment and manpower utilization. It will also describe electrification of irrigation equipment and potential for conversion to electricity of existing power sources within the area. Drawing upon available data and sample field surveys, the profile of the potential study area will include data on population density and geographical distribution, income levels and income distribution, farm size distribution and tenant patterns, non-farm employment patterns, existing and potential education, health and social institutions, and local leadership within the area.

4. Utilizing the economic and social profile the Consultant shall develop a preliminary load forecast for the selected rural areas, The load forecast shall classify the load for both public and private power use including deep and shallow tubewells, low-lift pumps, rural industries, agro-based industries and domestic, commercial and institutional load in the selected areas.

5. Based on the data developed by the review, individual areas will be selected by priority order for the preparation of feasibility studies. Selection criteria will include projected electric load, potential economic returns, potential residential connections and service to industrial, agricultural, and agroindustrial projects, and commercial and institutional development within the area. In the selection of such areas, due consideration will be given to social development criteria. The Consultant will document his analysis and recommendations on the selection of the project areas for preparation of feasibility studies and will provide copies to the Power Development Board and AID and obtain their approval prior to initiation of the individual studies. At that time, the Power Development Board and AID will review with the Consultant the criteria for development of a plan by which the project will be evaluated during implementation.

6. For each selected area the Consultant will prepare a detailed feasibility study of a rural electrification system. The feasibility study will include detailed load projections for a period of fifteen years, preparation of preliminary designs and a preliminary cost estimate of the system showing foreign exchange and local currency components separately. For each feasibility study the Consultant shall calculate the financial rate of return and cost/benefit ratio and shall calculate the national economic rate of return. These calculations shall be based on a range of load projections

and alternate rate levels for electric service. The methodology for undertaking the economic analysis shall be developed by the Consultant and shall be approved by the Power Development Board and AID prior to preparation of the individual economic analysis. It is estimated that not more than 10 areas will be selected for detailed feasibility studies.

7. Upon completion of the feasibility studies, the Consultant shall prepare a rank order priority list of electrification projects. Based on the review of individual feasibility studies and on the rank order rating of the Consultant, the Power Development Board and AID will select specific project areas for the preparation of the electrification plans outlined in Phase II below.

8. The Consultant shall undertake an analysis of organization staffing and training requirements for the development and implementation of the rural electrification program. Model alternative institutions for administering the program shall be examined listing the advantages of each and an indication of differences in man-power, training and administrative costs separately classified for implementing system development and system operation. Alternatives to be considered shall include but not necessarily be limited to the following:

a) Power Development Board and its present organization or modifications.

b) Autonomous agency with locally administered sub-divisions.

c) Autonomous agency with locally organized cooperatives.

9. The Consultant shall prepare for the Power Development Board's consideration, an analysis of existing, alternate and recommended rate structures and rate levels for the rural electrification systems. The evaluation shall include analysis of the financial and economic impact of the alternate pricing policies on the individual electrification projects prepared above, but shall also examine the impact on specific consumer groups, e.g., large, medium and small industries, family owned and operated manufacturing enterprises, agro-industries, irrigation users, small commercial establishment and institutional and residential consumers. For residential consumers, the analysis shall relate alternate pricing policies to the willingness and ability of low income consumers to utilize electric power. Related policies shall be examined with respect to the financing of house connections and house wiring.

10) Each study shall include a section on environmental effects as set forth in AID publication entitled Environmental Assessment Guidelines Manual, September 1974.

11. The Consultant will prepare an evaluation plan consistent with the criteria previously reviewed with AID and the Board per paragraph 5 above, for measuring project accomplishments. For this purpose, social, economic, technical and financial guidelines will be established by the Consultant as a basis for comparing anticipated and realized results of operations. The evaluation plan will be subject to AID and Board approval.

12. A field survey of selected electrified and unelectrified market towns is planned by AID through a separate contract with a local institution The focus of the survey will be to obtain data on economic factors and related behaviour of enterpreneurs who use or could use electric power. The Consultant shall maintain liaison with the institution performing the survey. Available data from the survey may be provided to the Consultant for its use in the Phase I study.

Phase II

Implementing the electrification plan will begin immediately after the rank order of area feasibilities has been completed, approved by the Power Development Board and AID and after the Consultant has received a notice to proceed from the Power Development Board. Certain tasks of Phase II, such as preparing design criteria and technical specifications, are common to the electrification plans of all prospective areas. These tasks can be started prior to the above approval and notice to proceed. Three additional months will be required to complete Phase II.

Power Development Board engineering personnel will be provided as set forth separately in the Agreement to assist the Consultant in the formulation of all major tasks of Phase II. The combined consultant and Power Development Board team of engineers will pursue the necessary tasks in a coordinated fashion in order to effect project completion within the scheduled time period.

The activity in each task of Phase II is as follows:

1. Power Sources

The knowledge of existing and planned system capabilities will be generally obtained in Phase I as a necessary input into the feasibility studies. In Phase II, the power availability in selected project areas will be reviewed in greater detail to ensure coordination with proposed distribution development programs.

2. Design Criteria

Distribution system design criteria and construction standards will be adopted from U.S. Rural Electrification Administration methods, modified as necessary to meet the specific types of materials selected for use in Bangladesh. Recommended design criteria will recognize the aim of developing simple and economic systems with acceptable quality and which attain the requirements of rural electrification in Bangladesh. Construction standards will be adopted to obtain the maximum use of acceptable local materials. System voltage levels will be selected which best meet the need of rural electrification and minimize conflict with existing Bangladesh voltage standards.

3. Technical Specifications

Technical specifications for material and equipment will be prepared to cover system procurement requirements. Existing Power Development Board specifications will be reviewed and adopted wherever considered appropriate by the Consultant. The Consultant will continuously review with the Engineering Representatives of the Board the materials and equipment, and their sources, being considered as these specifications evolve. Source of all adopted specifications will be identified.

4. Right-Of-Way (ROW)

Specific right-of-way clearance requirements will be recommended. Present procedures implemented by the Power Development Board for obtaining ROW will be reviewed and evaluated as related to their technical soundness.

5. Circuit Maps

Information assimilated during Phase I with respect power sources, population centers, load forecasts, etc., will be used for developing circuit maps showing preliminary substation locations and feeder main circuit routing. Substation capacity and main circuit extensions will be developed and facility requirements for supplying the system loads will be identified. Circuit capacity and loading design will be based on design criteria established in paragraph 2 above.

6. Transformer and Secondaries Estimate

The number and type of initial customer connections, projected as per the feasibility studies will be reviewed and updated as applicable to the project area. This information will be used to develop quantity estimates of meter and service requirements. Transformers and secondaries material estimates will be based on practical engineering judgment in view of standard secondary voltages and expected customer dispersion. An effort will be made to minimize the variety of secondary conductor sizes required in the interest of warehousing simplicity.

7. Material and Equipment Estimate

The material and equipment quantity requirement for substation and main feeder development will be based on information extracted from circuit maps. Additional primary circuit requirements for minor lateral extensions will be estimated on the basis of engineering judgment. Estimated quantities will be tabulated according to principal items such as power and distribution transformers, feeder bays, poles, conductor, pole top assemblies, etc.

8. Cost Estimate

A cost estimate for engineering, procurement, and erection, separated into domestic and foreign exchange requirements, and including a schedule of annual expenditures, will be prepared for each principal material item on the quantity tabulation prepared in paragraph 7. The Power Development Board will work closely with the Consultant in determining cost estimates for local materials and labour, for import duties etc. The estimated costs will be applied to procurement and erection requirements defined by the paragraph No.6 work schedule. Total expenditures for system development in each project area will be the final product of this task.

9. Work Schedule

A detailed work schedule will be prepared for each project area with recognized practical procurement and delivery periods, plus local construction capabilities and climatic conditions.

10. Detail Material List

The tabulation of principal material and equipment requirements tabulated in paragraph 8 will be broken down into specific components of material. The detailed material list completed in this task will be separated according to local and foreign procurement.

11. Local Materials

Maximizing the use of local materials will be considered of substantial importance to the beneficial aspects of a rural electrification program in Bangladesh. The possible use of local materials and the capability of local industry to produce additional materials will be investigated continuously throughout the course of the Project. Obtaining acceptable local availability of all foundation and structure requirements and of simple hardware items may be possible and will be evaluated.

12. Tender Documents - Construction and Local Materials

Draft Tender Documents will be prepared for construction contracts and for local materials.

13. Tender Documents - Foreign Materials

Foreign material requirements for system implementation (paragraph 10) will be combined with technical specifications (paragraph 3) for the purpose of serving as Tender Documents. The Power Development Board will provide the general and special conditions which are required of these documents.

ENVIRONMENTAL ASSESSMENT

As rural electric lines are constructed in Bangladesh the environment will be affected by clearing of right of way, pole location, crossings, land use, formally classified areas, area economy and human activities.

Right of Way Clearing

It will be necessary to clear trees at least 30 feet from the pole line on each side of the right of way. Regrowth must be controlled so that trees are not permitted to grow so that, in case of a windstorm, they could uproot and strike the line while falling. Even under such conditions outages will occur from falling trees being broken or uprooted and blown into the line. Under the severe weather conditions existing in Bangladesh, satisfactory electric service reliability will not be possible without a rigid right-of-way clearing and maintenance program.

Because many miles of electric line will be required to serve rural users at the lowest possible cost, the original tree clearing and subsequent maintenance of such right-of-way will require good management and perhpas some sacrifice on the consumers' part. While land owners should be reimbursed for any damages resulting in monetary losses due to line construction, it will be necessary that they provide right-of-way for poles without compensation. Consumers should also provide labor for tree clearing without compensation for construction of extensions from the main feeder lines.

While this work will effect changes in the appearances of the country side it will not adversely do so provided adherence to proper line design and tree cutting procedures. With these conditions the noise effect of electrical interference will also be negligible.

Pole Location

The location of poles will be important both from an appearance and safety point of view. Where possible pole lines should be located at least 100 to 200 feet from the center of an existing road. This will reduce the possibilities of vehicle collisions. It will also provide flexibility in locating anchors, will provide a tree screen between the road and the line right-of-way in wooded areas, and will permit road widening and reconstruction without affecting the distribution line. The disadvantage in locating the lines off existing roads is the increase in cost both during construction and during subsequent operations and maintenance because work cannot be done with equipment located on the road. However, the long term environmental impact

will be less and a higher standard of service reliability will result because of less exposure of the line to vehicular interference.

Crossings

Electric line crossings over rail-roads, other utility lines including pipelines, pucca and katcha roads and navigable waters are important areas for consideration in design of rural electric distribution systems. While the effect of such crossings in terms of safety and inconvenience can be substantial, minimum effect is obtained by proper location of facilities and the use of underground cable in those crossing areas where adequate clearance and overhead safety is a serious problem. While underground systems have less environmental effects than overhead systems, they cannot be considered for general use in Bangladesh because of high foreign exchange investment costs and operation and maintenance problems resulting from flooding.

Land Use

With an average of two and a half miles of electric line to each square mile of area, the use of land for electrification become an important consideration, especially in a country where there is a shortage of land for agricultural use. Therefore, line design must take into consideration utilization of land. Use of long spans between poles and the minimum number of circuits (maximum wire size) is an important consideration. Poles and anchors must be located so as to permit maximum use of the electric line right-of-way for agricultural purposes as well as to cause the least possible damage to crops during construction, operation and maintenance. Provisions must be made to reimburse adequately the land owner for damages caused. Damage must be kept to a minimum by proper scheduling work, taking into consideration the various crop growth and harvest seasons. In the case of substations and buildings to be associated with the project, the design must be such as to make the best possible use of available land to enhance the appearance of the surrounding area.

While poles and anchors cause inconvenience to the farmer, the actual loss of land for cultivation purposes is negligible, particularly in Bangladesh where only hand labor and small equipment are used.

Due to unusual flooding conditions special consideration will have to be given to rural line design. Where normal annual flooding is higher than three or four feet, extra ground clearance must be provided by use of higher poles or shorter spans. In areas that frequently flood up to twelve

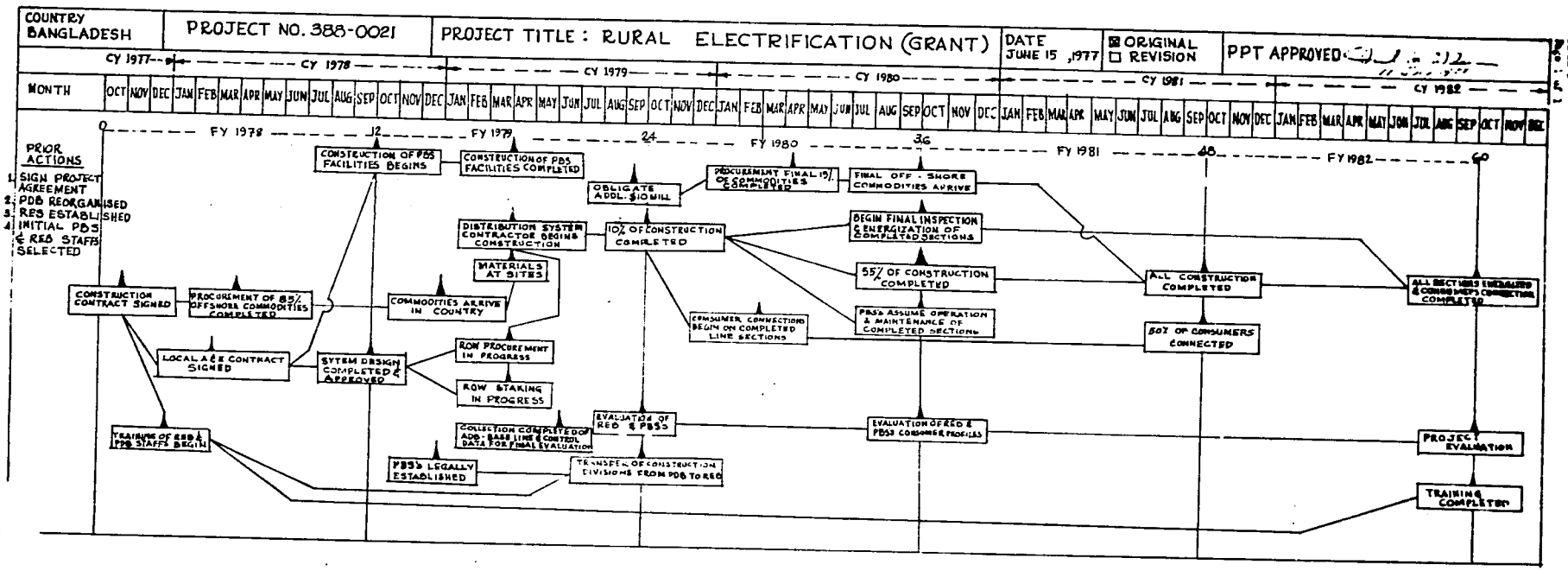
or more feet it will be necessary to provide sufficient clearance approximately every half mile to provide passage for boats with up to 15 foot masts. In order that the electric line remains firmly upright during flood conditions the poles will have to be "rocked in", backfilled with concrete, set on a prefabricated concrete base or installed in some suitable alternative manner.

Formally Classified Area

Wherever possible, power lines should not pass through formally classified areas such as parks, scenic, historical and wild life refuges. It is well to consider alternative routes as a high priority. If this is not possible, each case must then be studied on an individual basis with design and line routing negotiated to create the least possible effect on the classified area while still providing electric service to people who desire it.

Area Economy

The construction, operation and maintenance of a rural electric system directly and indirectly effects the economy of the area served as well as the country as a whole. During construction the acquisition and handling of materials becomes an important factor in business, trades, manufacturing and transportation sectors of the country's economy. On a local basis the activities stimulate the area's economy through payments received for services of all types effected by construction work. It is anticipated that the rural poor in particular will earn added income due to labor requirements during construction.


COUNTRY BANGLADESH
PROJECT NO. 388-0021
PROJECT TITLE: RURAL ELECTRIFICATION (GRANT)
DATE JUNE 15, 1977
ORIGINAL
REVISION
PPT APPROVED
CY 1977
CY 1978
CY 1979
CY 1980
CY 1981
CY 1982
MONTH
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FY 1978
12
FY 1979
24
FY 1980
36
FY 1981
48
FY 1982
60
PRIOR ACTIONS
1. SIGN PROJECT AGREEMENT
2. PDB REORGANIZED
3. RES ESTABLISHED
4. INITIAL PDS & RED STAFFS SELECTED
CONSTRUCTION CONTRACT SIGNED
PROCUREMENT OF 85% OFFSHORE COMMODITIES COMPLETED
LOCAL A&E CONTRACT SIGNED
TRAINING OF RED & PDB STAFFS BEGIN
CONSTRUCTION OF PBS FACILITIES BEGINS
SYTEM DESIGN COMPLETED & APPROVED
COMMODITIES ARRIVE IN COUNTRY
PBS'S LEGALLY ESTABLISHED
CONSTRUCTION OF PBS FACILITIES COMPLETED
MATERIALS AT SITES
ROW PROCUREMENT IN PROGRESS
ROW STAKING IN PROGRESS
DISTRIBUTION SYSTEM CONTRACTOR BEGINS CONSTRUCTION
COLLECTION COMPLETED OF ADD-BASE LINE & CONTROL DATA FOR FINAL EVALUATION
TRANSFER OF CONSTRUCTION DIVISIONS FROM PDB TO RED
OBLIGATE ADDL. $10 MILL
10% OF CONSTRUCTION COMPLETED
EVALUATION OF RED & PBS'S
PROCUREMENT FINAL 15% OF COMMODITIES COMPLETED
CONSUMER CONNECTIONS BEGIN ON COMPLETED LINE SECTIONS
FINAL OFF-SHORE COMMODITIES ARRIVE
BEGIN FINAL INSPECTION & ENERGIZATION OF COMPLETED SECTIONS
55% OF CONSTRUCTION COMPLETED
PBS'S ASSUME OPERATION & MAINTENANCE OF COMPLETED SECTIONS
EVALUATION OF RED & PBS'S CONSUMER PROFILES
ALL CONSTRUCTION COMPLETED
50% OF CONSUMERS CONNECTED
ALL SECTIONS ENERGIZED & CONSUMERS CONNECTION COMPLETED
PROJECT EVALUATION
TRAINING COMPLETED

FEASIBILITY STUDY

The following is a summary of tasks performed by the Consultant for selection of the final feasibility areas. (For a complete description of the tasks required see Annex B, Scope of Services, Phase I.)

1. Reviewed available information which would help determine areas most favorable to development of rural electrification systems. The Consultant and PDB personnel initially reviewed existing and planned generation, transmission and distribution systems, and on the basis of this information, plus information on BDG rural development plans and geographical balance priorities, selected general areas for distribution system development. The Consultant then made field trips to these areas, collecting further data on road network, 33 KV system, irrigation use, rural development programs, small, cottage and agro-industries, and local leadership. On the basis of the above, the Consultant and PDB selected twelve Thanas as core study areas for data collection and further analysis. These areas are listed in Table I of this Annex.

2. Developed preliminary economic and social profiles of the twelve areas selected above. Based on a survey of approximately 5,000 households plus bazars, farms and small industries in the twelve areas, profiles were prepared which included description of the agricultural commercial and industrial sectors and irrigation and included social profile data on population density and distribution, income levels and distribution, farm size distribution and tenant patterns, non-farm and employment patterns, existing and potential education, health and social institutions, and local leadership within the areas.

3. Utilizing the above profiles, the Consultant developed preliminary load forecasts for each area. Data used for this initial forecast came from the twelve thana survey data, site inspection by the Consultant, reports of the various PDB regional Executive Engineers, and other published sources. Data from this preliminary forecast is included in Tables II - V of this Annex.

4. Using the preliminary load forecast and profiles, the Consultant documented a rank ordering of the twelve core areas, and proposed that the top six priority areas be selected as feasibility study areas for this project. The ranking was determined on the basis of the following weighted criteria:

CRITERIA	WEIGHT FACTOR	PERCENT INFLUENCE
Power Supply	0.70	8.3%
Roads	0.75	8.9%
Residential	0.80	9.5%
Cottage Industries	0.30	3.6%
Institutions	0.60	7.1%
Pump Irrigation	1.00	11.9%
Commercial Shops	0.50	6.0%
Industrial	0.90	10.7%
Flooding	0.30	3.6%
Potential Economic Benefit	0.90	10.7%
Probability of Residential Connection	0.80	9.5%

The results of the priority ranking are shown at Table I. The detailed data and analysis for this selection is included in the NRECA/CAI Bangladesh Rural Electrification Detail Feasibility Study Area Selection Documentation Report, April 1, 1977.

5. The priority ranking and report were subsequently reviewed and approved by PDB and AID.

6. The Consultant then conducted a full feasibility study of the six priority areas. The feasibility study included load forecasts, cost estimates and preliminary design as well as economic return analysis for each of the six areas. Because all six areas were selected for inclusion under this project, the cost estimates, design, load forecast and economic return analysis data is the same as that reflected in this Project Paper. Complete details of this study are contained in the NRECA/CAI Phase I Report, Bangladesh Rural

Electrification Feasibility Study. The Consultant's priority ranking of the six areas was also submitted, based on power supply, benefit/cost ratio, potential consumers, financial viability and percent of the lowest 40 percent to be connected for the first five years of operation. The factors considered for each criteria and the rankings, both for each criteria and total, are shown in Tables VI - XI of this Annex. The final load forecasts which are reflected in this paper and in the ranking criteria are shown at Tables XII - XVII. These forecasts are for residential, commercial, industrial and agricultural users over the 17 year construction period. Both high and low consumption levels are presented. Tables XVII - XXIII show the respective income levels from survey data for the six areas that were used for connection forecasts. The low income connection forecast was based on both kerosene consumption and survey questions relating to the desire and ability to pay for service. For this purpose all households were classified as either low income (bottom 40 percent), middle income (middle 50 percent) or high income (top 10 percent). Levels of kerosene expenditure were then determined for each feasibility area, as shown at Table XXIV. The percentage of connections for each group was then derived by multiplying the percent spending Taka 9 or more times the percent within that group indicating they both desired and could afford service.

TABLE 1

THANA CORE STUDY AREAS
RANKING OF THANAS IN EACH CRITERIA

(1 = Highest Ranking)

	Power Supply Facilities	Roads	Residential	Cottage Industry	Institutions	Estimated Pump Irrigation	Commercial Shops	Industrial	Projected Load	Flooding	Potential Economic Benefits	Probability of residential connection	Priority Ranking
Shahzadpur	6	6	3	3	5	3	5	3	3	1	3	11	1
Kaliakair	3	2	8	4	3	1	8	7	2	5	2	8	2
Daudkandi	9	10	1	2	1	2	3	2	10	11	10	10	3
Natore	2	3	6	8	6	5	4	6	8	10	8	12	4
Jhikergacha	4	4	7	5	4	9	2	4	6	7	6	7	5
Chunarughat	1	1	9	6	8	11	11	1	1	8	1	1	6
Sherpur	10	5	5	11	7	6	6	8	7	6	7	6	7
Madhupur	8	8	11	10	10	4	7	5	4	2	4	3	8
Bhanga	11	12	2	1	2	8	1	10	9	9	9	5	9
Mithapukur	7	7	4	7	9	7	10	9	11	3	11	4	10
Trisal	5	11	10	9	11	10	9	11	5	4	5	2	11
Bandarban	12	9	12	12	12	12	12	12	12	12	12	9	12

TABLE II

PRELIMINARY LOAD FORECAST
ESTIMATED CONSUMPTION IN CORE THANAS (MWH/YEAR)

Name of Thana	Operating Year				
	Now	1	5	10	15
Chunarughat	184.8	3,856.8	6,948.0	9,308.4	11,493.6
Daudkandi	286.8	1,222.8	3,358.8	6,912.0	10,230
Mithapukur	60.0	687.6	2,748.0	5,467.2	8,113.2
Jhikargacha	288.0	649.2	1,892.4	4,712.4	7,498.8
Kaliakair	192.0	583.2	2,895.6	5,844.0	7,392.0
Shahzadpur	723.6	1,795.2	3,020.4	5,274.0	7,334.4
Natore	1,384.8	1,597.2	3,134.4	5,368.8	6,936.0
Madhupur	0.0	464.4	2,398.8	5,103.6	6,644.4
Bhanga	0.0	440.4	1,363.2	3,152.4	4,842.0
Sherpur	76.8	318.0	1,167.6	2,881.2	4,393.2
Trisal	6.0	246.0	1,188.0	2,695.2	4,016.4

TABLE III

PRELIMINARY LOAD FORECAST
ESTIMATED PEAK LOADS IN CORE THANA (MW)

Core Thana Name	OPERATING YEAR				
	Now	1	5	10	15
Daudkandi	127	432	1190	2976	4826
Mithapukur	28	232	885	2305	3701
Chunarughat	66	792	1512	2550	3625
Kaliakair	81	231	1338	2763	3508
Jhikargacha	115	234	725	1964	3320
Madhupur	0	176	1075	2381	2300
Natore	486	561	1184	2288	3198
Shahzadpur	362	504	945	1996	3080
Shabga	0	131	521	1366	2294
Sherpur	33	134	539	1353	2136
Trisal	2	90	522	1230	1740

TABLE IV

PRELIMINARY LOAD FORECAST
ESTIMATED NUMBER OF RESIDENTIAL CONNECTIONS
IN CORE THANAS

Core Thana Name	OPERATING YEAR				
	Now	1	5	10	15
Daudkandi	35	1809	4903	10982	18348
Mithapukur	22	1125	3140	7202	12391
Natore	2413	2573	4180	6379	8641
Jhikargacha	180	712	2021	4741	8341
Shahzadpur	0	719	2011	4627	7984
Bhanga	0	750	2019	4432	7297
Chunarughat	300	687	1885	4233	7128
Kaliakair	30	444	1281	3065	5500
Madhupur	0	525	1453	3300	5622
Sherpur	70	397	1104	2523	4324
Trisal	2	315	867	1954	3305

TABLE V

PRELIMINARY LOAD FORECAST
ESTIMATED NUMBER OF IRRIGATION CONNECTION
IN CORE THANAS

Core Thana Name	Now	OPERATING YEARS 1	5	10	15
Daudkandi	0	12	126	517	820
Kaliakair	3	25	253	599	817
Madhupur	0	15	143	433	632
Shahzadpur	0	10	102	298	665
Natore	0	7	68	361	625
Mithapukur	0	9	90	370	599
Sherpur	0	17	139	370	549
Bhanga	0	5	56	279	501
Jhikargacha	0	7	59	286	489
Trisal	0	7	72	258	414
Chunarughat	0	1	9	212	408

TABLE VI
FEASIBILITY AREA
CONNECTED CONSUMERS
(YEAR 7)

Area	No. Connections	Rank
Chunarughat	56,854	4
Daudkandi	74,020	1
Jhikergacha	50,590	6
Kaliakair	61,238	3
Natore	63,286	2
Shahzadpur	51,643	5

TABLE VII
FEASIBILITY AREA
*BENEFIT/COST RATIOS

Area	Benefit/Cost Ratio	Rank **
Chunarughat	1.05	6
Daudkandi	1.09	4
Jhikergacha	1.07	5
Kaliakair	1.33	1
Natore	1.15	3
Shahzadpur	1.27	2

* Based on quantifiable Economic Benefits only.

** Ranking revised after review of consultant's initial analysis.

TABLE VIII
FEASIBILITY AREAS
POWER SUPPLY

Area	Bulk Capacity	33 KV Reliability	Conflicts/ Schemes	E-W Balance	Construction Ease	10 Load Potential	Total	Rank
Chunarughat	2	3.5	1.5	2	2	2	13.0	1
Daudkandi	3	3	1.5	2	6	6	21.5	3
Jhikargacha	6	4.5	4	5	1	5	25.5	6
Kaliakair	1	4.5	6	2	5	4	22.5	4
Natore	4	2.5	3	5	3	1	18.5	2
Shahzadpur	5	3	5	5	4	3	25	5

TABLE IX
FEASIBILITY AREAS
FINANCIAL VIABILITY
(YEAR 5)

Area	Cash Position *	Rank
Chunarughat	546,296	1
Daudkandi	(417,814)	3
Jhikergacha	(994,266)	5
Natore	(1,196,156)	6
Shahzadpur	255,950	2

* Based on initial 40 paisa power cost, O&M and rate structure; relative ranks changed after further analysis.

TABLE X
FEASIBILITY AREAS
PERCENT LOWER 40% CONNECTED
(YEAR 5)

Area	Low Consumption	High Consumption	Rank
Chunarughat	33.6	39.7	3
Daudkandi	17.3	20.4	5
Jhikergacha	19.9	23.5	4
Kaliakair	39.2	46.4	1
Natore	33.9	40.0	2
Shahzadpur *	9.1	10.7	6

* Medium income of the lower 40 percent group in Shahzadpur is highest among all project areas. It is anticipated that actual connection of rural poor in Shahzadpur will greatly exceed the Consultant's forecast.

TABLE XI
FEASIBILITY AREA PRIORITY RANK

Area	Power Supply	Benefit/ Cost Ratio	Connected Consumers	Financial Viability	Percent Lower 40% Connected	Total	Rank*
Chunerughat	1	6	4	1	3	15	1
Daudkandi	3	4	1	3	5	16	3
Jhikergacha	6	5	6	5	4	26	6
Kaliakair	4	1	3	4	1	19	4
Natore	2	3	2	6	2	15	2
Shahzadpur	5	2	5	2	6	20	5

* Consultants initial ranking was as follows:

Chunarughat	1
Daudkhandi	2
Jhikergacha	6
Kaliakair	3
Natore	4
Shahzadpur	5

This was revised based on data not reflected in consultant's analysis.

Estimate of Connections and Kilowatt Hour Consumption by Customer Class and Total System For DAUDKANDI AREA

TABLE XII

YEAR		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Residential Connections	High	30,868	41,968	52,396	60,714	69,484	78,726	88,459	98,706	109,488	120,827	132,749	145,277	158,437	172,256	186,762
	Low	27,147	36,910	46,081	53,396	61,109	69,236	77,797	86,808	96,290	106,263	116,748	127,766	139,340	151,493	164,251
MWH / Year	High	7,007	9,527	11,894	13,782	15,773	17,871	20,080	22,406	24,854	27,428	30,134	32,978	35,965	39,102	42,395
	Low	5,239	7,124	8,894	10,305	11,794	13,363	15,015	16,754	18,584	20,509	22,535	24,659	26,893	29,238	31,700
Commercial Connections	High	1,788	2,462	3,074	3,563	4,077	4,619	5,191	5,791	6,424	7,090	7,788	8,524	9,297	10,107	10,958
	Low	1,600	2,203	2,751	3,188	3,648	4,133	4,644	5,182	5,748	6,344	6,968	7,627	8,318	9,043	9,805
MWH/Year	High	751	1,034	1,291	1,497	1,712	1,940	2,180	2,432	2,698	2,978	3,271	3,580	3,905	4,245	4,602
	Low	480	661	825	955	1,094	1,240	1,393	1,555	1,724	1,903	2,090	2,288	2,495	2,713	2,942
Deep Tube Wells Connections	High	12	18	23	28	41	53	65	78	89	103	114	127	139	152	164
	Low	11	15	19	23	35	45	55	66	76	86	96	107	117	128	138
MWH/Year	High	198	297	380	462	677	875	1,073	1,287	1,469	1,700	1,881	2,096	2,294	2,508	2,706
	Low	149	203	257	311	473	608	743	891	1,026	1,161	1,296	1,445	1,580	1,728	1,863
Shallow Tube Wells Connections	High	3	6	8	11	68	124	180	239	293	350	406	462	519	574	631
	Low	2	4	6	9	59	108	158	208	257	307	358	408	458	507	551
MWH/Year	High	10	20	26	36	224	409	594	782	967	1,155	1,340	1,525	1,713	1,894	2,082
	Low	5	11	16	24	159	292	427	562	694	829	967	1,102	1,237	1,369	1,504
Low Lift Pumps Connections	High	12	23	35	46	110	172	236	298	362	424	488	551	614	676	740
	Low	9	19	28	38	89	142	193	244	296	347	399	451	502	554	605
MWH/Year	High	66	127	193	253	605	946	1,298	1,639	1,991	2,332	2,684	3,031	3,377	3,718	4,070
	Low	41	86	126	171	401	639	869	1,098	1,332	1,562	1,796	2,030	2,259	2,493	2,723
Small Industries Connections	High	169	188	207	223	240	256	274	294	314	335	357	380	404	428	455
	Low	164	182	199	213	229	244	261	279	297	317	337	358	380	402	427
MWH/Year	High	4732	5264	5796	6244	6720	7168	7672	8232	8792	9380	9.996	10.640	11.312	11.984	12.740
	Low	3280	3640	3980	4260	4580	4880	5220	5580	5.940	6.340	6.740	7.160	7.600	8.040	8.540
Total Connections	High	32,852	44,665	55,743	64,585	74,020	83.950	94,405	105,404	116.970	129,129	141.902	155,321	169,410	184,193	199,710
	Low	28.933	39.333	49.084	56.867	65.169	73.908	83.108	92.787	102.964	113.664	124.906	136.717	149.115	162.127	175,783
MWH/Year	High	12.764	16,269	19,580	22,274	25,711	29,209	32,897	36,778	40,771	44,973	49,306	53,850	58,566	63,651	68,595
	Low	9,194	11,725	14,098	16,027	18,501	21,022	23,667	26,440	29,300	32,304	35,422	38,684	42,064	45,581	49,172

Estimate of Connections and Kilowatt Hour Consumption by Customer Class
For SHAHZADPUR AREA

TABLE XIII

YEAR		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Residential Connections	High	20945	28505	35622	41318	47332	53679	60374	67433	74871	82705	90954	99634	108766	[illegible]	128460
	Low	18478	25147	31425	36450	41756	47355	53262	59489	66051	72963	80239	87897	95953	104424	113377
MWH / Year	High	5069	6898	8621	9999	11454	12990	14611	16319	18119	20015	22011	24111	26321	28645	31083
	Low	3807	5180	6474	7509	8602	9755	10972	12255	13607	15030	16529	18107	19766	21511	23345
Commercial Connections	High	1665	2267	2833	3286	3764	4269	4801	5363	5955	6577	7231	7923	8650	9414	10216
	Low	1490	2028	2535	2940	3368	3820	4296	4798	5328	5885	6472	7089	7739	8423	9141
MWH/Year	High	699	952	1190	1380	1581	1793	2016	2253	2501	2762	3037	3328	3633	3954	4291
	Low	447	608	761	882	1010	1146	1289	1439	1598	1766	1942	2127	2322	2527	2742
Deep Tube Wells Connections	High	2	4	6	8	25	41	59	76	93	110	127	14[illegible]	162	179	195
	Low	2	3	4	6	21	36	51	66	81	97	111	127	141	157	172
MWH/Year	High	33	66	99	132	413	677	974	1254	1535	1815	2096	2393	2673	2954	3218
	Low	27	41	54	81	284	486	689	891	1094	1310	1499	1715	1904	2120	2322
Shallow Tube Wells Connections	High	7	14	20	27	215	404	591	778	966	1153	1340	1528	1715	1903	2091
	Low	5	11	16	21	187	354	519	685	852	1018	1183	1349	1515	1681	1847
MWH/Year	High	23	46	66	89	710	1333	1950	2567	3188	3805	4422	5042	5660	6280	6900
	Low	14	30	43	57	505	956	1401	1850	2300	2749	3194	3642	4091	4539	4987
Low Lift Pumps Connections	High	9	19	28	37	81	126	171	216	260	304	350	394	439	483	528
	Low	8	15	23	30	67	103	140	177	213	250	286	323	359	396	432
MWH/Year	High	50	105	154	204	446	693	941	1188	1430	1672	1925	2167	2415	2657	2904
	Low	36	68	104	135	302	464	630	797	959	1125	1287	1454	1616	1782	1944
Small Industries Connections	High	173	187	202	213	226	239	254	268	284	300	317	334	353	372	392
	Low	170	183	197	207	219	232	245	259	273	289	304	320	338	355	372
MWH/Year	High	4844	5236	5656	5964	6328	6692	7112	7504	7952	8400	8876	9352	9884	10416	10976
	Low	3400	3660	3940	4140	4380	4640	4900	5180	5460	5780	6080	6400	6760	7100	7480
		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		537	1874	1343	1343	1343	1343	1343	1343	1343	1343	1343	1343	1343	1343	1343
		537	1874	1343	1343	1343	1343	1343	1343	1343	1343	1343	1343	1343	1343	1343
Total Connections	High	22802	30997	38712	44880	51644	58756	66251	74135	82420	91140	100310	109959	120086	130719	141883
	Low	20154	27388	34201	39654	45619	51901	58514	65475	72799	80503	88596	97106	106046	115437	125294
MWH/Year	High	11255	14377	17129	19111	22275	25521	28947	32628	36068	39912	43710	47734	51929	56249	60719
	Low	8268	10681	12719	14142	16626	18790	21224	23755	26361	29103	31874	34988	37802	40972	44[illegible]

Estimate of Connections and Kilowatt Hour Consumption by Customer Class and Total System For JHIKERGACHA AREA

TABLE IV

YEAR		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Residential Connections	High	21 140	28 630	35 605	41 097	46 851	52 876	59 183	65 782	72 684	79 900	87 443	95 324	103 555	112 150	121 122
	Low	18 593	25 181	31 316	36 147	41 208	46 507	52 054	57 858	63 929	70 276	76 909	83 841	91 081	98 641	106 531
MWH / Year	High	4 609	6 241	7 762	8 959	10 214	11 527	12 902	14 341	15 845	17 418	19 063	20 781	22 575	24 449	26 405
	Low	3 458	4 684	5 825	6 723	7 665	8 650	9 682	10 762	11 891	13 071	14 305	15 596	16 941	18 347	19 815
Commercial Connections	High	1 542	2 088	2 142	2 997	3 417	3 856	4 316	4 797	5 300	5 827	6 376	6 951	7 552	8 179	8 832
	Low	1 380	1 868	1 917	2 682	3 057	3 450	3 862	4 292	4 742	5 214	5 705	6 220	6 757	7 318	7 903
MWH/Year	High	648	877	900	1 259	1 435	1 620	1 813	2 015	2 226	2 447	2 678	2 919	3 172	3 435	3 709
	Low	414	560	575	805	917	1 035	1 159	1 288	1 423	1 564	1 712	1 866	2 027	2 195	2 371
Deep Tube Wells Connections	High	5	9	14	18	38	58	77	97	115	135	156	174	194	212	232
	Low	4	7	11	14	32	47	65	83	98	116	133	149	166	183	200
MWH/Year	High	83	149	231	297	627	957	1 291	1601	1898	2 228	2 574	2871	3 201	3498	3 828
	Low	54	95	149	189	432	635	878	1 121	1323	1 566	1 796	2 012	2 241	2 671	2 700
Shallow Tube Wells Connections	High	4	8	11	15	113	209	307	404	502	600	697	795	892	989	1 087
	Low	3	6	9	12	98	183	270	356	442	529	615	701	788	874	960
MWH/Year	High	13	26	36	50	373	690	1013	1333	1657	1 980	2 300	2 624	2 944	3 264	3 587
	Low	8	16	24	32	265	494	729	961	1 193	1 428	1 661	1893	2 128	2 360	2 592
Low Lift Pumps Connections	High	4	9	13	17	43	68	93	119	144	169	194	219	244	270	294
	Low	4	7	11	14	35	55	76	96	118	139	158	179	200	221	241
MWH/Year	High	22	50	72	94	237	374	512	655	792	924	1 067	1 205	1 342	1 485	1617
	Low	18	32	50	63	158	248	342	432	531	626	711	806	900	996	1085
Small Industries Connections	High	84	97	108	118	128	139	149	161	173	185	198	213	227	241	256
	Low	81	92	103	111	121	131	140	151	162	172	185	198	211	224	237
MWH/Year	High	2 352	2 716	3 024	3 304	3 584	3 892	4 172	4 508	4 844	5 180	5 544	5 964	6356	6748	7168
	Low	1 620	1 840	2 060	2 220	2 420	2 620	2 800	3 020	3 240	3 440	3 700	3 960	4 220	4 480	4 744
Total Connections	High	22 779	30 841	37 893	44 262	50 590	57 206	64 125	71 360	78 918	86 815	95 064	103 676	112 664	122 041	131 823
	Low	20 065	27 161	33 367	38 980	44 551	50 373	56 467	62 836	69 491	76 446	83 705	91 288	99 203	107 461	116 072
MWH/Year	High	7 729	10 059	12 025	3 963	16 470	19 060	21 683	24 453	27 262	30 177	33 226	36 964	39 590	42 879	46 34
	Low	5 572	7 227	8 683	10 032	11 857	13 682	15 590	17 584	19601	21695	23 885	26 131	28 457	30 868	33 303

Estimate of Connections and Kilowatt Hours Consumption by Customers Class For NATORE AREA

TABLE XV

YEAR		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Residential Connections	High	26790	36377	45358	52493	59999	67894	76191	84910	94065	103677	113763	124341	135436	147051	159204
	Low	23456	31850	39714	45961	52534	59445	66710	74364	82360	90777	99607	108870	118582	128762	139429
MWH / Year	High	5692	7457	9298	10761	12300	13918	15619	17407	19283	21254	23321	25488	27766	30148	32645
	Low	4105	5574	6950	8043	9196	10403	11674	13010	14413	15896	17431	19052	20757	22539	24400
Commercial Connections	High	1286	1747	2178	2521	2881	3260	3659	4078	4517	4979	5464	5972	6504	7063	7648
	Low	1151	1563	1949	2256	2578	2917	3273	3649	4042	4455	4888	5343	5819	6320	6843
MWH/Year	High	540	734	915	1059	1210	1369	1537	1713	1897	2091	2295	2508	2732	2967	3212
	Low	365	469	585	677	773	875	982	1095	1213	1337	1466	1603	1746	1896	2053
Deep Tube Wells Connections	High	9	18	27	36	58	82	104	127	149	172	195	217	240	263	285
	Low	7	14	21	28	47	67	86	105	124	143	162	182	201	220	239
MWH/Year	High	149	297	446	594	957	1353	1715	2096	2459	2838	3218	3581	3960	4340	4703
	Low	95	189	284	378	635	905	1161	1418	1674	1931	2201	2657	2714	2970	3227
Shallow Tube Wells Connections	High	4	7	11	14	175	334	495	655	816	976	1136	1297	1457	1617	1777
	Low	3	6	8	11	153	294	437	580	722	863	1005	1148	1290	1432	1574
MWH/Year	High	13	23	36	46	578	1102	1637	2162	2693	3221	3749	4280	4808	5336	5864
	Low	9	16	22	30	473	794	1180	1566	1969	2370	2714	3180	3487	3866	4250
Low Lift Pumps Connections	High	4	8	12	16	58	99	141	183	225	267	308	350	392	433	475
	Low	3	7	10	13	48	82	116	150	184	218	254	289	321	355	389
MWH/Year	High	22	44	66	88	319	565	776	1087	1238	1469	1694	1925	2156	2387	2613
	Low	14	32	45	59	216	369	522	675	828	981	1143	1292	1445	1598	1751
Small Industries Connections	High	85	93	101	107	115	122	129	139	145	154	161	172	182	192	200
	Low	83	90	98	104	111	117	123	132	139	144	156	164	172	182	192
MWH/Year	High	2380	2604	2828	2996	3220	3416	3612	3836	4060	4312	4564	4816	5096	5376	5600
	Low	1660	1800	1960	2080	2070	2340	2460	2640	2780	2940	3120	3280	3440	3640	3840
Total Connections	High	28178	38250	47687	55187	63286	71791	80720	90090	99917	110225	121029	132349	144209	156629	169632
	Low	24703	33530	41800	48373	55471	62922	70745	78960	87591	96603	106073	115994	126385	137271	148666
MWH/Year	High	8596	11159	13589	15946	18586	21703	24897	28221	31630	35185	38841	42600	46516	50589	54721
	Low	6227	8080	9846	11267	13251	15686	17979	20404	22857	25405	28075	30784	33580	36503	39521

Estimate of Connections and Kilowatt Hour Consumption by Customer Class and Total System
For KALIAKAIR AREA

TABLE XV

YEAR		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Residential Connections	High	26759	36124	44781	51522	58546	65862	73481	81411	89664	98249	107177	116452	126111	136139	146567
	Low	23374	31555	39117	45005	51141	57531	64156	71113	78322	85822	93621	101731	110159	118919	128024
MWH/Year	High	5325	7189	8911	10253	11651	13107	14623	16201	17843	19552	21328	23176	25096	27092	29166
	Low	3974	5364	6650	7651	8694	9780	10912	12089	13315	14590	15916	17294	18727	20216	21764
Commercial Connections	High	1040	1362	1650	1891	2135	2388	2650	2925	3211	3510	3819	4142	4477	4825	5188
	Low	945	1233	1500	1708	1926	2153	2388	2634	2890	3159	3436	3724	4025	4337	4662
MWH/Year	High	437	570	693	794	897	1003	1113	1229	1347	1474	1604	1740	1880	2027	2179
	Low	284	370	450	512	578	646	716	790	867	948	1031	1117	1208	1301	1399
Deep Tube Wells Connections	High	30	57	84	111	138	165	192	219	246	273	300	327	354	381	408
	Low	22	41	60	79	98	117	136	155	174	193	212	231	250	269	288
MWH/Year	High	495	941	1386	1832	2277	2723	3168	3614	4059	4505	4950	5396	5841	6287	6732
	Low	297	553	810	1067	1323	1580	1836	2093	2349	2606	2862	3119	3375	3632	3888
Shallow Tube Wells Connections	High					125	250	375	500	626	751	877	1002	1127	1252	1383
	Low					111	222	334	445	556	667	778	890	1001	1113	1230
MWH/Year	High					413	825	1238	1650	2066	2478	2894	3307	3719	4132	4564
	Low					300	599	902	1202	1501	1801	2100	2403	2703	3005	3321
Low Lift Pumps Connections	High	22	44	66	88	149	209	269	330	391	451	512	572	633	693	759
	Low	18	36	54	72	122	171	221	270	320	369	419	468	518	567	621
MWH/Year	High	121	242	363	484	820	1150	1480	1815	2151	2481	2816	3146	3482	3812	4175
	Low	81	162	243	324	549	770	995	1215	1440	1661	1886	2106	2331	2552	2795
Small Industries Connections	High	118	125	133	139	145	153	160	167	174	182	191	198	207	216	225
	Low	117	123	130	136	142	149	155	162	169	176	184	191	200	208	216
MWH/Year	High	3304	3500	3724	3892	4060	4284	4480	4676	4872	5096	5348	5544	5796	6048	6300
	Low	2340	2460	2600	2720	2840	2980	3100	3240	3380	3520	3680	3820	4000	4160	4320
Total Connections	High	27969	37712	46714	53751	61238	69027	77127	85552	94312	103416	112876	122703	132909	143506	154530
	Low	24476	32988	40861	47000	53500	60343	67426	74779	82431	90386	98650	107235	116153	125413	135041
MWH/Year	High	9682	12444	15077	17255	20117	23091	26102	29185	32360	35586	38940	42388	45804	49390	53116
	Low	6976	8909	10753	12279	14204	16354	18461	20629	22852	25125	27476	29859	32363	34865	37486

ANNEX G
TABLE XVII

Estimate of Connections and Kilowatt Hour Consumption by Customer Class and Total System
For CHUNARUGHAT AREA

YEAR		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Residential Connections	High	24,383	32,990	40,987	47,264	53,828	60,691	67,864	75,357	83,183	91,353	99,879	108,775	118,053	127,726	137,809
	Low	21,340	28,873	35,872	41,366	47,111	53,113	59,395	65,953	72,802	79,952	87,414	95,200	103,320	111,787	120,611
MWH / Year	High	5,023	6,796	8,443	9,736	11,089	12,502	13,980	15,524	17,136	18,819	20,575	22,408	24,319	26,312	28,389
	Low	3,756	5,082	6,313	7,280	8,292	9,349	10,454	11,608	12,813	14,072	15,385	16,755	18,184	19,675	21,228
Commercial Connections	High	1,297	1,721	2,115	2,424	2,749	3,087	3,440	3,810	4,195	4,598	5,019	5,455	5,913	6,390	6,887
	Low	1,171	1,551	1,904	2,181	2,471	2,774	3,091	3,422	3,767	4,128	4,505	4,896	5,306	5,733	6,178
MWH/ Year	High	545	723	888	1,018	1,155	1,297	1,445	1,600	1,762	1,931	2,108	2,292	2,484	2,684	2,893
	Low	351	465	571	654	741	832	927	1,027	1,130	1,238	1,352	1,469	1,592	1,720	1,853
Deep Tube Wells Connections	High					3	6	9	11	14	17	20	23	26	29	31
	Low					3	5	8	10	13	15	18	20	23	26	28
MWH/Year	High					50	99	149	182	231	281	347	380	429	479	512
	Low					41	68	108	135	176	203	243	270	311	351	378
Shallow Tube Wells Connections	High					68	135	203	270	338	405	473	540	608	675	743
	Low					60	120	180	240	300	360	420	480	540	600	660
MWH/Year	High					224	446	670	891	1,115	1,337	1,561	1,782	2,006	2,228	2,452
	Low					162	324	486	648	810	972	1,134	1,296	1,458	1,620	1,782
Low Lift Pumps Connections	High	5	10	15	21	56	90	125	159	194	229	263	299	333	368	403
	Low	4	8	13	17	45	74	102	131	159	187	216	244	273	301	329
MWH/Year	High	28	55	83	116	309	495	688	875	1,067	1,260	1,447	1,645	1,832	2,024	2,217
	Low	18	36	59	77	203	333	459	590	716	842	972	1,098	1,229	1,355	1,481
Small Industries Connections	High	80	87	94	98	104	110	116	123	129	136	142	150	157	164	173
	Low	79	85	91	95	101	107	112	118	124	131	136	143	149	156	165
MWH/Year	High	2,240	2,436	2,632	2,744	2,912	3,080	3,248	3,444	3,612	3,808	3,976	4,200	4,396	4,592	4,844
	Low	1,580	1,700	1,820	1,900	2,020	2,140	2,240	2,360	2,480	2,620	2,720	2,860	2,980	3,120	3,300
		26	31	36	41	46	47	47	48	49	50	50	51	52	53	53
		22	26	32	36	41	42	42	43	44	45	45	46	47	48	48
		4,290	5,115	5,940	6,765	7,590	7,755	7,755	7,920	8,085	8,250	8,250	8,415	8,580	8,745	8,745
		2,970	3,510	4,320	4,860	5,535	5,670	5,670	5,805	5,940	6,075	6,075	6,210	6,345	6,480	6,480
Total Connections	High	25,791	34,839	43,247	49,048	56,854	64,166	71,804	79,778	88,102	96,788	105,846	115,294	125,142	135,485	146,099
	Low	22,616	30,543	37,912	43,685	49,832	56,239	62,930	69,917	77,209	84,818	92,754	101,029	109,658	118,651	128,69
MWH/Year	High	12,126	15,125	17,906	20,379	23,328	26,674	27,935	30,436	33,008	35,686	38,264	41,122	44,046	47,064	50,052
	Low	8,675	10,793	13,803	14,771	16,994	18,716	20,944	22,173	24,853	26,822	27,881	29,958	32,899	34,321	36,302

TABLE XVIII

CHUNARUGHAT
HOUSEHOLD INCOME DISTRIBUTION

Annual Income (Takas)	Percentage Distribution of Household by Income Size		Share of Total Income by Income Group	
	Percentage	Cumulated Percentage	Percentage	Cumulated Percentage
500 - 1,000	1.2	1.2	.1	.1
1,000 - 2,000	13.8	15.0	4.9	5.0
2,000 - 3,000	25.9	40.9	13.5	18.5
3,000 - 4,000	20.7	61.6	15.2	33.7
4,000 - 5,000	9.8	71.4	9.3	43.0
5,000 - 6,000	10.0	81.4	11.4	54.4
6,000 - 7,000	3.5	84.9	4.8	59.2
7,000 - 8,000	3.3	88.2	5.2	64.4
8,000 - 9,000	2.3	90.5	4.1	68.5
9,000 - 10,000	1.6	92.1	3.4	71.9
10,000 - 11,000	1.6	93.7	3.6	75.5
11,000 - 12,000	1.6	95.3	3.9	79.4
12,000 and above	4.7	100.0	20.6	100.0

Median Income: 3,400

TABLE XIX

DAUDKANDI
HOUSEHOLD INCOME DISTRIBUTION

Annual Income (Takas)	Percentage Distribution of Household by Income Size		Share of Total Income by Income Group	
	Percentage	Cumulated Percentage	Percentage	Cumulated Percentage
500 - 1,000	1.6	1.6	.2	.2
1,000 - 2,000	11.7	13.3	3.1	3.3
2,000 - 3,000	17,7	31.0	7.7	11.0
3,000 - 4,000	16.6	47.6	9.9	20.9
4,000 - 5,000	11.6	59.2	8.9	29.8
5,000 - 6,000	10.6	69.8	8.6	38.4
6,000 - 7,000	6.5	76.3	7.3	45.7
7,000 - 8,000	4.5	80.8	5.8	51.5
8,000 - 9,000	3.8	84.6	5.6	57.1
9,000 - 10,000	2.0	86.6	3.3	60.4
10,000 - 11,000	1.9	88.5	3.4	63.8
11,000 - 12,000	1.6	90.1	3.2	67.0
12,000 - 13,000	1.6	91.7	3.5	70.5
13,000 - 14,000	1.2	92.9	2.8	73.3
14,000 - 15,000	2.0	94.9	5.1	78.4
15,000 and above	5.1	100.0	21.6	100.0

Median Income: 4,250

TABLE XX

JHIKERGACHA
HOUSEHOLD INCOME DISTRIBUTION

Annual Income (Takas)	Percentage Distribution of Household by Income Size		Share of Total Income by Income Group	
	Percentage	Cumulated Percentage	Percentage	Cumulated Percentage
500 - 1,000	2.7	2.7	.3	.3
1,000 - 2,000	14.0	16.7	4.5	4.8
2,000 - 3,000	18.9	35.6	8.9	13.7
3,000 - 4,000	17.6	53.2	11.9	25.6
4,000 - 5,000	12.0	65.2	10.3	35.9
5,000 - 6,000	9.9	75.1	10.3	46.2
6,000 - 7,000	6.1	81.2	7.3	53.5
7,000 - 8,000	6.0	87.2	8.5	62.0
8,000 - 9,000	3.1	90.3	5.0	67.0
9,000 - 10,000	1.2	91.5	2.1	69.1
10,000 - 11,000	1.2	92.7	2.4	71.5
11,000 - 12,000	1.0	93.7	2.0	73.5
12,000 - 13,000	1.2	94.9	2.8	76.3
13,000 - 14,000	1.2	96.1	3.0	79.3
14,000 and above	3.9	100.0	20.7	100.0

Median Income: 3,900

TABLE XXI

KALIAKAIR
HOUSEHOLD INCOME DISTRIBUTION

Annual Income (Takas)	Percentage Distribution of Household by Income Size		Share of Total Income by Income Group	
	Percentage	Cumulated Percentage	Percentage	Cumulated Percentage
500 - 1,000	2.4	2.4	0.3	0.3
1,000 - 2,000	11.9	14.3	3.4	3.7
2,000 - 3,000	13.0	27.3	5.5	9.2
3,000 - 4,000	19.3	46.6	11.0	20.2
4,000 - 5,000	10.7	57.3	7.7	27.9
5,000 - 6,000	9.9	67.2	8.9	36.8
6,000 - 7,000	8.3	75.5	8.6	45.4
7,000 - 8,000	3.1	78.6	4.0	49.4
8,000 - 9,000	3.1	81.7	4.3	53.7
9,000 - 10,000	3.5	85.2	5.4	59.1
10,000 - 11,000	1.6	86.8	2.7	61.8
11,000 - 12,000	1.2	88.0	2.2	64.0
12,000 - 13,000	1.6	89.6	3.2	67.2
13,000 and above	10.4	100.0	32.8	100.0

Median Income: 4,300

TABLE XXII

NATORE
HOUSEHOLD INCOME DISTRIBUTION

Annual Income (Takas)	Percentage Distribution of Household by Income Size		Share of Total Income by Income Group	
	Percentage	Cumulated Percentage	Percentage	Cumulated Percentage
500 - 1,000	.7	.7	.3	.3
1,000 - 2,000	5.1	5.8	1.0	1.3
2,000 - 3,000	15.2	21.0	4.8	6.1
3,000 - 4,000	12.7	33.7	5.8	11.9
4,000 - 5,000	10.3	44.0	5.9	17.8
5,000 - 6,000	11.0	55.0	7.7	25.5
6,000 - 7,000	7.2	62.2	6.0	31.5
7,000 - 8,000	6.5	68.7	6.1	37.6
8,000 - 9,000	4.9	73.6	5.3	42.9
9,000 - 10,000	4.4	78.0	5.3	48.2
10,000 - 11,000	3.0	81.0	4.1	52.3
11,000 - 12,000	2.8	83.8	4.1	56.4
12,000 - 13,000	2.8	86,6	4.4	60.8
13,000 - 14,000	1.2	87.8	2.0	62.8
14,000 - 15,000	1.2	89.0	2.1	64.9
15,000 - 16,000	1.2	90.2	2.3	67.2
16,000 - 17,000	1.2	91.4	2.4	69.6
17,000 and above	8.6	100.0	30.4	100.00

Median Income: 5,600

TABLE XXIII

SHAHZADPUR
HOUSEHOLD INCOME DISTRIBUTION

Annual Income (Takas)	Percentage Distribution of Household by Income Size		Share of Total Income by Income Group	
	Percentage	Cumulated Percentage	Percentage	Cumulated Percentage
500 - 1,000	2.0	2.0	.0	.0
1,000 - 2,000	8.1	10.1	1.6	1.6
2,000 - 3,000	9.4	19.5	2.9	4.5
3,000 - 4,000	17.2	36.7	7.3	11.8
4,000 - 5,000	8.6	45.3	4.8	16.6
5,000 - 6,000	5.6	50.9	3.7	20.3
6,000 - 7,000	7.9	58.8	7.1	27.4
7,000 - 8,000	6.8	65.6	7.0	34.4
8,000 - 9,000	4.3	69.9	4.3	38.7
9,000 - 10,000	4.1	74.0	4.7	43.4
10,000 - 11,000	5.2	79.2	6.5	49.9
11,000 - 12,000	3.2	82.4	4.3	54.2
12,000 - 13,000	2.2	84.6	3.3	57.5
13,000 - 14,000	2.0	86.6	3.3	60.8
14,000 - 15,000	1.7	88.3	2.9	63.7
15,000 and above	11.7	100.0	36.3	100.0

Median Income: 5,770

TABLE XXIV

PERCENTAGE OF HIGH, MIDDLE AND
LOW INCOME GROUPS BY LEVEL OF KEROSENE EXPENDITURE
FOR EACH FEASIBILITY STUDY AREA

Feasibility Study Area	Low Income (Bottom 40%)			Middle Income (Middle 50%)			High Income (Top 10%)		
	Tk 6 or More	Tk 9 or More	Tk 12 or More	Tk 6 or More	Tk 9 or More	Tk 12 or More	Tk 6 or More	Tk 9 or More	Tk 12 or More
Kaliakair	98.0	71.3	59.4	99.2	92.9	73.8	100.0	96.0	76.0
Natore	93.0	61.6	40.7	100.0	94.9	84.6	100.0	100.0	100.0
Daudkandi	56.6	31.4	14.1	91.1	64.8	42.7	98.6	95.8	80.6
Chunarughat	91.4	61.1	25.7	98.6	85.5	61.2	100.0	100.0	95.0
Jhikergacha	84.3	36.1	12.7	99.8	79.8	59.1	100.0	95.1	87.8
Shahzadpur*	56.7	16.5	13.4	91.5	58.7	46.1	100.0	94.6	85.7

* Shahzadpur, while having a very low kerosene expenditure, has the highest average income of all feasibility areas (see Table 23). It is therefore felt that the projected low connection rate for the rural poor in Shahzadpur will in fact be considerably exceeded.

BENEFIT/COST CALCULATIONS

The following tables contain the information used in calculating the benefit/cost ratios for each of the six feasibility areas. The primary data sources are in NRECA/CAI load forecast and system cost estimates from the Rural Electrification Feasibility Study.

Tables I - VI show the NRECA/CAI project area cost estimates for the seventeen years construction period. There are two corrections submitted by NRECA which are not reflected in these sheets. First, the power cost was calculated on a wholesale power rate of 40 paisa/KWH. The current PDB calculation of the incremental power cost is actually 17 paisa/KWH. This cost will drop significantly if the east-west connector is completed. However, the 17 paisa rate reduces the total present worth low and high consumption cost estimates in Tables I-VI by approximately 10 and 14 percent respectively. The difference between the low and high power cost estimates becomes negligible when using the 17 paisa rate, so the distinction between low and high cost estimates has been disregarded.

The second correction is that the NRECA/CAI O & M costs were calculated at 5 percent of system investment. Actual O & M costs were subsequently calculated to be approximately 3 percent of system investment for the initial construction stage. The O & M costs for these calculations have therefore been reduced to reflect the current estimates.

Tables XX - XXV show cost estimates for years 18 through 25, these costs being added to the NRECA/CAI construction period cost estimates. During the post construction period no additional system investment is required, but annual O & M costs are projected at 5 percent of year seventeen total investment rather than 3 percent. This allows for increased maintenance as the systems age. Annual power costs are assumed to remain constant after year seventeen when all consumers are connected.

The revised total cost figures (in $ 000) are as follows:

Area	Initial Estimate	Power Cost Reduction	O & M Reduction	Post-Construction	Final Estimate
Natore	$ 16,644	$ 1,660	$ 1,100	$ 1,287	$ 15,171
Jhikergacha	14,612	1,460	975	1,114	13,291
Kaliakair	15,358	1,530	1,000	1,181	14,009
Shahzadpur	17,261	1,720	1,120	1,346	15,767
Daudkandi	17,691	1,770	1,120	1,442	16,243
Chunarughat	17,073	1,700	1,150	1,261	15,484

Tables VII - XII show the NRECA/CAI construction period benefit estimates based on revenues only. The calculations for residential, commercial and industrial revenue and cost savings for conversion from diesel to electric pumps under irrigation have been used in calculating the benefits for this project. However, the revenue-benefit approach does not adequately reflect employment or increased crop production benefits. Table XIII shows the calculation of employment benefits for each feasibility area. This calculation is based on the targeted PBS power use employment generation beginning in the fourth year of the project -- employment of 60 persons in small/cottage industries, 40 in home production and 110 in agriculture and agro-processing, or 210 jobs created per year per PBS. The benefits are calculated on the basis of $250 per person employed, this being the average survey household income in the feasibility study areas. The household income level is used to reflect the participation of many family members in home and farm production activities. It is assumed that this average household income will remain constant during the project period. The yearly benefits have been discounted at 12 percent for the present worth total. As is seen, the employment benefits are approximately $200,000 per year for each project area. A more accurate approach would reflect the per capita cost of urban and rural services, food rations, personal deprivation etc., which would be incurred if such employment was not generated. In the absence of such data, average household income is a reasonable proxy.

Tables XIV - XIX show the calculation of irrigation benefits for each feasibility area. The number of irrigation units is based on the annual average number of connections from the final irrigation load forecast in the Feasibility Study. The average forecast connections were reduced to account for diesel-electric conversions by 50 percent during the first five years, 25 percent during the sixth through tenth year, and 10 percent thereafter. This reflects the reduced number of conversions once most pumps have initially been converted. The estimated command areas for pump types are 20 acres for deep tubewells, 10 acres for shallow tubewells, and 15 acres for low lift pumps. These are estimates of actual rather than capacity command areas. The benefits are based on the production of an extra boro crop producing 40 maunds of paddy per acre, the selling price estimated at Taka 85 per maund. The input cost of Taka 1026 per acre was taken from recent calculations in the Rural Finance Project Paper, Annex B.5(2) for HYV boro rice. All assumptions listed in Annex B.5(2) are the same for this analysis, i.e. recommended fertilizer dosages and farmer-grown seedlings, except that yield is conservatively estimated at 40 maunds for this analysis rather than at 51 maunds. Accordingly, the benefit per acre is (Tk 85 x 40) - (Taka 1026) = Taka 2374 or $158/acre. The benefit per pump is thus:

DTW : 20 acres x $158/acre = $3160
STW : 10 acres x $158/acre = $1580
LLP : 15 acres x $158/acre = $2370

The total annual benefits for all three pump categories are summed in the tables, and then the average of the high and low DTW, STW and LLP irrigation revenue estimates from Tables VII - XII are subtracted out to avoid double counting. The adjusted total is then discounted at 12% for the present worth.

The benefits for the 8 year post-construction period are shown in Tables XX - XXV. The average of the high and low revenues for year 17 has been used as the annual benefit for residential, commercial, small industries and conversion cost savings for succeeding years. The employment and irrigation benefits for year seventeen

have also been used as the projected annual benefits. While all of these benefits may actually continue to increase after the construction period, a conservative constant benefit stream has been forecasted in the absence of load forecast data beyond year seventeen.

The total benefit is then the average of the low and high estimates from Tables VII - XII (the high consumption estimate reflecting connection and power use projections of this project) plus the employment, irrigation, and post-construction benefits from Tables XII, XIV - XIX, and XX - XXV respectively. The total benefits (in $000) are as follows:

Area	Domestic Commercial Industrial and Conversion Estimate	Employment	Crop Production	Post-Construction	Final Estimate
Natore	5,638	2,840	4,191	4,832	17,501
Jhikergacha	4,886	2,840	2,719	3,837	14,282
Kaliakair	6,107	2,840	4,799	4,871	18,617
Shahzadpur	7,272	2,840	4,512	5,383	20,007
Daudkandi	7,360	2,840	2,935	4,547	17,682
Chunarughat	7,541	2,840	1,978	3,856	16,215

PROJECT COST - KALUAKAIR FEASIBILITY AREA
(US $ or US $ Equivalent)

Year	System Investment			O & M	Purchased Power (MWH)		Power Cost		Total Cost		Discount	Present Worth	
	Local Fund	Foreign Exchange	Total	Cost	Low	High	Low	High	Low	High	Factor	Low	High
1	154,515	30,323	184,838	-	-	-	-	-	184,838	184,838	.893	165,060	165,060
2	486,862	716,551	1,203,413	-	-	-	-	-	1,203,413	1,203,413	.797	959,120	959,120
3	832,362	2,872,800	3,705,162	248,327	7,751	10,758	206,719	286,916	4,160,208	4,240,405	.712	2,962,068	3,019,168
4	456,916	2,500,254	2,957,170	395,280	9,899	13,827	264,006	368,766	3,616,456	3,721,216	.636	2,300,066	2,366,693
5	248,261	1,312,494	1,560,755	472,411	11,948	16,752	318,653	446,776	2,351,819	2,479,942	.567	1,333,481	1,406,127
6	306,427	711,324	1,017,751	522,392	13,638	19,172	363,725	511,317	1,903,868	2,051,460	.507	965,261	1,040,090
7	169,186	663,415	832,601	563,116	15,871	22,352	423,280	596,128	1,818,997	1,991,845	.452	822,187	900,314
8	149,176	655,825	805,001	602,460	18,171	25,657	484,621	684,272	1,892,082	2,091,733	.404	764,401	845,060
9	149,176	655,825	805,001	641,804	20,512	29,002	547,055	773,483	1,993,860	2,220,288	.361	719,763	801,524
10	237,933	697,018	934,951	687,645	22,921	32,428	611,303	864,855	2,233,899	2,487,451	.322	719,315	800,959
11	149,636	659,965	809,601	727,219	25,391	35,933	677,178	958,333	2,213,998	2,495,153	.287	635,417	716,109
12	149,176	655,825	805,001	766,563	27,917	39,540	744,546	1,054,532	2,316,110	2,626,096	.257	595,240	674,907
13	149,176	655,825	805,001	805,907	30,529	43,267	814,208	1,153,931	2,425,116	2,764,839	.229	555,352	633,148
14	136,126	654,375	790,501	844,707	33,177	47,009	884,831	1,253,730	2,520,039	2,888,938	.205	516,608	592,232
15	136,126	654,375	790,501	883,507	35,937	50,904	958,440	1,357,610	2,632,448	3,031,618	.183	481,738	554,786
16	136,126	654,375	790,501	922,307	38,739	54,887	1,033,169	1,463,836	2,745,977	3,176,644	.163	447,594	517,793
17	123,078	652,920	775,998	960,563	41,651	59,018	1,110,832	1,574,010	2,847,393	3,310,571	.146	415,719	483,343
TOTAL	4,170,258	15,403,489	19,573,747	10,044,205	354,052	500,506	9,442,566	13,348,495	39,060,521	42,966,450		15,358,410	16,476,433

PROJECT COST - DAUDKANDI FEASIBILITY AREA
(US $ or US $ Equivalent)

Year	System Investment			O & M	Purchased Power (MWH)		Power Cost		Total Cost		Discount	Present Worth	
	Local Fund	Foreign Exchange	Total	Cost	Low	High	Low	High	Low	High	Factor	Low	High
1	176,862	32,807	209,669	-	-	-	-	-	209,669	209,669	.893	187,234	187,234
2	484,780	412,028	896,808	-	-	-	-	-	896,808	896,808	.797	714,756	714,756
3	877,991	2,523,393	3,401,384	217,963	10,216	14,182	272,461	378,234	3,891,808	3,997,581	.712	2,770,967	2,846,278
4	604,398	2,826,362	3,430,760	388,440	13,028	18,077	347,457	482,114	4,166,657	4,301,314	.636	2,649,994	2,735,636
5	436,316	2,215,116	2,651,432	519,950	15,664	21,756	417,759	580,233	3,589,141	3,751,615	.567	2,035,043	2,127,166
6	339,629	876,929	1,216,558	579,717	17,808	24,749	474,939	660,056	2,271,214	2,456,331	.507	1,151,505	1,245,360
7	202,388	829,020	1,031,408	630,226	20,557	28,568	548,255	761,[illegible]	2,209,889	2,423,543	.452	998,870	1,095,441
8	182,378	821,430	1,003,808	679,355	23,358	32,454	622,958	865,548	2,306,121	2,548,711	.404	931,673	1,029,679
9	182,378	821,430	1,003,808	728,484	26,297	36,552	701,341	974,842	2,433,633	2,707,134	.361	878,542	977,275
10	271,135	862,623	1,133,758	784,110	29,378	40,864	783,511	1,089,843	2,701,379	3,007,711	.322	869,844	968,483
11	182,838	825,570	1,008,408	833,469	32,556	45,301	868,269	1,208,178	2,710,146	3,050,055	.287	777,812	875,366
12	182,378	821,430	1,003,808	882,598	35,893	49,970	957,266	1,332,700	2,843,672	3,219,106	.257	730,824	827,310
13	182,378	821,430	1,003,808	931,727	39,358	54,784	1,049,678	1,461,089	2,985,213	3,304,624	.229	683,614	777,827
14	167,094	819,732	986,826	980,219	42,982	59,833	1,146,330	1,595,746	3,113,375	3,562,791	.205	638,242	730,372
15	167,094	819,732	986,826	1,027,863	46,738	65,073	1,246,502	1,735,497	3,261,191	3,750,186	.183	596,798	686,284
16	167,094	819,732	986,826	1,077,204	50,646	70,501	1,350,729	1,880,262	3,414,759	3,944,292	.163	556,606	642,929
17	151,812	818,019	969,831	1,125,059	54,767	76,217	1,460,102	2,032,707	3,554,992	4,127,397	.146	519,029	602,629
TOTAL	4,958,943	17,966,783	22,925,726	11,385,384	459,226	638,881	12,247,557	17,038,958	46,559,667	51,351,068		17,601,353	19,070,016

PROJECT COST - JHIKERGACHA FEASIBILITY AREA
(US $ or US $ Equivalent)

Year	System Investment			O & M	Purchased Power (MWH)		Power Cost		Total Cost		Discount	Present Worth	
	Local Fund	Foreign Exchange	Total	Cost	Low	High	Low	High	Low	High	Factor	Low	High
1	153,497	30,210	183,707	-	-	-	-	-	183,707	183,707	.893	164,050	164,050
2	526,762	887,522	1,414,284	-	-	-	-	-	1,414,284	1,414,284	.797	1,127,184	1,127,184
3	889,722	2,906,638	3,796,360	263,424	6,191	8,586	165,114	228,989	4,224,898	4,288,773	.712	3,008,127	3,053,606
4	429,870	2,070,369	2,500,239	387,536	8,030	11,177	214,160	298,091	3,101,935	3,185,866	.636	1,972,831	2,026,211
5	169,881	770,536	940,417	433,658	9,648	13,361	257,312	356,338	1,631,387	1,730,413	.567	924,996	981,144
6	315,016	754,653	1,069,669	486,242	11,147	15,514	297,290	413,758	1,853,201	1,969,669	.507	939,573	998,622
7	177,775	706,744	884,519	529,569	13,174	18,300	351,351	488,061	1,765,439	1,902,149	.452	797,978	859,771
8	157,765	699,154	856,919	571,516	15,202	21,178	405,437	564,817	1,833,872	1,993,252	.404	740,884	805,274
9	157,765	699,154	856,919	613,463	17,322	24,092	461,978	642,534	1,932,360	2,112,916	.361	697,582	762,763
10	246,522	740,347	986,869	661,907	19,538	27,170	521,078	724,624	2,169,854	2,373,400	.322	698,693	764,235
11	158,225	703,294	861,519	704,084	21,779	30,291	580,846	807,861	2,146,449	2,373,464	.287	616,031	681,184
12	157,765	699,154	856,919	740,031	24,106	33,530	642,907	894,245	2,245,857	2,497,195	.257	577,185	641,779
13	157,765	699,154	856,919	787,977	26,539	36,918	707,795	984,603	2,352,691	2,629,499	.229	538,766	602,155
14	144,817	697,712	842,529	829,385	29,034	40,404	774,337	1,077,575	2,446,251	2,749,489	.205	501,581	563,645
15	144,817	697,712	842,529	870,792	31,619	43,989	843,279	1,173,187	2,556,600	2,886,508	.183	467,858	528,231
16	144,817	697,712	842,529	912,199	34,276	47,643	914,141	1,270,639	2,668,869	3,025,367	.163	435,026	493,135
17	131,870	696,269	828,140	953,067	37,003	51,460	986,870	1,372,438	2,768,077	3,153,645	.146	404,139	460,432
TOTAL	4,264,651	15,156,334	19,420,986	9,750,850	304,608	423,613	8,123,895	11,297,760	37,295,731	40,469,596		14,612,384	15,513,421

PROJECT COST - NATORE FEASIBILITY AREA
(US $ or US $ Equivalent)

Year	System Investment			O & M	Purchased Power (MWH)		Power Cost		Total Cost		Discount	Present Worth	
	Local Fund	Foreign Exchange	Total	Cost	Low	High	Low	High	Low	High	Factor	Low	High
1	171,580	32,219	203,799	-	-	-	-	-	203,799	203,799	.893	181,993	181,993
2	595,494	946,129	1,541,623	-	-	-	-	-	1,541,623	1,541,623	.797	1,228,674	1,228,674
3	1,066,537	3,179,631	4,246,168	292,407	6,919	9,551	184,530	254,725	4,723,105	4,793,300	.712	3,362,851	3,412,830
4	566,968	2,333,485	2,900,453	436,405	8,978	12,399	239,443	330,681	3,576,301	3,667,539	.636	2,274,527	2,332,555
5	213,696	965,863	1,179,559	494,358	10,940	15,099	291,770	402,690	1,965,687	2,076,607	.567	1,114,545	1,177,436
6	336,965	856,529	1,193,494	553,008	12,519	17,271	333,882	460,618	2,080,384	2,207,120	.507	1,054,755	1,119,010
7	199,724	808,620	1,008,344	602,400	14,723	20,649	392,662	550,709	2,003,406	2,161,453	.452	905,540	976,977
8	179,714	801,030	980,744	650,413	17,429	24,114	464,831	643,120	2,095,988	2,274,277	.404	846,779	918,808
9	179,714	801,030	980,744	698,425	19,977	27,663	532,787	737,772	2,211,956	2,416,941	.361	798,516	872,516
10	268,471	842,223	1,110,694	752,935	22,671	31,357	604,636	836,291	2,468,265	2,699,920	.322	794,781	869,374
11	180,174	805,170	985,344	801,178	25,397	35,144	677,338	937,290	2,463,860	2,723,812	.287	707,128	781,734
12	179,714	801,030	980,744	849,190	28,228	39,094	752,841	1,042,637	2,582,775	2,872,571	.257	663,773	738,251
13	179,714	801,030	980,744	897,203	31,194	43,157	831,944	1,150,997	2,709,891	3,028,944	.229	620,565	693,628
14	164,959	799,390	964,349	944,600	34,204	47,333	912,221	1,262,371	2,821,170	3,171,320	.205	578,340	650,121
15	164,959	799,390	964,349	991,998	37,311	51,664	995,084	1,378,412	2,951,431	3,334,759	.183	540,112	610,261
16	164,959	799,390	964,349	1,039,396	40,559	56,166	1,081,709	1,497,947	3,085,454	3,501,692	.163	502,929	570,776
17	150,208	797,760	947,968	1,086,179	43,912	60,801	1,171,133	1,621,563	3,205,280	3,655,710	.146	467,971	533,734
TOTAL	4,963,550	17,169,919	22,133,469	11,090,095	354,961	491,482	9,466,811	13,107,823	42,690,375	46,331,387		16,643,779	17,668,678

PROJECT COST - SHAHZADPUR FEASIBILITY AREA

(US $ or US $ Equivalent)

Year	System Investment			O & M	Purchased Power (MWH)		Power Cost		Total Cost		Discount	Present Worth	
	Local Fund	Foreign Exchange	Total	Cost	Low	High	Low	High	Low	High	Factor	Low	High
1	172,321	32,301	204,622	-	-	-	-	-	204,622	204,622	.893	182,727	182,727
2	580,185	956,103	1,536,288	-	-	-	-	-	1,536,288	1,536,288	.797	1,224,422	1,224,422
3	1,018,429	3,261,094	4,279,523	293,813	9,187	12,506	245,017	333,535	4,818,353	4,906,871	.712	3,430,667	3,493,692
4	538,122	2,431,543	2,969,665	441,266	11,846	15,974	315,933	426,027	3,726,864	3,836,958	.636	2,370,286	2,440,305
5	221,882	1,013,537	1,235,419	502,007	14,132	19,032	376,900	507,583	2,114,326	2,245,009	.567	1,198,823	1,272,920
6	338,730	851,235	1,189,965	560,476	15,719	21,234	419,226	566,311	2,169,667	2,316,752	.507	1,100,021	1,174,593
7	201,489	803,326	1,004,815	609,687	18,251	24,750	486,754	660,083	2,101,256	2,274,585	.452	949,768	1,028,112
8	181,479	795,736	977,215	657,518	20,878	28,357	556,816	756,281	2,191,549	2,391,014	.404	885,386	965,970
9	181,479	795,736	977,215	705,348	23,582	32,163	628,932	857,787	2,311,495	2,540,350	.361	834,450	917,066
10	270,236	836,929	1,107,165	759,677	26,394	36,031	703,928	960,947	2,570,770	2,827,789	.322	827,788	910,548
11	181,939	799,876	981,815	807,738	29,290	40,076	781,164	1,068,827	2,570,717	2,858,380	.287	737,796	820,355
12	181,479	795,736	977,215	855,569	32,337	44,236	862,428	1,179,774	2,695,212	3,012,558	.257	692,669	774,227
13	181,479	795,736	977,215	903,400	35,416	48,567	944,545	1,295,282	2,825,160	3,175,897	.229	646,962	727,280
14	166,649	794,087	960,736	950,612	38,653	53,038	1,030,876	1,414,524	2,942,224	3,325,872	.205	603,156	681,804
15	166,649	794,087	960,736	997,825	42,002	57,699	1,120,193	1,538,832	3,078,754	3,497,393	.183	563,412	640,023
16	166,649	794,087	960,736	1,045,038	45,469	62,499	1,212,658	1,666,848	3,218,432	3,672,622	.163	524,604	598,637
17	151,818	792,430	944,248	1,091,633	49,070	67,466	1,308,697	1,799,318	3,344,578	3,835,199	.146	488,308	559,939
TOTAL	4,901,014	17,343,579	22,244,593	11,181,607	412,226	563,628	10,994,067	15,031,959	44,420,267	48,458,159		17,261,245	18,412,620

PROJECT COST - CHUNARUGHAT FEASIBILITY AREA

(US $ or US $ Equivalent)

Year	System Investment			O & M	Purchased Power (MWH)		Power Cost		Total Cost		Discount	Present Worth	
	Local Fund	Foreign Exchange	Total	Cost	Low	High	Low	High	Low	High	Factor	Low	High
1	174,644	32,559	207,203	-	-	-	-	-	207,203	207,203	.893	185,032	185,032
2	592,908	1,087,165	1,680,073	-	-	-	-	-	1,680,073	1,680,073	.797	1,339,018	1,339,018
3	1,031,152	3,594,700	4,625,852	318,335	9,639	13,473	257,072	359,325	5,201,259	5,303,512	.712	3,703,296	3,776,101
4	529,323	2,578,581	3,107,904	472,684	11,992	16,806	319,827	448,216	3,900,415	4,028,804	.636	2,480,664	2,562,319
5	201,870	888,439	1,090,309	526,153	14,537	19,984	387,702	532,973	2,004,164	2,149,435	.567	1,136,361	1,218,730
6	340,965	837,668	1,178,633	584,039	16,412	22,643	437,708	603,889	2,200,380	2,366,561	.507	1,115,593	1,199,846
7	203,724	789,759	993,483	632,667	18,882	25,920	503,583	691,286	2,129,733	2,317,436	.452	962,639	1,047,481
8	183,714	782,169	965,883	679,915	20,796	28,527	554,629	760,815	2,[illegible]	2,406,613	.404	888,973	972,272
9	183,714	782,169	965,883	727,163	22,604	31,039	602,849	827,810	2,295,895	2,520,856	.361	828,818	910,029
10	272,471	823,362	1,095,833	780,909	24,637	33,818	657,069	901,926	2,533,811	2,778,668	.322	815,887	894,731
11	184,174	786,309	970,483	828,382	26,739	36,676	713,129	978,149	2,511,994	2,777,014	.287	720,942	797,003
12	183,714	782,169	965,883	875,635	28,913	39,651	771,110	1,057,492	2,612,628	2,899,010	.257	671,446	745,045
13	183,714	782,169	965,883	922,884	30,979	42,516	826,210	1,133,902	2,714,977	3,022,669	.229	621,730	692,191
14	168,652	780,495	949,147	969,504	33,287	45,691	887,764	1,218,579	2,806,415	3,137,230	.205	575,315	643,132
15	168,652	780,495	949,147	1,016,125	35,666	48,940	951,212	1,305,230	2,916,484	3,270,502	.183	533,717	598,502
16	168,652	780,495	949,147	1,062,745	38,134	52,293	1,017,034	1,394,654	3,028,926	3,406,546	.163	493,715	555,267
17	153,587	778,808	932,397	1,108,737	40,558	55,613	1,081,682	1,483,199	3,122,816	3,524,333	.146	455,931	514,553
TOTAL	4,925,630	17,667,515	22,593,143	11,505,877	373,775	513,590	9,968,580	13,697,445	44,067,600	47,796,465		17,073,146	18,651,252

PROJECT BENEFITS - KALIAKAIR FEASIBILITY AREA
(US $ Equivalent)

Low Consumption Level

YEAR	Residential Revenue	Commercial Revenue	Small Industry		Irrigation Pumps: Deep Tubewell		Irrigation Pumps: Shallow Tubewell		Irrigation Pumps: Low Lift Pumps		Total Benefits	Discount Factor	Present Worth
			Revenue	Cost Savings	Revenue	Cost Savings	Revenue	Cost Savings	Revenue	Cost Savings			
3	158,933	14,200	156,000	12,332	19,800	5,082	-	-	5,133	1,669	373,149	.712	265,682
4	214,533	18,533	164,000	12,964	36,933	9,471	-	-	10,267	3,338	470,039	.636	298,945
5	266,000	22,467	173,333	13,702	54,000	13,860	-	-	15,400	5,007	563,769	.567	319,657
6	306,067	25,600	181,333	14,334	71,133	18,249	-	-	20,533	6,677	643,926	.507	326,470
7	351,733	28,933	189,333	14,967	88,200	22,638	19,000	10,323	34,800	11,313	771,240	.452	348,600
8	391,200	32,267	198,667	15,705	105,333	27,027	37,933	20,646	48,800	15,857	893,435	.404	360,948
9	436,667	35,800	206,667	16,337	122,400	31,416	57,133	31,052	63,000	20,493	1,020,975	.361	368,572
10	483,533	39,533	216,000	17,075	139,533	35,805	76,133	41,385	76,933	25,037	1,150,967	.322	370,611
11	532,600	43,333	225,333	17,813	156,600	40,194	95,067	51,708	91,200	29,674	1,283,522	.287	368,371
12	583,600	47,400	234,667	18,550	173,733	44,583	114,067	62,031	105,200	34,217	1,418,048	.257	364,438
13	636,667	51,533	245,333	19,394	190,800	48,972	133,067	72,354	119,467	38,854	1,556,441	.229	356,425
14	691,800	55,867	254,667	20,131	207,933	53,361	152,200	82,770	133,400	43,398	1,695,527	.205	347,583
15	749,067	60,400	266,667	21,080	225,000	57,750	171,200	93,093	147,600	48,034	1,839,891	.183	336,700
16	808,667	65,067	277,333	21,923	242,133	62,139	190,400	103,509	161,600	52,578	1,985,349	.163	323,612
17	870,533	69,933	288,000	22,766	259,200	66,528	210,267	114,390	177,000	57,585	2,136,202	.146	311,885
													5,068,499

High Consumption Level

3	213,000	21,933	220,267	12,437	33,000	6,930	-	-	7,667	2,040	517,274	.712	368,299
4	287,533	28,600	233,333	13,175	62,733	13,167	-	-	15,333	4,080	657,954	.636	418,459
5	356,467	34,667	248,267	14,018	92,400	19,404	-	-	23,000	6,120	794,343	.567	450,392
6	410,133	39,733	259,467	14,651	122,133	25,641	-	-	30,667	8,160	910,585	.507	461,667
7	466,067	44,800	270,667	15,283	151,800	31,878	26,133	11,625	51,933	13,817	1,084,003	.452	489,969
8	524,267	50,133	285,600	16,126	181,533	38,115	52,267	23,250	72,867	19,381	1,263,539	.404	510,470
9	584,933	55,667	298,667	16,864	211,200	44,352	78,400	34,875	93,733	24,944	1,443,635	.361	521,152
10	648,067	61,467	311,733	17,602	240,933	50,589	104,533	46,500	114,933	30,601	1,626,958	.322	523,880
11	713,733	67,467	324,800	18,340	270,600	56,826	130,867	58,218	136,200	[illegible],257	1,813,308	.287	520,419
12	782,067	73,733	339,733	19,183	300,267	63,063	157,000	69,843	157,133	41,821	2,003,843	.257	514,988
13	853,133	80,200	356,533	20,131	330,000	69,300	183,267	81,561	178,333	47,478	2,199,936	.229	503,785
14	927,067	86,933	369,600	20,869	359,733	75,537	209,467	93,186	199,267	53,042	2,394,701	.205	490,914
15	1,003,867	94,000	386,400	21,818	389,400	81,774	235,533	104,811	220,533	58,698	2,596,834	.183	475,221
16	1,083,667	101,333	403,200	22,766	419,133	88,011	261,667	116,436	241,400	64,262	2,801,875	.163	456,706
17	1,166,667	108,933	420,000	23,715	448,800	94,248	289,067	128,619	264,400	70,382	3,014,831	.146	440,165
													7,146,486

PROJECT BENEFITS - DAUDKANDI FEASIBILITY AREA
(US $ Equivalent)

ANNEX F
TABLE VIII

Low Consumption Level

YEAR	Residential Revenue	Commercial Revenue	Small Industry		Irrigation Pumps: Deep Tubewell		Irrigation Pumps: Shallow Tubewell		Irrigation Pumps: Low Lift Pumps		Total Benefits	Discount Factor	Present Worth
			Revenue	Cost Savings	Revenue	Cost Savings	Revenue	Cost Savings	Revenue	Cost Savings			
3	209,533	24,000	218,667	17,286	9,933	2,541	333	186	2,600	835	485,914	.712	345,971
4	284,933	33,000	242,667	19,183	13,533	3,465	667	372	5,467	1,762	605,049	.636	384,811
5	355,733	41,267	265,333	20,975	17,133	4,389	1,000	558	8,000	2,596	716,984	.567	406,530
6	412,200	47,800	284,000	22,450	20,733	5,313	1,533	837	10,800	3,524	809,190	.507	410,259
7	471,733	54,667	305,33[illegible]	24,137	31,533	8,085	10,067	5,487	25,400	8,253	944,695	.452	427,002
8	534,533	62,000	325,333	25,718	40,533	10,395	18,467	10,044	40,467	13,168	1,080,658	.404	436,586
9	600,600	69,667	348,000	27,509	49,533	12,705	27,067	14,694	55,067	17,897	1,222,739	361	441,409
10	670,200	77,733	372,000	29,407	59,400	15,246	35,600	19,344	69,533	22,626	1,371,089	.322	441,491
11	743,400	86,200	396,000	31,304	68,400	17,556	43,933	23,901	84,400	27,448	1,522,542	.287	436,970
12	820,333	95,133	422,667	33,412	77,400	19,866	52,533	28,551	98,933	32,177	1,681,005	.257	432,018
13	901,333	104,533	449,333	35,520	86,400	22,176	61,267	33,294	113,733	36,999	1,844,588	.229	422,411
14	986,333	114,400	477,333	37,733	96,333	24,717	69,800	37,944	128,533	41,821	2,014,947	.205	413,064
15	1,075,733	124,733	506,667	40,052	105,333	27,027	78,333	42,594	143,067	46,550	2,190,089	.183	400,786
16	1,169,533	135,667	536,000	42,371	115,200	29,568	86,667	47,151	157,867	51,372	2,371,396	.163	386,538
17	1,268,000	147,133	569,333	45,006	124,200	31,878	95,267	51,801	172,467	56,102	2,561,187	.146	373,933
													6,159,779

High Consumption Level

3	280,267	37,533	315,467	17,813	13,200	2,772	667	279	4,200	1,113	673,311	.712	479,397
4	381,067	51,667	350,933	19,815	19,800	4,158	1,267	558	8,067	2,133	839,465	.636	533,900
5	475,733	64,533	386,400	21,818	25,333	5,313	1,600	744	12,200	3,246	996,920	.567	565,254
6	551,267	74,800	416,267	23,504	30,800	6,468	2,267	1,023	16,000	4,266	1,126,662	.507	571,218
7	630,867	85,600	448,000	25,296	45,133	9,471	14,133	6,324	38,333	10,200	1,313,357	.452	593,637
8	714,800	97,000	477,867	26,982	58,333	12,243	25,933	11,532	59,933	15,950	1,500,573	.404	606,231
9	803,200	109,000	511,467	28,880	71,533	15,015	37,600	16,740	82,200	21,884	1,697,519	.361	612,804
10	896,200	121,600	548,800	30,988	85,800	18,018	49,533	22,041	103,800	27,634	1,904,414	.322	613,221
11	994,133	134,867	586,133	33,096	97,933	20,559	61,200	27,249	126,067	33,568	2,114,805	.287	606,949
12	1,097,067	148,867	625,333	35,309	113,333	23,793	73,133	32,550	147,667	39,318	2,336,370	.257	600,447
13	1,205,333	163,333	666,400	37,628	125,400	26,334	84,867	37,758	170,000	45,252	2,562,505	.229	586,814
14	1,319,067	179,000	709,333	40,052	139,733	29,337	96,600	42,966	191,933	51,094	2,799,115	.205	573,819
15	1,438,600	205,467	754,133	42,582	152,933	32,109	108,467	48,267	213,867	56,936	3,053,361	.183	558,765
16	1,564,067	212,200	798,933	45,111	167,200	35,112	119,933	53,382	235,382	62,685	3,294,090	.163	536,937
17	1,695,800	230,067	849,333	47,957	180,400	37,884	131,867	58,683	257,800	68,620	3,558,411	.146	519,528
													8,358,921

PROJECT BENEFITS - JHIKARGACHA FEASIBILITY AREA
(US $ Equivalent)

Low Consumption Level

YEAR	Residential Revenue	Commercial Revenue	Small Industry Revenue	Small Industry Cost Savings	Irrigation Pumps: Deep Tubewell Revenue	Deep Tubewell Cost Savings	Shallow Tubewell Revenue	Shallow Tubewell Cost Savings	Low Lift Pumps Revenue	Low Lift Pumps Cost Savings	Total Benefits	Discount Factor	Present Worth
3	138,333	20,733	108,000	8,537	3,600	924	533	279	1,133	371	282,443	.712	201,099
4	187,333	28,000	122,667	9,697	6,333	1,617	1,000	558	2,000	649	359,854	.636	228,867
5	233,000	28,733	137,333	10,856	9,933	2,541	1,533	837	3,200	1,020	428,986	.567	243,235
6	268,933	40,267	148,000	11,699	12,600	3,234	2,000	1,116	4,000	1,298	493,147	.507	250,026
7	306,600	45,867	161,333	12,753	28,800	7,392	16,800	9,114	10,000	3,246	601,905	.452	272,061
8	346,000	51,733	174,667	13,807	42,333	10,857	31,267	17,019	15,733	5,100	798,516	.404	286,240
9	387,267	57,933	186,667	14,756	58,533	15,015	46,200	25,110	21,667	7,047	820,195	.361	296,090
10	430,467	64,400	201,333	15,915	74,733	19,173	60,867	33,108	27,333	8,902	936,231	.322	301,466
11	475,667	71,133	216,000	17,075	88,200	22,638	75,533	41,106	33,600	10,942	1,051,894	.287	301,894
12	522,867	78,200	229,333	18,129	104,400	26,796	90,467	49,197	39,667	12,889	1,171,945	.257	301,190
13	572,200	85,600	246,667	19,499	119,733	30,723	105,200	57,195	45,000	14,651	1,296,468	.229	296,891
14	622,933	93,333	264,000	20,869	134,133	34,419	119,867	65,193	51,067	16,599	1,422,413	.205	291,595
15	677,667	101,333	281,333	22,239	149,400	38,346	134,800	73,284	57,000	18,546	1,553,948	.183	284,372
16	733,867	109,733	298,667	23,610	164,733	42,273	149,466	81,282	63,000	20,493	1,687,124	.163	275,001
17	792,600	118,533	316,000	24,980	180,000	46,200	164,133	89,280	68,733	22,348	1,822,807	.146	266,130
													4,096,157

High Consumption Level

YEAR	Residential Revenue	Commercial Revenue	Small Industry Revenue	Small Industry Cost Savings	Irrigation Pumps: Deep Tubewell Revenue	Deep Tubewell Cost Savings	Shallow Tubewell Revenue	Shallow Tubewell Cost Savings	Low Lift Pumps Revenue	Low Lift Pumps Cost Savings	Total Benefits	Discount Factor	Present Worth
3	184,333	32,400	156,800	8,854	5,533	1,155	800	372	1,400	371	392,018	.712	279,117
4	249,667	43,867	181,067	10,224	9,933	2,079	1,067	744	3,200	835	503,283	.636	320,088
5	310,467	45,000	201,600	11,383	15,400	3,234	2,267	1,023	4,533	1,205	596,112	.567	337,996
6	358,533	62,933	220,267	12,437	19,800	4,158	3,200	1,395	5,933	1,576	690,032	.507	349,846
7	408,533	71,733	238,933	13,491	41,800	8,778	23,600	10,509	15,000	3,987	836,364	.452	378,037
8	461,067	81,000	259,467	14,651	63,800	13,398	43,733	19,437	23,667	6,306	986,526	.404	398,557
9	516,067	90,667	278,133	15,705	84,733	17,787	64,133	28,551	32,400	8,624	1,136,800	.361	410,385
10	573,667	100,733	300,533	16,969	106,733	22,407	84,400	37,572	41,467	11,035	1,295,516	.322	417,156
11	633,800	111,333	322,933	18,234	126,533	26,565	104,933	46,686	50,133	13,353	1,454,503	.287	417,442
12	696,733	122,333	345,333	19,499	148,533	31,185	125,400	55,800	58,533	15,579	1,618,928	.257	416,064
13	762,933	133,933	369,600	20,869	171,600	36,036	145,667	64,821	67,600	17,990	1,790,649	.229	410,059
14	831,267	145,933	397,600	22,450	191,400	40,194	166,200	73,935	76,333	20,308	1,965,620	.205	402,952
15	903,000	158,600	423,733	23,926	211,400	44,414	186,467	82,956	85,000	22,626	2,144,522	.183	392,448
	977,933	171,733	449,867	25,401	233,200	48,972	206,733	91,977	74,067	25,037	2,324,920	.163	378,962
17	1,056,200	185,467	477,867	26,982	255,200	53,592	227,200	101,091	102,400	27,263	2,513,262	.146	366,936
													5,676,045

PROJECT BENEFITS - NATORE FEASIBILITY AREA
(US $ Equivalent)

ANNEX F
TABLE X

Low Consumption Level

YEAR	Residential Revenue	Commercial Revenue	Small Industry Revenue	Small Industry Cost Savings	Irrigation Pumps: Deep Tubewell Revenue	Deep Tubewell Cost Savings	Shallow Tubewell Revenue	Shallow Tubewell Cost Savings	Low Lift Pumps Revenue	Low Lift Pumps Cost Savings	Total Benefits	Discount Factor	Present Worth
3	164,200	17,267	110,667	8,748	6,333	1,617	533	279	867	278	310,789	.712	221,282
4	222,933	23,467	120,000	9,486	12,600	3,234	1,000	558	2,000	649	395,927	.636	251,810
5	278,000	29,367	130,667	10,329	18,933	4,851	1,400	744	2,867	927	477,985	.567	271,017
6	321,733	33,867	138,667	10,962	25,200	6,468	1,867	1,023	3,733	1,205	544,725	.507	276,176
7	367,733	38,667	148,000	11,699	42,333	10,857	26,133	14,229	13,667	4,451	677,769	.452	306,352
8	416,133	43,733	156,000	12,332	60,333	15,477	50,267	27,342	23,400	7,604	812,621	.404	328,299
9	466,933	49,067	164,000	12,964	77,400	19,866	74,733	40,641	33,067	10,757	949,428	.361	342,744
10	520,400	54,733	176,000	13,913	94,533	24,255	99,200	53,940	42,733	13,910	1,093,617	.322	352,145
11	576,533	60,667	185,333	14,651	111,600	28,644	123,467	67,146	52,467	17,062	1,237,570	.287	355,183
12	635,467	66,867	196,000	15,494	128,733	33,033	147,533	80,259	62,133	20,215	1,385,734	.257	356,134
13	697,267	73,267	208,000	16,442	146,733	37,653	171,867	93,465	72,400	23,553	1,540,647	.229	352,808
14	762,067	80,133	218,667	17,286	163,800	42,042	196,333	106,764	81,800	26,614	1,695,506	.205	347,579
15	830,067	87,267	229,333	18,129	180,933	46,431	220,600	119,970	91,533	29,766	1,854,029	.183	339,287
16	901,333	94,800	242,667	19,183	198,000	50,820	244,867	133,176	101,200	32,919	2,018,965	.163	329,091
17	976,000	102,667	256,000	20,237	215,133	55,209	269,200	146,382	110,933	36,072	2,187,833	.146	319,424
													4,749,331

High Consumption Level

YEAR	Residential Revenue	Commercial Revenue	Small Industry Revenue	Small Industry Cost Savings	Irrigation Pumps: Deep Tubewell Revenue	Deep Tubewell Cost Savings	Shallow Tubewell Revenue	Shallow Tubewell Cost Savings	Low Lift Pumps Revenue	Low Lift Pumps Cost Savings	Total Benefits	Discount Factor	Present Worth
3	219,667	27,000	158,667	8,959	9,933	2,079	800	372	1,400	371	429,248	.712	305,625
4	298,267	36,733	173,600	9,802	19,800	4,158	1,467	651	2,800	742	548,020	.636	348,541
5	371,933	45,733	188,533	10,645	29,733	6,237	2,267	1,023	4,200	1,113	661,417	.567	375,023
6	430,467	52,933	199,733	11,278	39,600	8,316	2,933	1,302	5,600	1,484	753,646	.507	382,099
7	492,000	60,533	214,667	12,121	63,800	13,398	36,500	16,275	20,200	5,378	934,972	.452	422,607
8	556,733	68,467	227,733	12,859	90,200	18,942	69,800	31,062	34,533	9,180	1,119,509	.404	452,282
9	624,733	76,867	240,800	13,597	114,400	24,024	103,667	46,128	49,133	13,075	1,306,424	.361	471,619
10	696,267	85,667	255,733	14,440	139,733	29,337	136,933	60,915	63,800	16,970	1,499,795	.322	482,934
11	771,533	94,867	270,667	15,283	163,933	34,419	170,533	75,888	78,400	20,864	1,696,187	.287	486,806
12	850,133	104,533	287,467	16,232	189,200	39,732	204,000	90,768	93,067	24,759	1,899,891	.257	488,272
13	932,867	114,733	304,267	17,180	214,533	45,045	237,467	105,648	107,267	28,561	2,107,568	.229	482,633
14	1,019,600	125,400	321,067	18,129	238,733	50,127	271,067	120,621	121,933	32,456	2,319,133	.205	475,422
15	1,110,533	136,600	339,733	19,183	264,000	55,440	304,533	135,501	136,533	36,350	2,538,406	.183	464,528
16	1,205,933	148,333	358,400	20,237	289,333	60,753	337,933	150,381	150,867	40,152	2,762,322	.163	450,258
17	1,305,800	160,600	378,933	21,396	313,533	65,835	371,400	165,261	165,467	44,047	2,992,272	.146	436,872
													6,325,521

PROJECT BENEFITS - SHAHZADPUR FEASIBILITY AREA

(US $ Equivalent)

Low Consumption Level

YEAR	Residential Revenue	Commercial Revenue	Small Industry Revenue	Small Industry Cost Savings	Deep Tubewell Revenue	Deep Tubewell Cost Savings	Shallow Tubewell Revenue	Shallow Tubewell Cost Savings	Low Lift Pumps Revenue	Low Lift Pumps Cost Savings	Milk Plant Revenue	Total Benefits	Discount Factor	Present Worth
3	15[illegible],267	[illegible]2,333	226,667	17,918	1,800	462	[illegible]67	455	2,[illegible]67	742	53,667	479,[illegible]55	.712	341,372
4	2[illegible],2[illegible]	3[illegible],400	24[illegible],[illegible]	19,288	[illegible],733	693	[illegible],867	1,[illegible]23	[illegible],333	1,391	107,400	620,[illegible]28	.636	394,529
5	2[illegible],[illegible]33	[illegible],667	262,667	20,764	[illegible],[illegible]	92[illegible]	2,733	1,488	6,[illegible]00	2,133	134,267	732,176	.567	415,144
6	300,[illegible]	44,967	276,[illegible]	21,818	[illegible]	1,286	3,600	1,953	8,533	2,782	134,333	800,205	.507	405,704
7	344,667	50,467	292,000	23,083	18,933	4,851	32,000	17,391	19,133	6,213	134,267	942,405	.452	425,967
8	390,200	57,333	309,333	24,453	32,400	8,[illegible]16	60,533	32,922	24,400	9,551	134,333	1,088,774	.404	439,865
9	438,867	64,467	326,667	25,823	45,933	11,781	88,733	48,267	39,867	12,982	134,267	1,237,654	.361	446,793
10	490,200	71,933	345,333	27,299	59,400	15,246	117,200	63,705	50,467	16,413	134,333	1,391,529	.322	448,072
11	[illegible],267	79,867	364,000	28,774	73,933	18,711	145,667	79,236	60,733	19,[illegible]51	[illegible],267	1,548,206	.287	444,335
12	6[illegible],200	88,133	385,333	30,461	87,333	22,407	174,133	94,674	71,267	23,163	13[illegible],333	1,712,657	.257	4[illegible],[illegible]53
13	6[illegible],133	97,[illegible]67	405,333	32,042	9[illegible]	25,641	202,267	110,019	81,533	26,521	13[illegible]67	1,875,756	.229	429,548
14	724,267	106,333	426,667	33,728	114,[illegible]	29,337	230,667	125,457	92,067	29,[illegible]9	134,333	2,047,141	.2[illegible]5	4[illegible]9,604
15	790,667	116,133	450,667	35,625	128,[illegible]33	32,571	259,667	140,895	102,333	33,[illegible]	134,267	2,222,448	.183	4[illegible]0,708
16	860,467	126,333	473,333	37,417	14[illegible],333	36,267	287,467	156,[illegible]33	112,867	36,[illegible]1	134,333	2,402,871	.163	391,668
17	933,800	137,067	498,667	39,420	154,800	39,732	315,[illegible]	171,771	123,133	40,059	134,267	2,588,583	.146	377,933
														6,227,455

High Consumption Level

YEAR	Residential Revenue	Commercial Revenue	Small Industry Revenue	Small Industry Cost Savings	Deep Tubewell Revenue	Deep Tubewell Cost Savings	Shallow Tubewell Revenue	Shallow Tubewell Cost Savings	Low Lift Pumps Revenue	Low Lift Pumps Cost Savings	Milk Plant Revenue	Total Benefits	Discount Factor	Present Worth
3	202,733	34,933	322,933	18,234	2,200	562	1,467	651	3,200	835	53,733	641,381	.712	456,663
4	275,933	47,600	349,667	19,710	4,400	927	2,933	1,302	6,667	1,762	107,400	817,698	.636	520,056
5	344,867	59,533	377,667	21,[illegible]	6,6[illegible]	1,386	4,200	1,860	9,733	2,596	134,267	963,400	.567	546,248
6	399,933	69,000	397,[illegible]	22,[illegible]	8,80[illegible]	1,848	5,667	2,511	12,933	3,431	134,333	1,058,506	.507	536,663
7	458,133	79,667	421,867	23,820	27,533	5,775	45,000	19,995	28,26[illegible]	7,511	134,267	1,251,235	.452	565,358
8	519,600	89,667	446,133	25,191	45,133	9,471	84,400	37,572	43,867	11,684	134,333	1,447,051	.404	584,609
9	584,467	100,800	474,133	26,772	64,933	13,629	123,533	54,963	59,600	15,857	134,267	1,652,954	.361	596,716
10	652,733	112,667	500,267	28,247	83,600	17,556	162,000	72,354	75,267	20,030	134,333	1,859,654	.322	598,809
11	724,733	125,667	530,133	29,934	102,333	21,483	201,933	89,838	90,600	24,110	134,267	2,074,431	.287	595,362
12	80[illegible],600	138,133	560,000	31,620	121,000	25,410	241,000	107,229	105,867	28,190	134,333	2,293,382	.257	589,399
13	880,467	151,867	591,867	33,412	139,733	29,337	280,067	124,620	121,933	32,456	134,267	2,520,026	.229	577,086
14	964,467	166,400	623,333	35,204	159,533	33,495	319,333	142,104	137,267	36,536	134,333	2,752,005	.205	564,161
15	1,052,867	181,667	658,933	37,206	178,200	37,422	358,400	159,495	152,933	40,708	134,267	2,992,098	.183	547,554
16	1,145,800	197,667	694,400	39,209	196,933	41,349	397,667	176,979	168,200	44,789	134,333	3,237,326	.163	527,684
17	1,243,467	214,467	731,733	41,317	214,533	45,045	436,933	194,463	183,867	48,961	134,267	3,489,053	.146	509,402
														8,315,970

PROJECT BENEFITS - CHUNSUGHAT FEASIBILITY AREA
(US $ Equivalent)

Low Consumption Level

YEAR	Residential Revenue	Commercial Revenue	Small Industry Revenue	Small Industry Cost Savings	Irrigation Pumps: Deep Tubewell Revenue	Deep Tubewell Cost Savings	Shallow Tubewell Revenue	Shallow Tubewell Cost Savings	Low Lift Pumps Revenue	Low Lift Pumps Cost Savings	Tea Garden Revenue	Total Benefits	Discount Factor	Present Worth
3	150,267	17,533	105,333	8,327	-	-	-	-	1,133	371	297,000	579,964	.712	412,934
4	203,267	23,267	113,333	8,959	-	-	-	-	2,267	742	351,000	702,835	.636	447,003
5	252,533	28,533	121,333	9,591	-	-	-	-	3,733	1,205	432,000	848,928	.567	481,342
6	291,200	32,733	126,667	10,013	-	-	-	-	4,867	1,576	486,000	953,056	.507	483,199
7	331,667	37,067	134,667	10,645	2,733	693	10,267	5,580	12,867	4,173	553,533	1,103,892	.452	498,959
8	37[illegible],933	41,600	142,667	11,278	4,533	1,155	20,533	11,160	21,067	6,862	567,000	1,201,788	.404	485,522
9	418,133	46,333	149,333	11,805	7,200	1,848	30,800	16,740	29,067	9,458	567,000	1,287,717	.361	464,866
10	464,333	51,333	157,333	12,437	9,000	2,310	41,067	22,320	37,400	12,148	580,533	1,390,214	.322	447,649
11	512,533	56,533	165,333	13,070	11,733	3,003	51,333	27,900	45,333	14,744	594,000	1,495,515	.287	429,213
12	562,867	61,933	174,667	13,807	13,533	3,465	61,533	33,480	53,333	17,341	607,533	1,603,492	.257	412,097
13	615,400	67,600	181,333	14,334	16,200	4,158	71,800	39,060	61,533	20,030	607,533	1,698,981	.229	389,067
14	670,200	73,467	190,667	15,072	18,000	4,620	82,067	44,640	69,533	22,626	621,000	1,811,892	.205	371,438
15	727,333	79,600	198,667	15,705	20,733	5,313	92,333	50,220	77,867	25,315	634,533	1,927,619	.183	352,754
16	787,000	86,000	208,000	16,442	23,400	6,006	102,600	55,800	85,800	27,912	648,000	2,046,960	.163	333,654
17	849,133	92,667	220,000	17,391	25,200	6,468	112,867	61,380	93,800	30,508	648,000	2,157,414	.146	314,982
Total														6,324,679

High Consumption Level

YEAR	Residential Revenue	Commercial Revenue	Small Industry Revenue	Small Industry Cost Savings	Irrigation Pumps: Deep Tubewell Revenue	Deep Tubewell Cost Savings	Shallow Tubewell Revenue	Shallow Tubewell Cost Savings	Low Lift Pumps Revenue	Low Lift Pumps Cost Savings	Tea Garden Revenue	Total Benefits	Discount Factor	Present Worth
3	200,933	27,267	149,333	8,432	-	-	-	-	1,800	464	429,000	817,229	.712	581,867
4	271,867	36,133	162,400	9,170	-	-	-	-	3,467	927	511,533	995,497	.636	633,136
5	337,733	44,400	175,467	9,908	-	-	-	-	5,267	1,391	594,000	1,168,166	.567	662,350
6	389,467	50,933	182,933	10,329	-	-	-	-	7,333	1,947	676,533	1,319,475	.507	668,974
7	443,533	57,733	194,133	10,962	3,333	693	14,200	6,324	19,533	5,193	759,000	1,514,637	.452	696,081
8	500,067	64,867	205,333	11,594	6,600	1,386	28,267	12,555	31,33[illegible]	8,346	775,533	1,645,881	.404	664,616
9	559,200	72,267	216,533	12,226	9,933	2,079	42,467	18,879	43,600	11,591	775,533	1,764,308	.361	636,936
10	62[illegible],933	80,[illegible]	2[illegible],600	12,964	12,133	2,5[illegible]	56,400	25,110	55,400	14,744	792,000	1,901,825	.322	612,3[illegible]
11	685,467	88,133	240,800	13,597	15,400	3,234	70,600	31,434	67,600	17,990	808,533	2,042,7[illegible]	.287	5[illegible],280
12	754,733	[illegible],533	253,867	14,3[illegible]	18,733	3,927	84,667	37,6[illegible]5	79,800	21,235	825,000	2,18[illegible],4[illegible]	.257	562,[illegible]
13	823,133	105,400	265,067	14,[illegible]67	23,133	4,62[illegible]	98,867	43,989	91,[illegible]67	24,388	825,000	2,3[illegible],2[illegible]1	.229	5[illegible],[illegible]
14	89[illegible],533	11[illegible],600	280,600	15,[illegible]10	25,33[illegible]	5,31[illegible]	112,867	50,220	104,200	27,724	841,533	2,[illegible],935	.205	5[illegible],15[illegible]
15	972,733	12[illegible],200	293,067	16,548	2[illegible],600	6,006	127,067	56,544	116,000	30,879	858,000	2,629,6[illegible]	.183	481,225
16	1,052,467	134,200	306,133	17,286	31,933	6,699	141,133	62,775	128,200	34,125	874,533	2,789,[illegible]	.163	454,[illegible]
17	1,135,533	144,600	322,933	18,234	34,133	7,161	155,200	69,099	140,333	37,370	874,533	2,939,129	.146	429,112
Total														8,750,565

TABLE XIII
EMPLOYMENT BENEFITS
(PER FEASIBILITY AREA)

Year	Total	Present Worth
1	-	-
2	-	-
3	-	-
4	$ 105,000	$ 66,780
5	210,000	119,070
6	315,000	159,700
7	420,000	189,840
8	525,000	212,100
9	630,000	227,430
10	735,000	236,670
11	840,000	241,080
12	945,000	242,860
13	1,050,000	240,450
14	1,155,000	236,770
15	1,260,000	230,580
16	1,365,000	222,400
17	1,470,000	214,620
		$ 2,840,350

KALIAKAIR

TABLE XIV
CALCULATION OF IRRIGATION BENEFITS

	DTW		STW		LLP			Less	Adj	Present
Year	No.	Benefit	No.	Benefit	No.	Benefit	Total	Table VII	Total	Worth
3	13	41,080		-	10	23,700	64,780	32,800	31,980	22,770
4	24	75,840	-	-	20	47,400	123,240	62,633	60,607	38,546
5	36	113,760	-	-	30	71,100	184,860	94,400	90,460	51,291
6	48	151,680	-	-	40	94,800	246,480	122,233	124,247	62,994
7	59	186,440	89	149,620	68	161,160	488,220	185,933	302,287	136,633
8	106	334,960	177	279,660	143	338,910	953,530	249,366	704,264	284,523
9	123	388,680	266	420,280	184	436,080	1,245,040	312,933	932,107	336,491
10	141	445,560	355	560,900	225	533,250	1,539,710	376,499	1,163,216	374,556
11	158	499,280	441	701,520	267	632,790	1,833,590	440,267	1,393,323	399,884
12	175	553,000	532	[illegible]	308	729,960	2,123,520	503,700	1,619,820	416,294
13	231	729,960	748	[illegible]	419	993,030	2,900,090	567,467	2,332,623	534,171
14	252	796,320	85[illegible]	[illegible]	468	1,109,160	3,231,640	631,000	2,620,640	577,232
15	272	859,520	958	1,513,640	518	1,227,660	3,600,820	694,633	2,906,187	531,833
16	293	925,880	1065	1,682,700	567	1,343,790	3,952,370	758,166	3,199,209	520,656
17	314	992,240	1176	1,858,080	621	1,471,770	4,322,090	824,367	3,497,723	510,668
										4,798,542

DAUDKANDI

TABLE XV
CALCULATION OF IRRIGATION BENEFITS

Year	DTW No.	DTW Benefit	STW No.	STW Benefit	LLP No.	LLP Benefit	Total	Less Table VIII	Adj Total	Present Worth
3	6	18,960	1	[illegible]80	5	11,850	32,390	15,467	16,923	12,049
4	8	25,280	3	4,740	11	26,070	56,090	24,400	31,690	20,155
5	11	34,760	4	6,320	16	37,920	79,000	32,633	46,367	26,290
6	13	41,080	5	7,900	21	49,770	98,750	41,067	57,683	29,245
7	19	60,040	32	50,560	50	118,500	229,100	82,300	146,800	66,354
8	37	116,920	87	137,460	118	279,660	534,040	121,833	412,207	166,532
9	45	142,200	127	200,660	161	381,570	724,430	161,500	562,930	203,218
10	54	170,640	167	263,860	203	481,110	915,610	201,833	713,777	229,836
11	62	195,920	206	325,480	247	585,390	1,106,790	240,967	865,823	248,491
12	71	224,360	246	388,680	289	684,930	1,297,970	281,500	1,016,470	261,233
13	95	300,200	344	543,520	399	945,630	1,789,350	320,834	1,468,516	336,290
14	105	331,800	392	619,360	451	1,068,870	2,020,030	361,466	1,658,564	340,006
15	115	363,400	440	695,200	502	1,189,740	2,248,340	401,000	1,847,340	338,063
16	126	398,160	486	767,880	554	1,312,980	2,479,020	441,125	2,037,895	332,177
17	136	429,760	532	840,560	605	1,433,850	2,704,170	481,001	2,223,169	324,583
										2,934,521

NALORE

TABLE XVI
CALCULATION OF IRRIGATION BENEFITS

Year	DTW No.	DTW Benefit	STW No.	STW Benefit	LLP No.	LLP Benefit	Total	Less Table IX	Adj Total	Present Worth
[illegible]	4	12,640	2	3,160	2	4,740	20,540	9,933	10,607	7,553
[illegible]	8	25,280	4	6,320	4	9,480	41,080	19,833	21,247	13,514
5	12	37,920	5	7,900	6	14,220	60,040	29,700	30,340	17,203
6	16	50,560	7	11,060	7	16,590	78,210	39,466	38,744	19,643
7	27	85,320	82	129,560	27	63,990	278,870	101,366	177,504	80,232
8	54	170,640	235	371,300	69	163,530	705,470	164,266	541,204	218,647
9	71	224,360	350	553,000	97	229,890	1,007,810	226,200	781,610	282,162
10	87	274,920	464	733,120	126	298,620	1,306,660	288,466	1,018,194	327,859
11	102	322,320	579	914,820	153	362,610	1,599,750	350,200	1,249,550	358,621
12	128	404,480	690	1,090,200	183	433,710	1,928,390	412,333	1,516,057	389,027
13	161	508,760	963	1,521,540	253	599,610	2,629,910	475,133	2,154,777	493,444
14	180	568,800	1101	1,739,580	288	682,560	2,990,940	536,833	2,454,107	503,092
15	198	625,680	1228	1,940,240	321	760,770	3,326,690	599,066	2,727,624	499,156
16	217	685,720	1373	2,169,340	355	841,350	3,696,410	660,856	3,035,554	494,796
17	236	745,760	1508	2,382,640	389	921,930	4,050,330	722,730	3,327,600	485,829
										4,191,378

JHIKERGACHA

TABLE XVII
CALCULATION OF IRRIGATION BENEFITS

Year	DTW No.	DTW Benefit	STW No.	STW Benefit	LLP No.	LLP Benefit	Total	Less Table X	Adj Total	Present Worth
3	2	6,320	2	3,160	2	4,740	14,220	6,500	7,720	5,497
4	4	12,640	4	6,320	4	9,480	28,440	12,066	16,374	10,413
5	7	22,120	5	7,900	6	14,220	44,240	18,433	25,807	14,632
6	8	25,280	7	11,060	8	18,960	55,300	23,767	31,533	15,988
7	18	56,880	54	85,320	20	47,400	189,600	68,000	121,600	54,964
8	40	126,400	147	232,260	46	109,020	467,680	110,280	357,400	144,389
9	54	170,640	217	342,860	64	151,680	665,180	153,833	511,347	184,597
10	68	214,880	285	450,300	81	191,970	857,150	214,966	642,184	206,784
11	80	252,000	354	559,320	99	234,630	1,046,750	239,466	807,284	231,691
12	95	300,200	424	669,920	116	274,920	1,245,040	283,500	961,540	247,116
13	131	413,960	591	933,780	110	379,200	1,726,940	327,350	1,399,690	320,529
14	146	461,360	673	1,063,340	180	426,600	1,951,300	369,500	1,581,800	324,269
15	162	511,920	756	1,194,480	199	471,630	2,178,030	413,033	1,764,997	322,995
16	179	565,640	839	1,325,620	221	523,770	2,415,030	445,099	1,969,931	321,099
17	195	616,200	927	1,464,660	241	571,170	2,652,030	498,833	2,153,197	314,367
										2,719,320

TABLE XVIII

SHAHZADPUR — CALCULATION OF IRRIGATION BENEFITS

Year	FLOW No.	FLOW Benefit	SLW No.	SLW Benefit	LLP No.	LLP Benefit	Total	Less Table XI	Adj Total	Present Worth
3	1	3,160	3	4,740	5	11,850	19,750	5,901	13,849	9,860
4	2	6,320	7	11,040	9	21,330	38,710	11,467	27,243	17,327
5	3	9,480	9	14,220	13	30,810	54,510	16,733	37,777	21,420
6	4	12,640	12	18,960	17	40,290	71,890	22,467	49,423	25,057
7	12	37,920	101	159,580	37	87,690	285,190	85,433	199,757	90,290
8	29	91,640	284	448,720	86	203,820	744,180	150,367	593,813	239,900
9	41	129,560	416	657,280	117	277,290	1,064,130	211,300	852,830	307,872
10	53	167,480	549	867,420	147	348,390	1,383,290	274,267	1,109,023	357,105
11	65	205,400	682	1,077,560	177	419,490	1,702,450	337,100	1,365,350	391,855
12	78	246,480	814	1,286,120	208	492,960	2,025,560	400,300	1,625,260	417,692
13	107	338,120	946	1,494,680	286	677,820	2,510,620	462,733	2,047,887	468,966
14	122	385,520	1795	2,046,100	323	765,510	3,197,130	526,600	2,670,530	547,459
15	136	429,760	1454	2,297,320	359	850,830	3,577,901	588,933	2,988,977	546,983
16	151	477,160	1613	2,548,540	396	938,520	3,964,220	652,234	3,311,986	539,854
17	165	521,400	1772	2,799,760	432	1,023,840	4,345,000	714,567	3,630,433	530,043
										4,511,683

TABLE XIX
CALCULATION OF IRRIGATION BENEFITS

CHUNURUGHAT

Year	DTW No.	DTW Benefit	STW No.	STW Benefit	LLP No.	LLP Benefit	Total	Less Table XII	Adj Total	Present Worth
3	-	-	-	-	2	4,740	4,740	1,467	3,273	2,330
4	-	-	-	-	5	11,850	11,850	2,867	8,983	5,713
5	-	-	-	-	7	16,590	16,590	4,500	12,090	6,855
6	-	-	-	-	10	23,700	23,700	6,100	17,600	8,923
7	2	6,320	32	50,560	25	59,250	116,130	31,467	84,663	38,268
8	4	12,640	96	151,680	62	146,940	311,260	56,167	255,093	103,058
9	6	18,960	144	227,520	85	201,450	447,930	81,384	366,546	132,323
10	8	25,280	191	301,780	109	258,330	585,390	105,700	479,690	154,460
11	10	31,600	239	377,620	132	312,840	722,060	131,000	591,060	169,634
12	12	37,920	287	453,460	156	369,720	861,100	155,800	705,300	181,262
13	17	53,720	402	635,160	216	511,920	1,200,800	181,600	1,019,200	233,397
14	19	60,040	459	725,220	244	578,280	1,363,540	206,000	1,157,540	237,296
15	22	69,520	517	816,860	273	647,010	1,533,390	231,300	1,302,090	238,282
16	25	79,000	574	906,920	301	713,370	1,699,290	256,533	1,442,757	235,169
17	27	85,320	631	996,980	329	779,730	1,862,030	280,767	1,581,263	230,864
										1,977,835

TABLE XX
CALCULATION OF POST CONSTRUCTION BENEFITS/COSTS
(YEARS 18-25)

KALIAKAIR - BENEFITS

Year	Residential	Commercial	Small Industries Revenue	Small Industries Cost Savings	Employment	Irrigation Crops	Irrigation Cost Savg.	Total	Present Worth
18	1,018,600	89,433	354,000	23,241	1,470,000	3,497,723	265,876	6,718,873	873,453
19	"	"	"	"	"	"	"	"	779,389
20	"	"	"	"	"	"	"	"	698,763
21	"	"	"	"	"	"	"	"	624,855
22	"	"	"	"	"	"	"	"	557,666
23	"	"	"	"	"	"	"	"	497,197
24	"	"	"	"	"	"	"	"	443,446
25	"	"	"	"	"	"	"	"	396,414
									4,871,183

- COSTS

Year	O & M	Power	Total	Discount Factor	Present Worth
18	960,563	668,954	1,629,517	.130	211,837
19	"	"	"	.116	189.024
20	"	"	"	.104	169.470
21	"	"	"	.093	151,545
22	"	"	"	.083	135,250
23	"	"	"	.074	120,584
24	"	"	"	.066	107,548
25	"	"	"	.059	96,142
					1,181,400

TABLE XXI

CALCULATION OF POST CONSTRUCTION BENEFITS/COSTS
(YEARS 18-25)

DAUDKANDI - BENEFITS

Year	Residential.	Commercial.	Small Industries Revenue	Small Industries Cost Savings	Employment	Irrigation Crops	Irrigation Cost Savg.	Total	Present Worth
18	1,481,900	188,600	709,333	46,482	1,470,000	2,223,169	152,484	6,271,968	815,356
19	"	"	"	"	"	"	"	"	727,548
20	"	"	"	"	"	"	"	"	652,285
21	"	"	"	"	"	"	"	"	583,293
22	"	"	"	"	"	"	"	"	520,573
23	"	"	"	"	"	"	"	"	464,126
24	"	"	"	"	"	"	"	"	413,950
25	"	"	"	"	"	"	"	"	370,046
									4,547,177

- COSTS

Year	O & M	Power	Total	Discount Factor	Present Worth
18	1,125,059	863,900	1,988,959	.130	258,565
19	"	"	"	.116	230,719
20	"	"	"	.104	206,852
21	"	"	"	.093	184,973
22	"	"	"	.083	165,084
23	"	"	"	.074	147,183
24	"	"	"	.066	131,271
25	"	"	"	.059	117,349
					1,441,996

TABLE XXII

CALCULATION OF POST CONSTRUCTION BENEFITS/COSTS

(YEARS 18-25)

NATORE-BENEFITS

Year	Residential	Commercial	Small Industries Revenue	Small Industries Cost Savings	Irrigation Employment	Irrigation Crops	Irrigation Cost Savg.	Irrigation Total	Present Worth
18	1,140,900	131,634	317,467	20,817	1,470,000	3,327,600	256,043	6,664,461	866,380
19	"	"	"	"	"	"	"	"	773,077
20	"	"	"	"	"	"	"	"	693,104
21	"	"	"	"	"	"	"	"	619,795
22	"	"	"	"	"	"	"	"	553,150
23	"	"	"	"	"	"	"	"	493,170
24	"	"	"	"	"	"	"	"	439,854
25	"	"	"	"	"	"	"	"	393,204
									4,831,734

- COSTS

Year	O & M	Power	Total	Discount Factor	Present Worth
18	1,086,179	689,164	1,775,343	.130	230,795
19	"	"	"	.116	205,940
20	"	"	"	.104	184,636
21	"	"	"	.093	165,107
22	"	"	"	.083	147,353
23	"	"	"	.074	131,375
24	"	"	"	.066	117,173
25	"	"	"	.059	104,745
					1,287,124

TABLE XXIII

CALCULATION OF POST CONSTRUCTION BENEFITS/COSTS
(YEARS 18-25)

JHIKERGACHA - BENEFITS

Year	Residential	Commercial	Small Industries		Employment	Irrigation		Total	Present Worth
			Revenue	Cost Savings		Crops	Cost Savg.		
18	924,400	152,000	396,934	25,981	1,470,000	2,153,197	159,887	5,292,399	688,012
19	"	"	"	"	"	"	"	"	613,918
20	"	"	"	"	"	"	"	"	550,409
21	"	"	"	"	"	"	"	"	492,193
22	"	"	"	"	"	"	"	"	439,269
23	"	"	"	"	"	"	"	"	391,638
24	"	"	"	"	"	"	"	"	349,298
25	"	"	"	"	"	"	"	"	312,251
									3,836,988

Year	Costs			Discount Factor	Present Worth
	O & M	Power	Total		
18	953,067	583,286	1,536,353	.130	199,726
19	"	"	"	.116	178,217
20	"	"	"	.104	159,781
21	"	"	"	.093	142,881
22	"	"	"	.083	127,517
23	"	"	"	.074	113,690
24	"	"	"	.066	101,399
25	"	"	"	.059	90,645
					1,113,856

TABLE XXIV

CALCULATION OF POST CONSTRUCTION BENEFITS/COSTS
(YEARS 18-25)

SHAHZADPUR - BENEFITS

Year	Residential.	Commercial.	Small Industries Revenue	Small Industries Cost Savg.	Milk Plant	Employment	Irrigation Crops	Irrigation Cost Savg.	Total	Present Worth
18	1,088,634	175,767	615,200	40,369	134,267	1,470,000	3,630,433	270,016	7,424,686	965,209
19	"	"	"	"	"	"	"	"	"	861,264
20	"	"	"	"	"	"	"	"	"	772,167
21	"	"	"	"	"	"	"	"	"	690,496
22	"	"	"	"	"	"	"	"	"	616,249
23	"	"	"	"	"	"	"	"	"	549,427
24	"	"	"	"	"	"	"	"	"	490,029
25	"	"	"	"	"	"	"	"	"	438,056
										5,382,897

- COSTS

Year	O & M	Power	Total	Discount Factor	Present Worth
18	1,091,633	764,710	1,856,343	.130	241,325
19	"	"	"	.116	215,336
20	"	"	"	.104	193,060
21	"	"	"	.093	172,640
22	"	"	"	.083	154,076
23	"	"	"	.074	137,369
24	"	"	"	.066	122,518
25	"	"	"	.059	109,524
					1,345,848

TABLE XXV

CALCULATION OF POST CONSTRUCTION BENEFITS/COSTS
(YEARS 18-25)

CHUNARUGHAT - BENEFITS

Year	Residential.	Commercial.	Small Industries Revenue	Small Industries Cost Savg.	Tea	Emplymt.	Irrigation Crops	Irrigation Cost Savg.	Total	Present Worth
18	992,333	118,634	271,467	17,813	761,267	1,470,000	1,581,263	105,993	5,318,770	691,440
19	"	"	"	"	"	"	"	"	"	616,977
20	"	"	"	"	"	"	"	"	"	553,152
21	"	"	"	"	"	"	"	"	"	494,646
22	"	"	"	"	"	"	"	"	"	441,458
23	"	"	"	"	"	"	"	"	"	393,589
24	"	"	"	"	"	"	"	"	"	351,039
25	"	"	"	"	"	"	"	"	"	313,807
										3,856,108

- COSTS

Year	O & M	Power	Total	Discount Factor	Present Worth
18	1,108,737	630,359	1,739,096	.130	226,082
19	"	"	"	.116	201,735
20	"	"	"	.104	180,866
21	"	"	"	.093	161,736
22	"	"	"	.083	144,345
23	"	"	"	.074	128,693
24	"	"	"	.066	114,780
25	"	"	"	.059	102,607
					1,260,844

FINANCIAL CASH FLOW

Tables IA-C show the estimated sources of cash for the six areas. Sales of power is forecasted on the basis of the average of the high and low consumption forecast (see Annex E, Tables XII - XVII) and 60 paisa and 75 paisa rates for residential and non residential loads respectively. Construction loans are based on system cost, general plant and land expenses, with $30,000 added for each area during year two as the only operational loan forecasted. Operational loans have also been scheduled into debt service. Membership revenues are based on Taka 5 membership and Taka 12 deposit per connection.

Tables IIA-C show the estimated applications of cash for the six areas. Purchase of power expenses are calculated as 17/40 of the average of high and low forecasts shown at Tables 1 - VI in Annex F. The fraction represents the final 17 paisa per KWH rate whereas the initial costs in Tables I - VI were calculated at the rate of 40 paisa per KWH. O & M costs are also listed in Tables I - VI of Annex F, although again the final estimates are 60 percent of those figures, based on the Consultant's most recent estimate of a 3 percent rather than 5 percent O & M cost.

Tables IIIA- C show the gross and net cash flows and accumulated cash after depreciation. Debt service begins in year ten, with the first three years due at year ten. Depreciation is calculated as 51 percent of total system cost. The 51 percent is derived from 100 percent cost less both a 23 percent reduction for handling and erection allowances included in the total cost and a 33% reduction to account for future local procurement rather than overseas procurement. Handling and erection costs are excluded because these costs will be covered through normal O & M replacement of parts. Second, in as local products will become more available due to increased demand and specific encouragement from the REB, it is estimated that system costs per kilometer of line will decrease from the current $6,000 to approximately $4,000, the average cost in many other developing countries. Therefore it is assumed that local replacement commodities will be purchased at 2/3 the cost of U.S. source materials.

TABLE 1-A

CASH FLOW ANALYSES - SOURCE OF FUNDS FOR YEARS 1 - 6
($ 000)

	1	2	3	4	5	6
Sales of Power						
Chunarughat	-	-	476	589	703	794
Daudkandi	-	-	488	617	738	837
Jhikergacha	-	-	292	378	450	522
Kaliakair	-	-	370	471	568	649
Natore	-	-	323	416	505	577
Shahzadpur	-	-	444	566	671	745
Total	0	0	2393	3037	3635	4124
Construction Loans						
Chunarughat	58	1,273	3,877	2,630	875	952
Daudkandi	57	588	2,810	2,909	2,232	984
Jhikergacha	56	1,073	3,176	2,112	755	868
Kaliakair	58	887	3,096	2,508	1,294	822
Natore	56	1,157	3,550	2,451	954	967
Shahzadpur	57	1,151	3,578	2,511	1,003	963
Total	342	6,029	20,087	15,121	7,113	5,556
Membership Revenues						
Chunarughat	-	-	27	10	9	7
Daudkandi	-	-	35	12	11	10
Jhikergacha	-	-	24	9	8	6
Kaliakair	-	-	26	9	9	7
Natore	-	-	29	11	10	8
Shahzadpur	-	-	24	9	8	6
Total	0	0	165	60	55	44
Total Cash Available						
Chunagughat	58	1,273	4,380	3,229	1,587	1,753
Daudkandi	57	588	3,333	3,538	2,989	1,831
Jhikergacha	56	1,073	3,492	2,499	1,213	1,396
Kaliakair	58	887	3,492	2,988	1,871	1,478
Natore	56	1,157	3,902	2,878	1,469	1,552
Shahzadpur	57	1,151	4,046	3,086	1,682	1,714
Total	342	6,129	22,645	18,218	10,811	9,724

TABLE I-B

CASH FLOW ANALYSIS - SOURCE OF FUNDS FOR YEARS 7 - 12
($ 000)

	7	8	9	10	11	12
Sales of Power						
Chunagughat	911	1,001	1,085	1,180	1,277	1,378
Daudkandi	968	1,100	1,242	1,385	1,535	1,686
Jhikergacha	619	718	819	926	1,033	1,145
Kaliakair	761	873	987	1,104	1,224	1,347
Natore	694	813	935	1,064	1,194	1,330
Shahzadpur	868	994	1,127	1,258	1,402	1,548
Total	4,821	5,499	6,195	6,917	7,665	8,434
Construction Loans						
Chunarughat	791	767	767	880	771	767
Daudkandi	823	799	799	912	803	799
Jhikergacha	707	683	683	796	687	683
Kaliakair	661	637	637	750	641	637
Natore	806	782	782	782	785	782
Shahzadpur	802	778	778	891	782	778
Total	4,590	4,446	4,446	5,011	3,828	4,446
Membership Revenues						
Chunarughat	8	8	8	8	9	9
Daudkandi	9	10	11	12	11	14
Jhikergacha	7	7	7	8	8	8
Kaliakair	7	7	8	7	9	9
Natore	9	9	9	10	10	11
Shahzadpur	7	8	7	8	9	9
Total	47	49	50	53	56	60
Total Cash Available						
Chunarughat	1,710	1,776	1,860	2,068	2,057	2,154
Daudkandi	1,800	1,909	2,052	2,309	2,349	2,499
Jhikergacha	1,333	1,408	1,509	1,730	1,728	1,836
Kaliakair	1,429	1,517	1,632	1,861	1,874	1,973
Natore	1,509	1,604	1,726	1,856	1,989	2,123
Shahzadpur	1,677	1,780	1,912	2,157	2,193	2,335
Total	9,458	9,994	10,691	11,981	12,190	12,920

TABLE I-C

CASH FLOW ANALYSIS - SOURCE OF FUNDS FOR YEARS 13 - 17
($ 000)

	13	14	15	16	17
Sales of Power					
Chunarughat	1,474	1,581	1,691	1,805	1,916
Daudkandi	1,855	2,026	2,208	2,385	2,576
Jhikergacha	1,261	1,380	1,515	1,627	1,760
Kaliakair	1,475	1,602	1,735	1,870	2,008
Natore	1,470	1,612	1,760	1,913	2,071
Shahzadpur	1,697	1,852	2,013	2,179	2,350
Total	9,232	10,053	10,922	11,779	12,681
Construction Loans					
Chunarughat	767	767	767	767	767
Daudkandi	799	799	799	799	799
Jhikergacha	683	683	683	683	683
Kaliakair	637	637	637	637	637
Natore	782	782	782	782	782
Shahzadpur	778	778	778	778	778
Total	4,446	4,446	4,446	4,446	4,446
Membership Revenues					
Chunarughat	9	11	10	11	11
Daudkandi	14	14	15	16	17
Jhikergacha	8	9	10	9	10
Kaliakair	9	9	9	10	10
Natore	11	11	12	14	14
Shahzadpur	9	9	11	10	11
Total	60	63	67	70	73
Total Cash Advailable					
Chunarughat	2,250	2,359	2,468	2,583	2,694
Daudkandi	2,668	2,839	3,022	3,200	3,392
Jhikergacha	1,952	2,072	2,208	2,314	2,453
Kaliakair	2,121	2,248	2,381	2,517	2,655
Natore	2,263	2,404	2,553	2,708	2,866
Shahzadpur	2,484	2,639	2,802	2,967	3,139
Total	13,738	14,561	15,434	16,294	17,199

TABLE 2-A

CASH FLOW ANALYSIS - APPLICATION OF FUNDS FOR YEARS 1 - 6
($ 000)

	1	2	3	4	5	6
Purchase of Power						
Chunarughat	-	-	131	163	196	221
Daudkandi	-	-	138	176	212	241
Jhikergacha	-	-	84	109	130	151
Kaliakair	-	-	105	134	163	186
Natore	-	-	93	121	148	169
Shahzadpur	-	-	123	158	188	209
Total	0	0	674	861	1037	1177
Operations & Maintenance						
Chunarughat	-	30	191	284	316	350
Daudkandi	-	30	131	233	312	348
Jhikergacha	-	30	158	233	260	292
Kaliakair	-	30	149	237	283	313
Natore	-	30	175	262	297	332
Shahzadpur	-	30	176	265	301	336
Total	0	180	980	1512	1769	1971
Capital Costs						
Chunarughat	58	1243	3877	2630	875	952
Daudkandi	57	558	2810	2909	2232	984
Jhikergacha	56	1043	3176	2112	755	868
Kaliakair	58	857	3096	2508	1294	822
Natore	56	1127	3550	2451	954	967
Shahzadpur	57	1121	3578	2511	1003	963
Total	342	5947	20087	15121	7113	5556
Total Cash Requirements Ex Debt Service						
Chunarughat	58	1273	4199	3077	1387	1523
Daudkandi	57	588	3079	3318	2756	1573
Jhikergacha	56	1073	3418	2453	1145	1311
Kaliakair	58	887	3350	2879	1740	1321
Natore	56	1157	3818	2834	1399	1468
Shahzadpur	57	1151	3877	2933	1492	1508
Total	342	6129	21741	17494	9919	8704

TABLE 2-B

CASH FLOW ANALYSIS - APPLICATION OF FUNDS FOR YEARS 7 - 12
($ 000)

	7	8	9	10	11	12
Purchase of Power						
Chunarughat	254	280	304	331	359	389
Daudkandi	278	316	356	398	441	487
Jhikergacha	178	206	235	265	295	327
Kaliakair	217	248	281	314	348	382
Natore	200	235	270	306	343	382
Shahzadpur	244	279	316	354	393	434
Total	1371	1564	1762	1968	2179	2401
Operation and Maintenance						
Chunarughat	380	408	436	469	497	525
Daudkandi	378	408	437	470	500	530
Jhikergacha	318	343	368	397	422	448
Kaliakair	338	361	385	413	436	460
Natore	361	390	419	452	481	510
Shahzadpur	366	395	423	456	485	513
Total	2141	2305	2468	2657	2821	2986
Capital Costs						
Chunarughat	791	767	767	880	771	767
Daudkandi	823	799	799	912	803	799
Jhikergacha	707	683	683	796	687	683
Kaliakair	661	637	637	750	641	637
Natore	806	782	782	782	785	782
Shahzadpur	802	778	778	891	782	778
Total	4590	4446	4446	5011	4469	4446
Total Cash Requirements Ex Debt Service						
Chunarughat	1425	1455	1507	1680	1627	1681
Daudkandi	1479	1523	1592	1780	1744	1816
Jhikergacha	1203	1232	1286	1458	1404	1458
Kaliakair	1216	1246	1303	1477	1425	1479
Natore	1367	1407	1471	1540	1609	1674
Shahzadpur	1412	1452	1517	1701	1660	1725
Total	8102	8315	8676	9636	9469	9833

TABLE 2-C

CASH FLOW ANALYSIS - APPLICATION OF FUNDS FOR YEARS 13 - 17
($ 000)

	13	14	15	16	17
Purchase of Power					
Chunarughat	417	448	479	512	545
Daudkandi	534	583	634	687	742
Jhikergacha	360	394	428	464	501
Kaliakair	418	454	492	531	571
Natore	421	462	504	548	593
Shahzadpur	476	520	565	612	660
Total	2626	2861	3102	3354	3612
Operations and Maintenance					
Chunarughat	554	582	610	638	665
Daudkandi	559	588	617	646	675
Jhikergacha	473	498	522	547	572
Kaliakair	484	507	530	553	576
Natore	538	567	595	624	652
Shahzadpur	542	570	599	627	655
Total	3150	3312	3473	3635	3795
Capital Costs					
Chunarughat	767	767	767	767	767
Daudkandi	799	799	799	799	799
Jhikergacha	683	683	683	683	683
Kaliakair	637	637	637	637	637
Natore	782	782	782	782	782
Shahzadpur	778	778	778	778	778
Total	4446	4446	4446	4446	4446
Total Cash Requirements Ex Debt Service					
Chunarughat	1738	1797	1856	1917	1977
Daudkandi	1892	1970	2050	2132	2216
Jhikergacha	1516	1575	1633	1694	1756
Kaliakair	1539	1598	1659	1721	1784
Natore	1741	1811	1881	1954	2027
Shahzadpur	1796	1868	1942	2017	2093
Total	10222	10619	11021	11435	11853

TABLE 3-A

CASH FLOW ANALYSIS - SUMMARY FOR YEARS 1 - 6
($ 000)

	1	2	3	4	5	6
Gross Cash Flow						
Chunarughat	-	-	181	152	200	230
Daudkandi	-	-	254	220	233	258
Jhikergacha	-	-	74	46	68	85
Kaliakair	-	-	142	109	131	157
Natore	-	-	84	44	71	84
Shahzadpur	-	-	169	153	190	206
Total	0	0	904	724	893	1020
Debt Service						
Chunarughat	-	-	-	-	-	-
Daudkandi	-	-	-	-	-	-
Jhikergacha	-	-	-	-	-	-
Kaliakair	-	-	-	-	-	-
Natore	-	-	-	-	-	-
Shahzadpur	-	-	-	-	-	-
Total	0	0	0	0	0	0
Net Cash Flow						
Chunarughat	-	-	181	152	200	230
Daudkandi	-	-	254	220	233	258
Jhikergacha	-	-	74	46	68	85
Kaliakair	-	-	142	109	131	157
Natore	-	-	84	44	71	84
Shahzadpur	-	-	169	153	190	206
Total	0	0	904	724	893	1020
Accumulated Cash After Depreciation						
Chunarughat	(1)	(20)	86	119	193	283
Daudkandi	(1)	(10)	194	322	430	549
Jhikergacha	(1)	(17)	(5)	(52)	(88)	(120)
Kaliakair	(1)	(14)	69	83	100	131
Natore	(1)	(18)	(3)	(64)	(112)	(161)
Shahzadpur	(1)	(18)	82	129	199	270
Total	(6)	(97)	423	537	722	952

TABLE 2-B

CASH FLOW ANALYSIS - SUMMARY FOR YEARS 7 - 12
($ 000)

	7	8	9	10	11	12
Gross Cash Flow						
Chunarughat	285	321	353	388	430	473
Daudkandi	321	386	460	529	605	683
Jhikergacha	130	176	223	272	324	378
Kaliakair	213	271	329	384	449	494
Natore	142	197	256	316	380	449
Shahzadpur	265	328	394	456	533	610
Total	1356	1679	2015	2345	2721	3087
Debt Service						
Chunarughat	-	-	-	261	393	437
Daudkandi	-	-	-	173	319	430
Jhikergacha	-	-	-	216	321	359
Kaliakair	-	-	-	202	327	392
Natore	-	-	-	238	361	408
Shahzadpur	-	-	-	239	365	415
Total	0	0	0	1329	2086	2441
Net Cash Flow						
Chunarughat	285	321	353	127	37	36
Daudkandi	321	386	460	356	286	253
Jhikergacha	130	176	223	56	3	19
Kaliakair	213	271	329	182	122	102
Natore	142	197	256	78	19	41
Shahzadpur	265	328	394	217	168	195
Total	1356	1679	2015	1016	635	646
Accumulated Cash After Depreciation						
Chunarughat	416	574	753	693	532	358
Daudkandi	719	942	1228	1396	1483	1525
Jhikergacha	(117)	(78)	(2)	(105)	(270)	(430)
Kaliakair	208	334	509	526	474	392
Natore	(163)	(122)	(33)	(134)	(305)	(465)
Shahzadpur	389	559	784	819	794	784
Total	1452	2209	3239	3195	2708	2164

TABLE 3-C

CASH FLOW ANALYSIS - SUMMARY FOR YEARS 13 - 17

($ 000)

	13	14	15	16	17
Gross Cash Flow					
Chunarughat	515	562	612	666	717
Daudkandi	776	869	972	1068	1136
Jhikergacha	436	497	575	625	697
Kaliakair	582	650	722	796	871
Natore	522	593	672	754	839
Shahzadpur	688	771	860	950	1036
Total	3519	3942	4413	4859	5296
Debt Service					
Chunarughat	484	524	562	601	645
Daudkandi	480	521	561	601	646
Jhikergacha	403	438	472	506	546
Kaliakair	433	466	498	530	568
Natore	457	497	536	577	614
Shahzadpur	463	503	542	581	626
Total	2720	2949	3171	3396	3645
Net Cash Flow					
Chunarughat	31	38	50	65	72
Daudkandi	296	348	411	467	490
Jhikergacha	33	59	103	119	151
Kaliakair	149	184	224	266	303
Natore	65	96	136	177	225
Shahzadpur	225	268	318	369	410
Total	799	993	1242	1463	1651
Accumulated Cash After Depreciation					
Chunarughat	168	(26)	(219)	(408)	(601)
Daudkandi	1598	1712	1877	2086	2307
Jhikergacha	(583)	(724)	(830)	(929)	(1006)
Kaliakair	348	330	342	387	460
Natore	(613)	(741)	(837)	(907)	(941)
Shahzadpur	793	834	913	1032	1181
Total	1709	1385	1246	1261	1400

AID 1020-28 (1-72)

PROJECT DESIGN SUMMARY
LOGICAL FRAMEWORK

Life of Project:
From FY 77 to FY 81
Total U.S. Funding $50,000,000
Date Prepared: 16 June, 1977

Project Title & Number: RURAL ELECTRIFICATION 388-0021

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
Program or Sector Goal: The broader objective to which this project contributes: Improved rural standards of living.	Measures of Goal Achievement: 1. 210 new agricultural small industrial and household jobs created each year in each PBS area. 2. Annual increase in second and third crop production as reflected in irrigation load forecast. 3. Lower rate of out-migration in project areas than non-project areas.	Power use program records BADC adviser to PBS Thana office population records	Assumptions for achieving goal targets: 1. BDG follows rational policies on investments in rural small-scale industries. 2. BDG establishes incentive output prices to farmers. 3. BADC able to provide new pumps and other HYV inputs.
Project Purpose: Provision of reliable electric service at reasonable rates to existing and potential sources of rural employment, to community service facilities and to rural residents, especially the rural poor, in all project areas.	Conditions that will indicate purpose has been achieved: End of project status. 1. 27,500 KWH sold by PBS to consumers in FY 82. 2. All targetted rural poor connected. 3. Adequate maintenance system in operation. 4. Twelve new small industries units established in each PBS. 5. Ten medical, educational or other community service buildings electrified in each PBS.	1. PBS operating and maintenance records 2. PBS initial and subsequent consumer roster. 3. REB inspection records 4. Power use program records, BSCIC loan records 5. PBS service records.	Assumptions for achieving purpose: 1. BDG agencies take advantage of availability of electricity for service expansion. 2. PBSs succeed in creating community-wide responsive organizations. 3. PDB power supply continues as is or is improved over time.
Outputs: Construction and energization of distribution systems in twelve PBS areas. Connection of houses REB and PBSs operational. Self-training capacity established in REB and PBSs.	Magnitude of Outputs: 1. 4000 miles of line and 24 substations constructed. 2. 268,000 consumers connected. 3. PBSs take complete financial responsibility for local systems. 4. REB and PBS training conducted by Bangladesh staff. 5. 100 small industry loans issued in each PBS area. 6. Housewiring loans available to PBS rural poor desiring connection.	1. REB construction records, site visits. 2. PBS service records. 3. REB financial reviews of PBSs, PBS records. 4. REB training program data. 5. BSCIC accounts. 6. REB housewiring loan accounts.	Assumptions for achieving outputs: 1. New local contractors become capable of performing quality work. 2. Local qualified people willing to serve on PBS staffs.
Inputs: Construction Commodities Technical Assistance Support Commodities Program Loans	Implementation Target (Type and Quantity) AID ($000) / BDG 41,875 / 6,225 5,000 / 3,500 1,225 / 1,942 1,900 / 5,000		Assumptions for providing inputs:

ANNEX H
Page 1 of 1

PROJECT DESCRIPTION
RURAL ELECTRIFICATION PROJECT

The project includes construction of 4,000 miles of distribution line (11 KV or less) and 24 transformer substations (33/11KV), rehabilitation of 300 miles of existing distribution line and five existing substations, connection and metering of 268,000 rural domestic, commercial, and small industrial consumers to the system, assistance in internal wiring for consumers, and establishment of one central and 12 local organizations to construct, maintain, administer and promote these systems. Initial project areas will include 12 sub-projects encompassing 49 Thanas (4373 sq. mi.) and 1,088,000 households. These figures are approximate and represent project targets. Project life is six years.

The purpose of the project is to provide electricity at reasonable cost for rural employment creation and community service facilities, and for rural households especially those of the poor. In light of the high percentage of landless laborers and underemployed workers in rural Bangladesh, it is of particular importance that this project will provide power for agricultural processing, non-farm industries and irrigation. Domestic services will be widespread based on an estimated 75 percent of households able to afford electric service in the project areas.

The central organization for implementation of the Bangladesh rural electrification program and this project will be the Rural Electrification Board (REB). The REB will be co-equal with the existing Power Development Board, and both will come under the Ministry of Flood Control, Water Resources and Power.

The REB will coordinate the Bangladesh Government's rural electrification activities with related rural development efforts; coordinate the assistance offered to rural electrification by all donors; conduct feasibility studies of proposed local distribution projects and provide interest free, long-term loans to local user

organizations to finance projects; assist local groups in contracting for construction services and supervising construction; promote development of rural enterprises using electricity by providing technical assistance and credit; determine and enforce safety and design standards; arrange the purchase of bulk power at favorable prices from the Power Development Board for rural user groups; provide training to local groups in operating and maintaining distribution systems; and arrange for the import or local purchase, storage, inventory and allocation of equipment and materials to local groups for construction of local distribution systems.

The Power Development Board, presently responsible for all power generation, transmission and rural distribution, will retain responsibility for generation and transmission up to the project area substations from which power will be distributed by local user groups.

The project will also establish local user organizations, or Palli Bidyut Samity (PBS), in each of the 12 sub-project areas. Each PBS will be responsible for operation and maintenance of the local distribution system, for maximizing the number of connections and for service billings and collection. Each PBS will be assisted by the REB through technical assistance, training, financing, contracting assistance, construction supervision and supply of construction equipment and materials.

The PBSs will each serve an area including approximately 30 Unions, with each union having a PBS representative. All area residents desiring electric service will be eligible for membership in the PBS. Payment of a nominal membership fee and deposit will entitle prospective consumers to a service connection at no additional cost. Housewiring loans are also to be made available to potential consumers who could not otherwise afford service.

The institutional framework for this project has been specifically established as a basis for future Government and donor activity in rural electrification. Future activities should include both the establishment of new PBSs and the procurement of additional equipment, materials and services for use by the initial PBSs after completion of this project.

The total project costs are estimated at $66.667 million. The AID contribution will total $50.0 million over the life of the project, including a loan in FY 1977 for $16 million and subsequent year grants totaling $34 million.

The Bangladesh Government will be financing the balance of $16.667 million in local currency equivalent.

BANGLADESH
RURAL ELECTRIFICATION

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

I, David M. Wilson, Acting 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 judgment Bangladesh has the financial and human resources capability effectively to utilize the project to be financed by this grant.

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

David M. Wilson
Acting Director

[illegible] 1977
Date

UNCLASSIFIED

Department of State

INCOMING TELEGRAM

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ACTION AID-31

INFO OCT-01 NEA-10 OES-07 L-03 IGA-02 EB-08 /062 W
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AIDAC

E.O. 11652: N/A
SUBJ: RURAL ELECTRIFICATION PROJECT -FY77:
GOVERNMENT REQUEST FOR ASSISTANCE

1. THE FOLLOWING REQUEST FOR ASSISTANCE ADDRESSED TO USAID DIRECTOR TONER HAS BEEN RECEIVED FROM THE GOVERNMENT OF BANGLADESH:

QUOTE: FROM: DR. FAKHRUDDIN AHMED MINISTRY OF PLANNING
JOINT SECRETARY EXTERNAL RESOURCES DIVISION
GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH
SHER-E-BANGLA NAGAR
DACCA-15

D.O. NO. 206/ERD/USA (P)-8/75 DATED: THE 11TH AUGUST, 1977

DEAR MR. TONER,

PLEASE REFER TO YOUR LETTER NO. 979 DATED AUGUST 8, 1977 ADDRESSED TO SECRETARY, ERD REGARDING PROPOSED USAID FINANCING OF THE RURAL ELECTRIFICATION PROJECT OF BANGLADESH. I AM TO INFORM YOU THAT THE GOVERNMENT GENERALLY AGREES WITH THE OUTLINE AND OBJECTIVES OF THE PROJECT SET FOURTH IN YOU LATEST RURAL ELECTRIFICATION PROJECT PAPER AND REQUESTS THE GOVERNMENT OF THE UNITED STATES TO PROVIDE $50 MILLION PROJECT ASSISTANCE IN THIS REGARD AS FOLLOWS:

FY 1977
$16.0 MILLION LOAN
FY 1978 - $21.0 MILLION GRANT
FY 1979 - $ 13.0 MILLION GRANT

WE UNDERSTAND THAT FY 1977 $16 MILLION LOAN AND FY 1978 $21 MILLION GRANT WILL BE MADE AVAILABLE UNDER A SINGLE AGREEMENT TO BE SIGNED IN OCTOBER, 1977. THE GOVERNMENT ON ITS PART STANDS READY TO PROVIDE $16.667 MILLION EQUIVALENT TO UNDERTAKE THE RURAL ELECTRIFICATION PROJECT.

I WOULD REQUEST YOU KINDLY TO MOVE YOUR GOVERNMENT TO GO AHEAD WITH THE RURAL ELECTRIFICATION PROJECT FINANCING AND TO SEND THE DRAFT PROJECT AGREEMENT AS QUICKLY AS POSSIBLE.

YOURS SINCEPELY,

(SIGNED)

(FAKHRUDDIN AHMED)
JOINT SECRETARY UNQUOTE.

2. PLEASE ADVISE STATUS OF PROJECT REVIEW.
BERGESEN

UNCLASSIFIED

(DRAFT)

PROJECT AUTHORIZATION

Bangladesh

Rural Electrification

A. I. D. Grant No. 388-0021

Pursuant to Part I, Chapter I, Section 103 of the Foreign Assistance Act of 1961 as amended, I hereby authorize a Grant to the Government of the People's Republic of Bangladesh, the "Grantee", of not to exceed forty million United States dollars ($40,000,000) to help in financing certain foreign exchange and local currency costs of goods and services required for a Project to provide electric services to up to 268,000 rural consumers in selected feasibility areas.

I approve the Project and a total Grant funding for the Project of not to exceed fifty million United States dollars ($50,000,000) of A. I. D. appropriated funding, including the funding authorized above and additional increments during the period FY 1978 through FY 1979 of up to ten million United States dollars ($10,000,000) subject to availability of funds in accordance with A. I. D. allotment procedures.

I hereby authorize the initiation of negotiation and execution of the Project Agreement by the officer to whom such authority has been delegated in accordance with A. I. D. regulations and delegations

of authority subject to the following essential terms, covenants and major conditions, and together with such other terms and conditions as A. I. D. may deem appropriate:

a. Except as A. I. D. may otherwise agree in writing goods financed by A. I. D. under the Project shall have their source and origin in countries included in A. I. D. Geographic Code 941 or in Bangladesh, and services financed by A. I. D. under the Project shall have their source and origin in the United States or in Bangladesh.

b. Prior to any disbursement or the issuance of any commitment documents under the Project Agreement, the Grantee shall furnish in form and substance satisfactory to A. I. D. evidence with respect to the following:

1) legal establishment of the Bangladesh Rural Electrification Board, appointment of Board Members, and establishment of an initial rate structure.

2) Grantee approval of the Project including the funding arrangements and levels therefore, and establishment of a budget for the first year of the Project;

3) arrangements to obtain the services of a Consultant to assist in implementation of the project;

4) assignment to the REB of Power Development Board personnel, organizational units and logistics support necessary for initial implementation of the Project;

5) selection of initial Rural Electric Society (Palli Bidyut Samity - PBS) board members in each of the 12 subproject areas; and

6) establishment of procedures for expeditious clearance of imported Project commodities.

c. Prior to any disbursement or the issuance of any commitment documents under the Project Agreement as amended to provide incremental funding during or after FY 1979, the Grantee shall furnish in form and substance satisfactory to A. I. D. evidence with respect to the following:

1) completion of transfer of Power Development Board staff and facilities to the REB;

2) establishment of the rate structure for the Project, such structure to reflect the following criteria:

   a) all Rural Electric Societies to be self-financing subject to interest free loans from REB; and

   b) domestic service to be provided at rates lower than rates for other user classes;

3) installation of a financial management system for the REB;

4) establishment of the Rural Electric Societies as legal entities;

5) assignment of one staff person to each Rural Electric Society from the Bangladesh Small and Cottage Industries Corporation (BSCIC) and the Bangladesh Agricultural Development Corporation (BADC); and

6) completion of the initial evaluation carried out under the Project and agreement on the implementation of resulting recommendation.

d. The Grantee shall covenant as follows:

1) to ensure that the REB establishes and maintains sound financial and operational criteria for implementation of the Project and applies minimum consumer connection levels for each Rural Electric Society as a principal criterion for determining the eligibility of such Rural Electric Societies for REB loans; and

2) to review consumer rates for the Rural Electric Society areas and adjust the rates as necessary to ensure both the financial self-sufficiency of the Rural Electric Societies and an optimum level of service to low income domestic users.

e. In accordance with the request of the Grantee and the judgment of both the Grantee and A. I. D. that the associated firms of NRECA International, Ltd. and Commonwealth Associates, Inc. (NRECA/CAI) performed satisfactorily under the feasibility study for this Project and have not achieved an unfair competitive advantage nor have been nor might be placed in a position where their judgment may have been or may be biased, the non-competitive selection in accordance with A. I. D. regulations of NRECA/CAI for the consultant services for this Project is approved.

f. Pursuant to the authorization of source and origin under subparagraph a. above, the waiver of A. I. D. regulations to permit A. I. D. Geographic Code 941 or Bangladesh source and origin for goods and United States or Bangladesh source and origin for services is hereby approved.

Signature_____

Date_____

STATUTORY CHECKLIST

A. GENERAL CRITERIA FOR COUNTRY

1. FAA Sec.116. Can it be demonstrated that contemplated assistance will directly benefit the needy? If not, has the Department of State determined that this government has engaged in a consistent pattern of gross violations of internationally recognized human right?	Yes, it can so be demonstrated.
2. FAA Sec. 481. Has it been determined that the government of the recipient country has failed to take adequate steps to prevent narcotics, drugs and other controlled substances (as defined by the Comprehensive Drug Abuse Prevention and Control Act of 1970) produced or processed, in whole or in part, in such country, from being sold illegally within the jurisdiction of such country to U.S. Government personnel or their dependents or from entering the U.S. unlawfully?	No, Department of State has not so determined.
3. FAA Sec.620(a). Does the recipient country furnish assistance to Cuba or fail to take appropriate steps to prevent ships or aircraft under its flag from carrying cargoes to or from Cuba?	The President has granted a waiver to the BDG to trade jute with Cuba.
4. FAA Sec.620(b). If assistance is to a government has the Secretary of State determined that it is not controlled by the international Communist movement?	Yes.

5.	FAA Sec.620(c). If assistance is to a government, is the government liable as debtor or unconditional guarantor on any debt to a U.S. citizen for goods or services furnished or ordered where (a) such citizen has exhausted available legal remedies and (b) debt is not denied or contested by such government?	No.
6.	FAA Sec.620(e). If assistance is to a government, has it (including government agencies or subdivisions) taken any action which has the effect of nationalizing, expropriating, or otherwise seizing ownership or control of property of U.S. citizens or entities beneficially owned by them without taking steps to discharge its obligations toward such citizens or entities?	In 1972 the BDG nationalized five firms which were fully or partially owned by U.S. entities. The BDG has announced a compensation policy and is taking steps to discharge its obligations toward U.S. citizens and entities.
7.	FAA Sec.620 (f); App.Sec.108. (a) Is recipient country a Communist Country? (b) Will assistance be provided to the Democratic Republic of Vietnam? Cambodia or Laos?	(a) No. (b) No.
8.	FAA Sec. 620 (i). In recipient country in any way involved in (a) subversion of, or military aggression against the United States or any country receiving U.S. assistance, or (b) the planning of such subversion or aggression?	No.
9.	FAA Sec. 620 (j). Has the country permitted, or failed to take adequate measures to prevent, the damage or destruction, by mob action, of U.S. property?	No.

10.	FAA Sec.620(l). If the country failed to institute the investment guaranty program for the specific risks of expropriation, inconvertibility or confiscation, has the AID Administrator within the past year considered denying assistance to such government for this reason?	An OPIC bilateral agreement was signed on January 15, 1975.
11.	FAA Sec.620(o). Fishermen's Protective Act, Sec.5. Has the country seized, or imposed any penalty or sanction against, any U.S. fishing activities in international waters? If so, a. has any deduction required by Fishermen's Protective Act been made? b. has complete denial of assistance been considered by AID Administrator?	No.
12.	FAA Sec.620(q); App.Sec.504. (a) is the government of the recipient country in default on interest or principal of any AID loan to the country? (b) is the country in default exceeding one year on interest or principal on U.S. loan under a program for which an Act of Congress appropriates funds, unless debt was earlier disputed or appropriate steps taken to cure default?	a) No. b) No.
13.	FAA Sec.620(s). a) What percentage of country budget is for military expenditures? (b) How much of foreign exchange resources are spent on military equipment?	a) Approximately seven percent. b) and c) The Soviet Union has provided a limited number of aircraft for the BDG airforce. This non-sophisticated equipment was purchased on credit

	c) How much is spent for the purchase of sophisticated weapons systems?	at reduced prices. The BDG is not diverting development assistance funds for military expenditures.
14.	FAA Sec.620(t). Has the country served diplomatic relations with the United States? If so, have they been resumed and have new bilateral assistance agreements been negotiated and entered into since such resumption?	No.
15.	FAA Sec.620(u). What is the payment status of the country's U.N. obligations? If the country is in arrears, were such arrearages taken into account by the AID Administrator in determining the current AID Operational Year Budget?	Not in arrears.
16.	FAA Sec.620A. Has the country granted sanctuary from prosecution to any individual or group which has committed an act of international terrorism?	No.
17.	FAA Sec.665. Does the country object, on the basis of race, religion, national origin or sex, to the presence of any officer or employee of the U.S. there to carry out economic development program under the FAA?	No.
18.	FAA Sec.669. Has the country delivered or received nuclear reprocessing or enrichment equipment, materials or technology, without specified arrangements on safeguards, etc.?	No.

19.	FAA Sec.901. Has the country denied its citizens the right or opportunity to emigrate?	No.

B. FUNDING CRITERIA FOR COUNTRY

1. Development Assistance Country Criteria

a. FAA Sec.102(c), (d). Have criteria been established and taken into account to assess the commitment and progress of the country in effectively involving the poor in development, on such indexes as: (1) small-farm labor intensive agriculture, (2) reduced infant mortality, (3) population growth, (4) equality of income distribution and (5) unemployment.

(1) Yes
(2) Yes
(3) Yes
(4) Yes
(5) Yes

b. FAA Sec.201(b)(5),(7) & (8); Sec.208; 211(a) (4),(7). Describe the extent to which the country is

(1) Making appropriate efforts to increase food production and improve means for food storage and distribution.	(1) Increasing foodgrain production is a major objective of the Bangladesh Five Year Development Plan (FYP). Included also in the FYP are programs for storage and distribution of food.
(2) Creating a favorable climate for foreign and domestic private enterprise and investment.	(2) BDG policy encourages both foreign and domestic private enterprise and investment, and in January 1975, in OPIC bilateral agreement was concluded. In addition, the new Martial Law Administration (since November 7, 1975) has particularly emphasized the role of private enterprise, is looking to the denationalization of a number of firms, and has announced a new private sector oriented investment policy
(3) Increasing the public's role in the development process.	(3) Implementation of Bangladesh's development plans requires a large public role in development. Cooperatives are encouraged by the Government, directly involving the public in a participatory role. In addition, the national rural works program also requires a high degree of local decision-making and participation.

(4) (a) Allocating available budgetary resources to development.

(4) (a) Bangladesh's budgetary resources are overwhelmingly allocated to relief and development expenditures.

(b) Diverting such resources for unnecessary expenditures and intervention in affairs of other free and independent nations.

(b) Bangladesh's military expenditures are very low in absolute and real terms. The level of defense spending is not a diversion of development funds.

(5) Making economic, social, and political reforms such as tax collection improvements and changes in land tenure arrangements, and making progress toward respect for the rule of law, freedom of expression and of the press and recognizing the importance of individual freedom, initiative, and private enterprise.

(5) Bangladesh is predominantly a nation of small farms, and while a large proportion of these are cultivated by shareholders and lease farmers, as well as farmers who both own some land and lease or sharehold, the average area per family is under two acres and large holdings are the exception. Accordingly, land tenure changes while necessary in the long term, are not as critical an element for the development of Bangladesh as for other LDCs. On the other question, the new Martial Law Administration has evidenced a concern for each of these; this has been manifested through tighter public administration, return of newspapers to private control, and encouragement of private enterprise. Recognition of the importance of individual freedom and initiative also appear to be marks of the new Government. Martial Law has been extended to the country in what appears principally to be an effort to clear up carry-over problems of corruption and abuse of power. Respect for the rule of law is stated as underlying the current measures.

(6) Otherwise responding to the vital economic, political, and social concerns of its people, and demonstrating a clear determination to take effective self-help measures.	(6) The new Government evidences a concern for these questions and has been taking action to improve the public service, to release economic activity from constraints formerly imposed by governmental intervention, and to alleviate conditions of the people through rural works programs, food for work and other self-help programs.
(c) FAA Sec.201(b),211(a). Is the country among the 20 countries in which development assistance loans may be made in this fiscal year, or among the 40 in which development assistance grants (other than for self-help projects) may be made?	(c) Yes.
(d) FAA Sec.115. Will country be furnished, in the same fiscal year, either security supporting assistance or Middle East peace funds? If so, is assistance for population programs, humanitarian aid through international organizations, or regional programs?	(d) No
2. Security Supporting Assistance Country Criteria	
a. FAA Sec.502 B. Has the country engaged in a consistent pattern of gross violations of internationally recognized human rights? Is program in accordance with policy of this Section?	a. No, Program is in accordance.
b. FAA Sec.531. Is the assistance to be furnished to a friendly country organization, or body eligible to receive assistance?	b. Not applicable.

c. FAA Sec. 609. If commodities are to be granted so that sale proceeds will accrue to the recipient country, have Special Account (counterpart) arrangements been made?	c. Not applicable.

C. GENERAL CRITERIA FOR PROJECT

1. App. Unnumbered; FAA Sec.653(b)

(a) Describe how Committees on Appropriations of Senate and House have been or will be notified concerning the project; (b) is assistance within (Operational Year Budget) country or international organization allocation reported to Congress (or not more than $ 1 million over that figure plus 10%)?

a) Loan project for $16 million included in FY 1977 Congressional Presentation.

b) Project was included in FY 1977 OYB at the $19 million grant level, increased funding level is within country program budget.

2. FAA Sec.611(a)(1). Prior to obligation in excess of $100,000, will there be (a) engineering, financial, and other plans necessary to carry out the assistance and (b) a reasonably firm estimate of the cost to the U.S. of the assistance?

( ) and (b): A detailed Rural Electrification Feasibility Study has been undertaken for the purpose of preparing all necessary financial, engineering and implementation plans, for the electrification of six project areas, the plans and costs for which are reflected in this Project Paper.

3. FAA Sec.611 (a) (2). If further legislative action is required within recipient country, what is basis for reasonable expectation that such action will be completed in time to permit orderly accomplishment of purpose of the assistance?

All legislative actions are conditions precedent to disbursement under this project.

4. FAA Sec. 611 (b): App.Sec.101. If for water or water-related land resource construction, has project met the standards and criteria as per Memorandum of the President dated Sept.5, 1973 (replaces Memorandum of May 15, 1962; see Fed. Register, Vol 38, No.174, Part III, Sept. 10, 1973)?

Not applicable to this project.

5. FAA Sec. 611(e). If project is capital assistance (e.g., construction), and all U.S. assistance for it will exceed $1 million, has Mission Director certified the country's capability effectively to maintain and utilize the project?	Yes, Certification included herein.
6. FAA Sec. 209, 619. Is project susceptible of execution as part of regional or multilateral project? If so why is project not so executed? Information and conclusion whether assistance will encourage regional development programs. If assistance is for newly independent country, is it furnished through multilateral organizations or plans to the maximum extent appropriate?	Subject to final publication of the Rural Electrification Study, multilateral organizations may consider supplemental assistance in rural electrification. This program is not feasible on a regional basis.
7. FAA Sec. 601 (a); (and Sec. 201(f) for development loans). Information and conclusions whether project will encourage efforts of the country to: (a) increase the flow of international trade; (b) foster private initiative and competition; (c) encourage development and use of cooperatives, credit unions, and savings and loan associations; (d) discourage monopolistic practices; (e) improve technical efficiency of industry, agriculture and commerce; and (f) strengthen free labor unions.	Through development of small scale industries and cooperative type local electric boards, this project should contribute to all sections (a - f) of this statute.
8. FAA Sec. 601(b). Information and conclusion on how project will encourage U.S. private trade and investment abroad and encourage private U.S. participation in foreign assistance programs (including use of private trade channels and the services of U.S. private enterprise).	The project will finance purchase of electrical distribution construction materials including from private US suppliers, thereby acting to encourage US-Bangladesh trade and the role of US private enterprise in participation in foreign assistance.

9. FAA Sec. 612(b); Sec.636(h). Describe steps taken to assure that, to the maximum extent possible, the country is contributing local currencies to meet the cost of contractual and other services, and foreign currencies owned by the U.S. are utilized to meet the cost of contractual and other services.

The host country contribution is 100 percent local currency. All contractor services local costs will be paid with U.S. owned Bangladesh Taka.

10. FAA Sec. 612(d). Does the U.S. own excess foreign currency and, if so, what arrangements have been made for its release?

No.

FUNDING CRITERIA FOR PROJECT

1. Development Assistance Project Criteria

a. FAA Sec. 102(c); Sec. 111; Sec.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, spreading investment out from cities to small towns and rural areas; and (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?

a) By its direct impact on employment for the rural poor in rural small-scale productive units, this project will encourage labor-intensive production in rural areas.

b) The local implementing institutions will have a cooperative structure which will receive considerable technical assistance from project activities.

b. FAA Sec. 103, 103A, 104, 105, 106, 107. Is assistance being made available; [include only applicable paragraph -- e.g., a, b, etc. -- 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;

Yes, Project is primarily designed to increase productivity and employment as a means to providing adequate income for currently unemployed and underemployed rural poor in Bangladesh.

(2) [104] for population planning or health; if so, extent to which activity extends low-cost, integrated delivery systems to provide health and family planning services, especially to rural areas and poor;

(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;

(4) [106] for technical assistance, energy, research, reconstruction, and selected development problems; if so, extent activity is:

(a) technical cooperation and development, especially with U.S. private and voluntary, or regional and international development, organizations;

(b) to help alleviate energy problem;

(c) research into, and evaluation of, economic development processes and techniques;

(d) reconstruction after natural or manmade disaster;

(e) for special development problem, and to enable proper utilization of earlier U.S. infrastructure, etc., assistance;

(f) for programs of urban development, especially small labor-intensive enterprises, marketing systems, and financial or other institutions to help urban poor participate in economic and social development.

(5) [107] by grants for coordinated private effort to develop and disseminate intermediate technologies appropriate for developing countries.

c. FAA Sec. 110(a); Sec.208(e). Is the recipient country willing to contribute funds to the project, and in what manner has or will it provide assurances that it will 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)?

Twenty-five percent of the project costs will be met by the Bangladesh Government. See Part IV-A of this Project Paper.

d. 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?

All grant capital assistance for this project will be disbursed within three years of respective obligation.

e. FAA Sec. 207; Sec. 113. Extent to which assistance reflects appropriate emphasis on; (1) encouraging development of democratic, economic, political, and social institutions; (2) self-help in meeting the country's food needs; (3) improving availability of trained worker-power in the country; (4) programs designed to meet the country's health needs; (5) other important areas of economic, political, and

Through development of local cooperative type organizations, this project will encourage many aspects of democratic political and social development in rural areas. Through increased number of annual crops from irrigation, food self-sufficiency will also be improved. The electrification of rural health centers will allow

social development, including industry; free labor unions, cooperative, and Voluntary Agencies; transportation and communication; planning and public administration; urban development, and modernization of existing laws; or (6) integrating women into the recipient country's national economy.

lighting and refrigeration of medicines both essential to properly coming for the health needs of the rural areas. Women will especially benefit from active participation on local institutions and from improved domestic environment from residential electrification.

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 civic education and training in skills required for effective participation in governmental and political processes essential to self-government.

This project has been designed to utilize to the maximum feasible extent the considerable resources of trained Bangladeshi personnel in the power development field and in the local institutional development field, the latter of which will contribute toward increased local involvement in civic and political affairs.

g. FAA Sec. 201(b)(2)-(4) and -(8); Sec. 201(e); Sec. 211(a)(1)-(3) and -(8). 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; or of educational or other institutions directed toward social progress? Is it related to and consistent with other development activities, and will it contribute to realizable long-range objectives? And does project paper provide information and conclusion on an activity's economic and technical soundness?

The project will have a significant sustained impact on the economic and social progress of people in the rural areas through the provision of basic long-term requirements for development infrastructure for rural areas. Both the economic and technical soundness of this project are clearly set forth in this Project Paper.

h. FAA Sec. 201(b)(6); Sec.211(a)(5), (6). Information and conclusion on possible effects of the assistance on U.S. economy, with special reference to areas of substantial labor surplus, and extent to which U.S. commodities and assistance are furnished in a manner consistent with improving or safeguarding the U.S. balance-of-payments position.

The large percentage of project commodities to be procured under United States source and origin will contribute to US labor usage and will no adverse impact on balance-of-payments.

2. Development Assistance Project Criteria (Loans only)

a. FAA Sec. 201(b)(1). Information and conclusion on availability of financing from other free-worl sources, including private sources within U.S.

Not applicable to grant financing.

b. FAA Sec. 201(b)(2); 201(d). Information and conclusion on (1) capacity of the country to repay the loan, including reasonableness of repayment prospects, and (2) reasonableness and legality(under laws of country and U.S.) of lending and relending terms of the loan.

c. FAA Sec. 201(e). If loan is not made pursuant to a multilateral plan, and the amount of the loan exceeds $100,000, has country submitted to AID and application for such funds together with assurances to indicate that funds will be used in an economically and technically sound manner?

d. FAA Sec. 201(f). Does project paper describe how project will promote the country's economic development taking into account the country's human and material resources requirements and relationship between ultimate objectives of the project and overall economic development?

D. STANDARD ITEM CHECKLIST

Procurement

1.	FAA Sec. 602. Are there arrangements to permit U.S. small business to participate equitably in the furnishing of goods and services financed?	Yes.
2.	FAA Sec. 604(a). Will commodity procurement be financed from the U.S. except as otherwise determined by the President or under delegation from him?	Yes.
3.	FAA Sec. 604(d). If the cooperating country discriminates against U.S. marine insurance companies, will agreement require that marine insurance be placed in the U.S. on commodities financed?	Yes, agreement will so provide.
4.	FAA Sec. 604(e). If offshore procurement of agricultural commodities or produce is to be financed, is there provision against such procurement when the domestic price of such commodity is less than parity?	Not applicable
5.	FAA Sec. 608(a). Will U.S. Government excess personal property be utilized wherever practicable in lieu of the procurement of new items?	Yes.
6.	FAA Sec. 901 (b), (a). Compliance with requirement that at least 50 percent of the gross tonnage of commodities (computed separately for dry bulk carriers, dry cargo liners and tankers) financed	Project Agreement will so provide.

shall be transported on privately owned U.S. flag commercial vessels to the extent that such vessels are available at fair and reasonable rates.

7. FAA Sec.621. If technical assistance is financed, will such assistance be furnished to the fullest extent practicable as goods and professional and other services from private enterprise on a contract basis? If the facilities of other Federal agencies will be utilized are they particularly suitable, not competitive with private enterprise, and made available without undue interference with domestic programs?

Yes.
Not applicable.

8. International Air Transport Fair Competitive Practices Act 1974

If air transportation of persons or property is financed on grant basis, will provision be made that U.S. flag carriers will be utilized to the extent such service is available?

Yes.

B. Construction

1. FAA Sec.601(d). If a capital (e.g., construction) project, are engineering and professional services of U.S. firms and their affiliates to be used to the maximum extent consistent with the national interest?

Yes.

2. FAA Sec.611(c). If contracts for construction are to be financed, will they be let on a competitive basis to maximum extent practicable?	Yes.
3. FAA Sec.620(k). If for construction of productive enterprise, will aggregate value of assistance to be furnished by the U.S. not exceed $100 million?	Aggregate value of U.S. assistance will not exceed $100 million.

C. Other Restrictions

1. FAA Sec.201(d). If development loans is interest rate at least 2 percent per annum during' grace period and at least 3 percent per annum thereafter?	Not applicable.
2. FAA Sec.301(d). If fund is established solely by U.S. contributions and administered by an international organization does Comptroller General have audit rights?	Not applicable.
3. FAA Sec. 620 (h). Do arrangements preclude promoting or assisting the foreign aid projects or activities of communist-bloc countries, contrary to the best interests of the U.S.?	Yes.
4. FAA Sec.636 (i). Is financing not permitted to be used, without waiver, for purchase, long-term lease, or exchange of motor vehicle manufactured outside the U.S. or guaranty of such transaction?	Such is not permitted.

5. Will arrangements preclude use of financing:

a. FAA Sec.114. to pay for performance of abortions or to motivate or coerce persons to practice abortions?	Yes.
b. FAA Sec.620(g). to compensate owners for expropriated nationalized property?	Yes
c. FAA Sec.660. to finance police training or other law enforcement assistance, except for narcotics programs?	Yes
d. FAA Sec.662. for CIA activities?	Yes.
e. App. Sec. 103. to pay pensions, etc., for military personnel?	Yes.
f. App. Sec.106. to pay U.S. assessments?	Yes.
g. App. Sec.107. to carry out provisions of FAA Sections 209(d) and 251(h) (transfer to multilateral organization for lending).	Yes.
h. App. Sec. 501. to be used for publicity or propaganda purposes within U.S. not authorized by Congress?	Yes.