PD-AAM-057

RURAL ELECTRIFICATION FEASIBILITY STUDIES

FOR

CENTRAL JAVA, INDONESIA

VOLUME 1

SUMMARY EVALUATION

NRECA INTERNATIONAL CONSULTING SERVICES

February 1978

ADDENDUM

On April 4, 1978 a review session for this report was held at PLN Pusat. Staff from USAID, the Subdirectorate for Rural Electrification (PLN) and the PLN Planning Division attended this meeting. It was requested by PLN that a summary of ideas and suggestions expressed at the meeting be summarized and included in Volume I of the report. The following represents this summary.

Load Development: In view that load estimates varied greatly between the preliminary and final feasibility studies, it was suggested by the NRECA Consultants that immediate attention be given to institute an action plan to monitor, evaluate and to encourage load development practices in the project sites. Particular attention should be placed on setting load development goals and the necessary activities and incentives to accomplish these goals, including the housewiring program recommended in the report, under the auspices of the Subdirectorate for Rural Electrification.

It was also suggested that the PLN Planning Division should use these load development goals and reports prepared by the Subdirectorate as a basis for making intermediate and long-range plans and decisions relative to power supply development and allocation in Central Java. In summarizing it was agreed that the best way to increase usage is by providing dependable 24 hour service at a low retail rate,and that electricity will sell itself when people learn its value to them.

Wholesale Power Cost Determination: Attached is a report form,required for submission by REA Power Supply borrowers, discussed at the meeting. The various line items and expenditures reported on the form were discussed. It was noted that these plant costs, the operating and maintenance costs and fuel costs are reported annually. It was suggested that a similar or modified PLN report should be developed which would lay the basis to determine what PLN incremental costs per KW and per KWH are, since power charges will be the major item of operational costs.

It was pointed out that the NRECA study team did not have access to this type of refined information and that the power costs used for analysis in Volume I of the report were based on team judgment, and that the 22 Rupiah/KWH for power costs to the metering point used in the Klaten Study obviously seemed excessive.

Economic System Design Planning: It was stressed by the NRECA Consultants that all engineering skills available should be used to keep the line investment per consumer and per KWH sold as low as possible. One technique suggested to accomplish this goal was to divide the project into sub-areas and concentrate on consumer connections before starting on the next section, etc. For example, by building say 10 Kilometer of the 3Ø feeder line and concentrating on secondaries and 1Ø laterals and service connections and perhaps, by doing so, setting a policy requiring so many energized services per kilometer of line before proceeding to the next sub-area. It was noted, however, that many local considerations must be considered before implementing such a plan.

Material Scheduling: For such scheduling it was suggested by the NRECA Consultants 3 month intervals be used and that these schedules include the following items:

a. Rupiah and dollar needs
b. Kilometers of line to be completed
c. Number of laborers required
d. Number of consumers to be energized
e. Kilometers of conductor
f. Number of poles
g. Number (and estimated sizes) of transformers
h. Number of meters
i. Miscellaneous hardware items

Cost Accounting: The importance of work planning and the preparation of project annual capital and operating budgets were discussed, and the importance of identifying key performance areas and measures was underlined by the NRECA Consultants. The measurements of consumer billing expenses and investment per KWH sold were used as examples. It was agreed that immediate attention should be given to these matters and that before project line construction commences, standardized rural project work order procedures and accounts be adopted by PLN.

Retail Rate Development: In view of the power cost analysis made in the report, indicating that power cost to the projects could be considerably lower than the 22 Rp. per KWH to the metering point assumed in the studies, it was suggested by the NRECA Consultants that the PLN Finance Division immediately re-analyze this projected cost of service to the projects, and thereafter commence a retail rate tariff study for the projects.

It was further suggested that the first tariffs adopted for the projects be designed to optimize simplicity and cost of service considerations. Since consumers shall be doing their own meter reading it was suggested that the tariffs be made for easy comprehension and application and should reflect the cash income and expenditure patterns of the rural farmer.

Project Organizational Implementation: In the development of the project organizational implementation plan, it was suggested by the NRECA Consultants that an analysis be made of potential cost savings that could be realized through centralized engineering and operation services, and that these findings be considered before finalizing such a plan.

Social Analysis: Since PLN does not have social scientists on employment, it was suggested by PLN that USAID assist them in recruiting personnel to design measurements to evaluate social benefits that will result from project implementation. Also, PLN stressed the merits of starting a pictorial record of activities in the project areas immediately.

A & E Services: PLN emphasized their requirement to USAID that all design proposals prepared by the A & E be accompanied by design reports substantiating that the most economical design has been proposed, and requested NRECA to provide them samples of rural electrification project construction schedules available.

STEAM-ELECTRIC GENERATING PLANT STATISTICS (Large Plants)

1. Large plants for the purpose of this schedule are steam plants of 25,000 kw or more of installed capacity (name plate rating). Include gas-turbine and internal combustion plants of 10,000 kw and more in this schedule. Include nuclear plants.
2. If any plant is leased or operated as a joint facility, indicate such facts by the use of asterisks and footnotes.
3. If net peak demand for 60 minutes is not available, give that which is available, specifying period.
4. If a group of employees attends more than one generating plant, report on line 11 the approximate average number of employees assignable to each plant.
5. If gas is used and purchased on a therm basis, the B.t.u. content of the gas should be given and the quantity of fuel burned converted to M cu. ft.
6. Quantities of fuel burned (line 38) and average cost per unit of fuel burned (line 41) should be consistent with charges to expense accounts 501 and 547 (line 42) as shown on line 21.
7. If more than one fuel is burned in a plant furnish only the composite heat rate for all fuels burned.
8. The items under cost of plant represent accounts or combinations of accounts prescribed by the Uniform System of Accounts. Production expenses do not include Purchased Power, System Control and Load Dispatching.

Line No.	Item (a)	Plant Name (b) ALMA			Plant Name (c) STONEMAN		
1	Kind of plant (steam, internal combustion, gas turbine or nuclear)	STEAM			STEAM		
2	Type of plant construction (conventional, outdoor boiler, full outdoor, etc.)	CONVENTIONAL			CONVENTIONAL		
3	Year originally constructed	1947			1950		
4	Year last unit was installed	1959			1954		
5	Total installed capacity (maximum generator name plate ratings in kw)	187,750			51,750		
6	Net peak demand on plant—kw. (60 minutes)	206,000			52,000		
7	Plant hours connected to load	8,610			5,507		
8	Net continuous plant capability, kilowatts						
9	(a) When not limited by condenser water	208,000			52,000		
10	(b) When limited by condenser water	205,500			NOT LIMITED		
11	Average number of employees	80			39		
12	Net generation, exclusive of plant use	818,601,300			152,110,000		
13	Cost of plant:						
14	Land and land rights	$ 287,969			$ 202,397		
15	Structures and improvements	5,533,021			1,775,490		
16	Equipment costs	29,073,813			7,512,015		
17	Total cost	$ 34,894,803			$ 9,494,902		
18	Cost per kw. of installed capacity (Line 5)	185.86			183.48		
19	Production expenses						
20	Operation supervision and engineering	$ 167,324			$ 40,988		
21	Fuel	9,281,740			1,842,675		
22	Coolants and water (nuclear plants only)	-			-		
23	Steam expenses	268,613			199,960		
24	Steam from other sources	-			-		
25	Steam transferred (Cr.)	-			-		
26	Electric expenses	323,261			217,525		
27	Misc. steam (or nuclear) power expenses	119,079			68,667		
28	Rents	2,597			1,222		
29	Maintenance supervision and engineering	53,942			13,168		
30	Maintenance of structures	76,789			7,973		
31	Maintenance of boiler (or reactor) plant	516,016			136,992		
32	Maintenance of electric plant	432,265			61,156		
33	Maint. of misc. steam (or nuclear) plant	16,050			8,792		
34	Total production expenses	$ 11,357,936			$ 2,599,341		
35	Expenses per net kwh. (Mills—2 places)	13.874			17.039		
36	Fuel: Kind (coal, gas, oil or nuclear)	COAL		OIL	COAL		OIL
37	Unit (Coal—tons of 2,000 lb.) (Oil—barrels of 42 gals.) (Gas—M cu. ft.) (Nuclear, indicate)	TONS		BARRELS	TONS		BARRELS
38	Quantity (units) of fuel burned	472,881		4,093	93,255		1,804
39	Average heat content of fuel burned (B.t.u. per lb. of coal, per gal. of oil, or per cu. ft. of gas) *	9,948		140,000	10,579		140,000
40	Average cost of fuel per unit, as delivered f.o.b. plant during year	$19.86		$14.08	$21.20		$14.29
41	Average cost of fuel per unit burned	$19.63			$19.76		
42	Avg. cost of fuel burned per million B.t.u.	98.41¢			92.90¢		
43	Avg. cost of fuel burned per kwh. net gen.	11.34 MILLS			12.11 MILLS		
44	Average B.t.u. per kwh. net generation	11,522			13,541		

* Nuclear, indicate units.

PART K

POWER SUPPLY FOR CENTRAL JAVA

K. POWER SUPPLY FOR CENTRAL JAVA.

Background Information:

The power sector currently consists of two major parts, the public sector, which is synonymous with PLN, the national power agency, and a large number of "captive" generating systems and minor distribution systems owned by hotels, industries and agricultural estates as well as a few small private local distribution systems. In 1976 the total generating capacity of PLN was 1,250 MW compared to 1,310 MW for the captive systems. The PLN total includes the 125 MW Juanda hydro station which is owned by the Jatiluhur (irrigation) Authority but which sells most of its electric power to PLN.

PLN was originally formed in 1945 and in 1954 was greatly expanded through its merger with three nationalized (formerly Dutch-owned private companies) utilities. A major change in the makeup of PLN occurred in 1972 following a study made by an IDA-financed consulting team. Among the changes was the creation of a national monopoly authority for all generation, transmission and distribution of electricity by Regulation 18-72. Under this authority any generation facility over 25 KW as well as any significant distribution system must be licenced by PLN. Until the reorganization the system had grown very little and was burdened with high operating costs and an old, obsolete generation and distribution system.

AID made its first loan (Tuntang Loan 019) to PLN in 1969 to rehabilitate generation and distribution systems in Central Java and this was followed by seven more loans through FY 1974 (total for eight loans - $132.4 million); however, for various reasons, no construction was actually started until 1974. IDA loans to PLN began in 1970 and to date IDA and IBRD loans total $348 million. Other foreign aid donors and commercial lenders have come in more recently and current plans call for PLN capital expenditures to reach about $1 billion annually by 1981 including about 75% foreign exchange.

Electric generation capacity of PLN has not increased substantially since 1970 and the increases that have occurred have come mostly from diesel stations and gas turbines. Generation of electricity has increased from 2,354 GWH in 1971 to 4,400 GWH in 1976 largely resulting from increased efficiency of existing equipment plus the addition of the interim generation capacity. Large new PLN steam stations at Semarang (AID Loan 024), Jakarta (IBRD) and Surabaya (Japanese loan) will be coming on the line within two years and generation is expected to increase sharply to over 10,000 GWH by 1981. Cost of generating power has been increasing from the use of interim equipment. The construction of efficient new facilities is expected to reduce the financial operating losses of past years to a comfortable surplus by the early 1980's.

On the consumption side PLN sold 3,250 GWH in 1976 and assuming an equal amount utilized by captive plants (no records available), the annual consumption per capita by Indonesia's 140 million citizens was 46 KWH, among the lowest in the world. This is used mostly in commercial and industrial (including estates) applications (40% of PLN and nearly all the captive) and by wealthier residents of a few large cities. Efforts to bring electricity to rural areas has followed two different lines. In areas outside of the PLN grid there are various programs of village electrification in which a small diesel or hydro generator of 300 KW or less is operated usually only at night to give power to public buildings, street lights and a few restaurants and private houses (usually less than 500 total connections). This effort is widespread and is being undertaken by both PLN and Departemen Dalam Negeri (Department of Internal Affairs, sometimes translated as Home Affairs) under various aid donor and GOI financing programs. In some areas conveniently located near the PLN grid, e.g., Bali, West Sumatra and North Sulawesi, PLN has extended its lines into the countryside where it is able to get two to ten percent of the rural residents to take the service even with a high connection charge.

In Central Java the PLN grid is further along in development than in most areas of the country. As of the end of 1978 the Province (including the Special District of Yogyakarta) will have over 500 Km of 150 KV transmission line tying together the major cities (and by 1981 tying into both Jakarta and Surabaya) and over 2,500 Km of recently installed pole distribution line sufficient for serving over 200,000 customers. In early 1977 the actual number of customers being served in the area was 182,000, most still connected to the obsolete systems being replaced (under AID Loans 019 and 025). Generation capacity in the area totalled 129 MW in 1977 but will be expanded to 229 MW on completion of the Semarang Steam Station (AID Loan - 024) by mid-1978. By 1981 three additional hydro units now under construction will add 26 MW capacity and the IBRD is planning to fund a new 200 MW steam unit in Semarang.

Peak generation in Central Java and Yogyakarta in February 1977 was 79,599 KW and 24,500,000 KWH were sold during the month. Of the 182,000 total customers, 126,000 are unmetered "social rate" connections, 34,000 are regular metered domestic customers, 16,000 are commercial customers and only 1,000 are small industry (minimum 13.5 KW). Sixty seven are large consumers (over 100 KW) which are connected for a total of 17,746 KW demand. The remainder are government buildings and street lights. - Project Paper Sept., 1977)

The monthly load factor for February 1977 was 24,500,000/(79,599) (672) = 45.8% which may be considered as a "typical" operating month for this report.

By mid-1978 it is expected that the 150 KV network tying Semarang, Magelang, Solo and Yogyakarta systems will be completed and connected to the new Semarang steam station of two 50 MW units. Also by mid-1978 the major load in Central Java will be inter connected to the 150 KV system. The capacity and capability of this interconnected system and the isolated system will be as follows:

		MW INSTALLED	MW CAPABILITY
HYDRO:	Tuntang	32.48	24.80
	Ketenger	7.04	4.00
	TOTAL HYDRO	39.52	28.80
GAS TURBINES:			
	Tuntang	55.90	51.00
	TOTAL GAS TURBINES:	55.90	51.00
DIESELS:			
	Tuntang	19.97	13.80
	Ketenger	17.15	13.00
	TOTAL DIESELS:	37.12	26.80
STEAM:	Tuntang	100.00	100.00
	TOTAL STEAM:	100.00	100.00
TOTAL GENERATION:		232.54	206.60
ISOLATED SYSTEMS:			
	Small Diesels	6.082	4.998
	Large Diesels	4.928	4.000
	TOTAL ISOLATED SYSTEMS:	11.01	8.988

The highest peak occurred in January 1977. Comparative system peaks are: (MW)

	JANUARY 1978	APRIL 1978
Tuntang	51.40	50.6
Ketenger	11.85	11.8
Isolated	4.43	4.3

The interconnected system (Tuntang plus Ketenger) will probably have a peak on the order of 70 MW in mid-1978 when Tuntang and Ketenger are interconnected.

We conclude from the preceding data together with the 5 year capital expenditure plan for fiscal 79/80 through fiscal 83/84 that PLN will have ample firm, regulated power available at the 20 KV bus to adequately serve the rural system loads. Of course, as loads grow, additional 20 KV bus capacity must be added.

Long term studies and plans made for expansion of PLN's generation and transmission facilities, which the feasibility plan reviewed, provide for load increase on exisiting distribution systems and for new loads in presently unserved areas. It is believed that PLN will be able to provide necessary firm regulated power to the rural projects as they grow, provided financing can be arranged. With no additions other than those described above, PLN's Central Java System with projected load growth probably would reach its capability in 1988 - 1990.

PLN's system has hydro - gas turbine - steam - diesel generating plants making actual cost of power difficult to forecast. To make the situation more complex, the largest units (Semarang steam) which will be base loaded are not presently on stream and have no historical costs in conjunction with other units. The Team believes, however, an approach using the new unit to calculate power costs for new load is valid. This approach assumes existing generation has all been "sold" and new loads must "buy" from new generation.

Calculating cost of power using anticipated per unit costs of Semarang steam units and the following data:

<u>Semarang Steam Plant</u>

Investment per kilowatt - Rp. 246,000 ($593)

System losses - % generation = 3%

Fuel cost - Rp. 22 per liter

Specific gravity of fuel (overage) = 0.955

Heat value - 9.500 KCAL/Kg

Net heat rate of gen. unit - 2,350 KCAL/KWH

The annual cost per kilowatt of generation and transmission investment has not been ascertained. Only assumptions can be made that hopefully are within reasonable attainability. Actual experience and detailed analysis of the plant accounts will give better values.

Generation cost of investment might be of the following order:

Interest	8%
Depreciation	2.9%
Operation and Maintenance	3.5%
Total:	14.4%

Calculated on KW basis:

$593 @ 14.4% = $85.39 year or $7.12/month

Energy cost can be calculated by the formula

$$\frac{\text{fuel cost/liter X net heat rate X 1.03}}{\text{specific gravity X heat value}}$$

Equals: $\frac{(22)\ (2350)\ (1.03)}{(0.955)\ (9500)}$ = Rp. 5.87 or 1.414¢/KWH

A reasonably loaded transmission system should not cost more than 4 mils (4/10¢) per KWH to deliver the energy. For example, 150 KM of double circuit 150 KV line might cost in the order of $15,000,000. This should deliver 150 MW. At 14.4% annual carrying charge, the annual expense would be $2,160,000 or $14.40 per KW per year. At 50% annual load factor the cost would be $0.0033 per KWH.

The rural loads will be small in relation to the PLN system load and should have no appreciable effect on the overall system load factor. Therefore, it could be argued that the effective cost to PLN and the wholesale rate charge to the rural systems could be based on the system load factor of 45.8%. Hence, the cost would be:

Demand @ $7.12 per month, and (8760/12) (0.458)

@ $0.01414 plus transmission costs of $0.0033 per KWH

= 3.87¢ per KWH = 16.1 Rp per KWH

Adding a contingency of 10% would bring the average charge per KWH to 4.26¢ or 17.7 Rupiah. It is believed that a charge of this order should be considered pending more and specific additional operating data from PLN.

PREPARED UNDER

TASK ORDER NO. 5

CONTRACT NO. AID/pha - 1090

PROJECT NO. 498-11-995-249

BETWEEN THE

UNITED STATES OF AMERICA

AGENCY FOR INTERNATIONAL DEVELOPMENT

AND THE

NATIONAL RURAL ELECTRIC COOPERATIVE ASSOCIATION

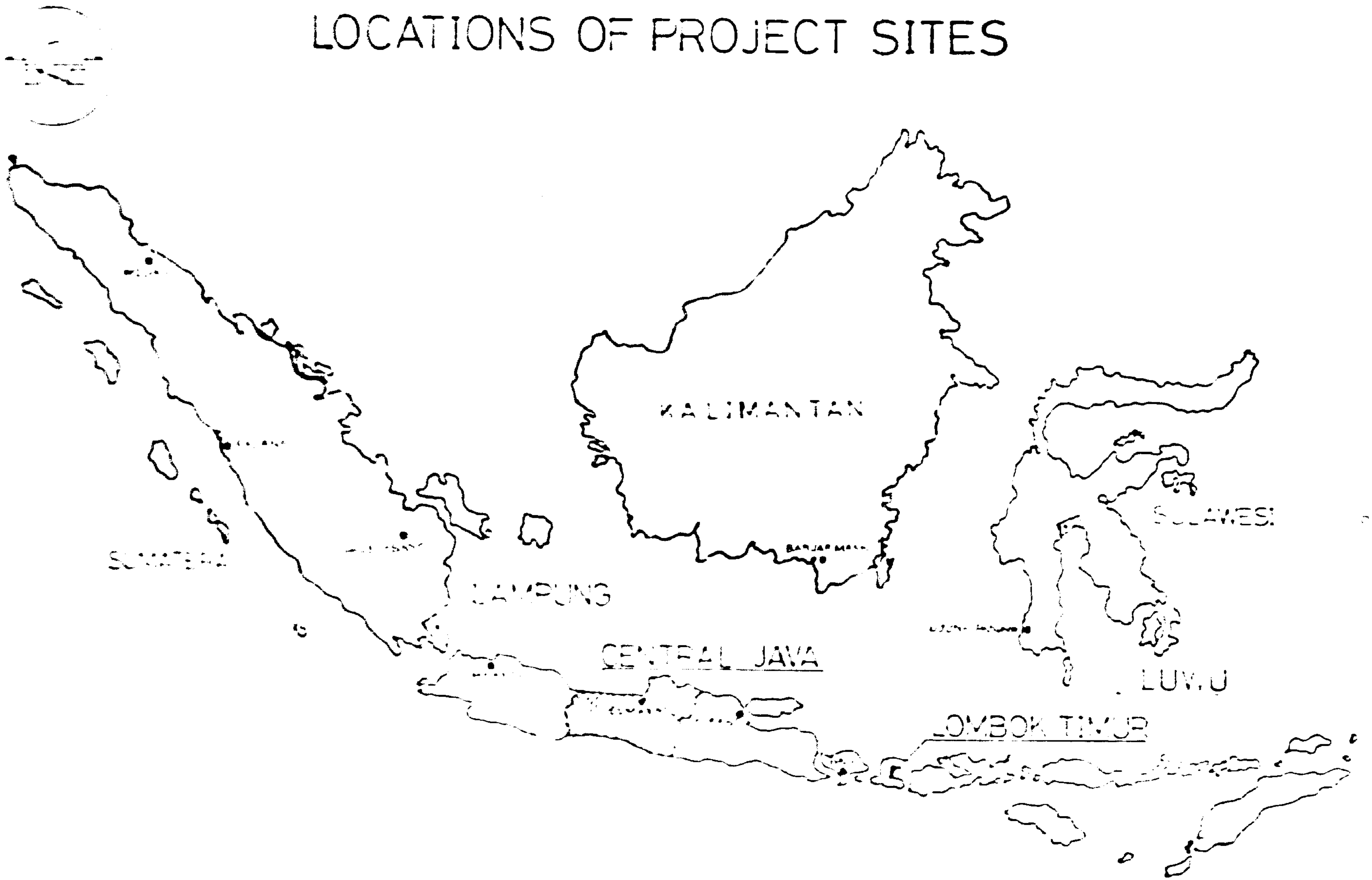
WASHINGTON, D.C.

March 1, 1977

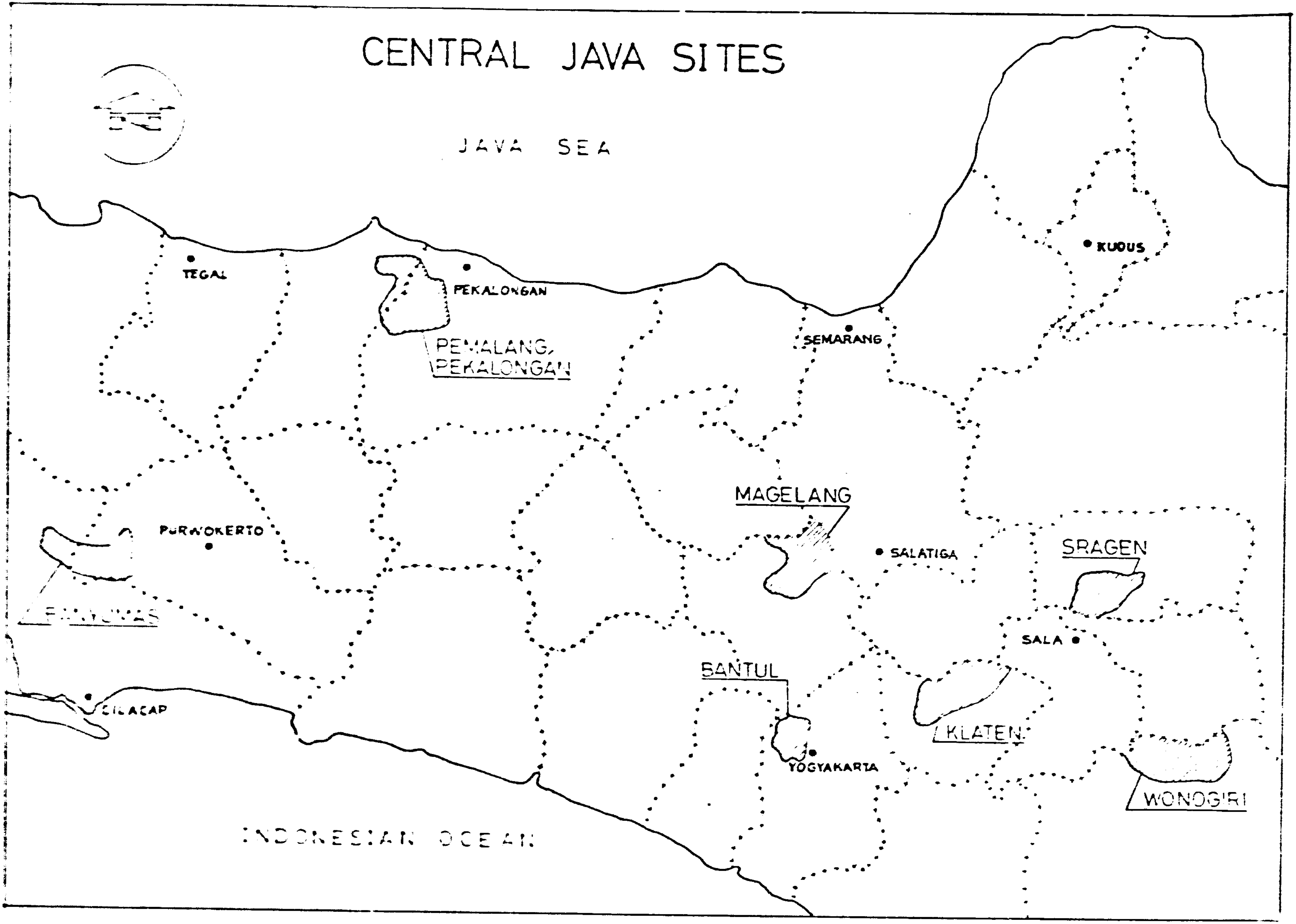
PIO/T 498-249-3-60279 and 498-249-3-6478013

March 2, 1977

LOCATIONS OF PROJECT SITES



CENTRAL JAVA SITES



4

PREFACE

This report is the last in a series of reports to be prepared by the NRECA Technical Assistance Team under contract with USAID, which required the preparation of ten feasibility studies for rural electric power systems in Indonesia, under the area coverage concept.

During August, 1977, the team issued four separate detailed feasibility reports covering project areas in North Central Klaten (Central Java), Central Lampung (Lampung), East Lombok (West Nusa Tenggara) and Luwu (South Sulawesi). The former study was prepared under the auspices of the Perusahaan Umum Listrik Negara (PLN), while the latter reports were prepared for implementation under the auspices of the Direktorat Jenderal Koperasi (DGC), Government of Indonesia.

This report is prepared for PLN and differs in format from the previously submitted reports in that six separate project areas are combined as one for this study report. Accordingly, the report is more extensive in scope and has been compiled in eight separate volumes. Volume 1 consists of summary evaluation comments of the project sites as extracted from the six financial forecasts prepared by PLN under the supervision of the NRECA Team.

Volume 2 consists of technical reference material assembled by the team which laid out the basic design and costing criteria used in financial forecast formulation. This document also includes a description of the sites under study and the numerous steps and analyses that were taken during study development.

The six individual financial forecasts comprise Volumes 3 through 8 of the report. The forecasts themselves were prepared by the PLN Wilayah XIII, Operating Division Staff in Semarang, Central Java under whose supervision the six project systems will be operated.

This volume, Volume 1, is divided into five parts. Part I consists of an evaluation of assumptions used in the financial forecasts and the load magnitudes assumed. Part II is an analysis and evaluation of plant design and costing. Operating expenses are evaluated in Part III, and the financial and economic evaluations of the six projects are performed in Part IV. Finally, retail rate levels and structures for the Central Java projects are discussed in Part V. The six project sites covered by the report are located in the Yogyakarta, Banyumas & Cilacap, Sragen, Pekalongan & Pemalang, Wonogiri, and Magelang areas of Central Java.

Special acknowledgment is made to the people and organizations who contributed to the report. Special appreciation for assistance is extended to Professor Suryono of PLN and his staff, including Ir. Soepangkat, Ir. Johannes J. Rumondor, and Ir. Moeljadi Oetji.

The cooperation of many individuals on the staff of USAID/Jakarta, under Director Thomas C. Niblock, was important in producing this report in its present form and on schedule. Invaluable support was given throughout study preparation by Mr. David C. Woody, Chief of Power, Transportation and Engineering, USAID, and by Mr. Jack A. Wright and Ir. Wahjoeni Muhardi.

Gratitude is finally extended to all the NRECA Advisory Team members assembled in Jakarta who had input in this final feasibility report, especially to Mr. William C. Wenner, Team Leader, under whose guidance and leadership the first four reports were prepared, and to Mr. Marion Schwartz and Mr. John Scoltock whose engineering research and concepts laid the foundation upon which these studies were prepared.

It is the hope of the Team that the concepts and findings of this report will prove to be of benefit to PLN, USAID/Jakarta and others involved in the implementation of the subject projects. Data in this report, refined to actual construction and operating statistics, will be useful to other projects. Success here will be an incentive for others to seek a similar remedy for electric power deficiencies in their respective areas. We believe that this report presents a reasonable and practical plan to bring benefits of electric service to a large number of rural people never before within reach of the opportunity.

Philip P. Costas, Economist
NRECA Team Leader

Harry W. Thiesfeld, PE
NRECA Engineer

INDONESIAN TERMS USED IN THIS REPORT

Bupati	Head of a kabupaten.
Camat	Head of a kecamatan.
Desa	Village or town.
Kabupaten	Administrative district below province level.
Kampung	Local district within a desa or town.
Kecamatan	Administrative district below kabupaten level.
Lurah	Official in charge of a desa or town.
Pusat	District center or headquarters.

CURRENCY AND MEASUREMENT EQUIVALENTS

US$1	=	415 Indonesian rupiah
Rp 1	=	US$.00241
1 mill	=	US$.001
1 kilometer	=	.6214 mile (about 5/8 mile)
1 mile	=	1.61 kilometers

ABBREVIATIONS

ADB	Asian Development Bank.
A & E	Architect and Engineering Firm.
AMPS	Ampere.
BAPPEDA	Provincial Economic Development Officer.
BAPPENAS	Planning Board of the Government of Indonesia.
BIMAS	Agriculture Credit Program.
BKK	Badan Kredit Kecamatan.
BRI	Bank Rakyat Indonesia.
CFC	National Rural Utilities Cooperative Finance Corporation (U.S.A.).
CIDA	Canadian International Development Agency.
COOP	Cooperative.
CP	Condition Precedent.
DGC	Directorate General of Cooperatives.
DSC	Debt Service Coverage.
GNP	Gross National Product.
GOI	Government of Indonesia.
GWH	Gigawatt hour, or a billion watt hours.
HP	Horsepower.
IDA	International Development Agency.
IBRD	World Bank.
IFB	Invitation for Bid.
IGGI	Intergovernmental Group for Indonesia, the Indonesian Foreign Aid consortium.
IPB	Institut Pertanian Bogor - the Agricultural College.
KM	Kilometer.
KV	Kilovolt or a thousand volts.

KVA	Kilovolt-Ampere.
KW	Kilowatt.
KWH	Kilowatt hour, or a thousand watt hour.
LEKNAS	National Institute of Economics and Social Research.
L.F.	Load Factor.
MW	Megawatt, or one million watts.
NEA	National Electric Administration of the Philippines.
NRECA	National Rural Electric Cooperative Association (U.S.A.).
OMT	Organizational, Management and Technical Team.
PACD	Project Assistance Completion Date.
PBS	Indonesian Control Bureau of Statistics.
PDO	Project Development Office of the Directorate General of Cooperatives.
PID	Project Identification Document.
PLN	Perusahaan Umum Listrik Negara, The National Electric Power Agency.
PP	The Project Paper.
PRP	Project Review Paper.
REA	Rural Electrification Administration (U.S. Department of Agriculture).
STM's	Technical High School.
TIER	Times Interest Earned Ratio.
USAID	United States Agency for International Development.
V	Volt.
VA	Volt-Ampere, approximately one watt.
W	Watt.

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PART I

LOAD AND ENERGY
FORECASTS

I. LOAD & USAGE FORECASTS.

A. General.

During the preparation of these studies, PLN conducted field load surveys in each project site. Desa household counts were checked with local officials and each operator of diesel generators in excess of 10-hp was interviewed. Analysis of pump irrigation demands was calculated based on the physiographic and the agricultural setting of each site.

Information on hand prepared for the project paper, especially the "Social Soundness" study included in the paper, and the social/economic studies prepared for each site by the faculty task team from the Department of Social Economics, Bogor Agricultural University (IPB), Bogor, Indonesia, were studied. The first feasibility report (North Central Klaten) prepared by the NRECA Team was analyzed in detail. Upon this data base, project consumer connection and usage assumptions were made.

For simplification, these assumptions can be summarized and compared to the consumer connection and usage assumptions made for the preliminary financial forecasts of the six sites included in the USAID Project Paper. In short, both consumer connection and usage estimates used for these studies were of lower value than those included in the Project Paper, with two notable exceptions. The PLN studies assume a slightly greater number of potential small commercial and grain mill consumer connections.

B. Consumer Assumptions.

At the fifteenth year of the project forecasts, 190,350 residential; 11,381 small commercial; 70 irrigation; 263 grain mill and 131 miscellaneous power consumer connections are assumed. In the pre-feasibility forecasts, 204,950; 11,010; 210;206 and 622 consumer connections were respectively estimated. A slightly more conservative assumption of consumer connections therefore is made in the PLN studies.

C. Usage Assumptions.

At the fifteenth year of the project forecasts, average monthly usage for residential consumers is assumed to reach 50.4 KWH; 151 KWH for small commercial users; 1,150 KWH for irrigation pumps; 2,621 KWH for grain mills and 6,250 KWH for miscellaneous power consumers. For the project paper, 58.3; 362; 2,685; 5,760 and 4,208 KWH respectively per consumer class were assumed. Therefore, except for anticipated average miscellaneous power consumer usage, usage assumptions used in the project studies are more conservative than the initial assumptions used in the project paper.

D. MW Demand Estimates.

Accordingly, MW demand estimates used in this report are of lower magnitude than those derived in the earlier studies. Combined demand for these six project studies is estimated to be 9.4 MW during the first year of project operations, and is expected to increase to 64.7 MW at the end of the forecast period. For the same six projects, MW demand was previously estimated to start at the level of 14.8 during the first year of operation and reach 93.9 MW during the fifteenth year of project operations.

E. Conclusion.

In summary, after re-evaluation of potential usage and consumer connections in the Central Java Area by the PLN staff, it appears likely that the load demand created by these six projects will reach only levels of 70% of those previously estimated. Based on this finding, and the disparity in the estimates involved, it is strongly recommended to PLN that these load estimates be re-evaluated once actual operations of the six projects are underway.

RECAP OF CENTRAL JAVA PROJECTS
(DIESEL SURVEY-OCTOBER 1977)

DIESEL HP SIZE GROUPING FOR RICE MILLS	1 MAGELANG			2 PEMALANG			3 PURWOKERTO			4 WONOGIRI			5 BANTUL			6 SRAGEN		
	NO	HRS MO	% CON INT	NO	HRS MO	% CON INT	NO	HRS MO	% CON INT	NO	HRS MO	% CON INT	NO	HRS MO	% CON INT	NO	HRS MO	% CON INT
10-14 HP	11	74	100	1	125	100	2	90	100	5	190	-	11	164	100	4	170	100
15-19 HP	1	90	100	7	150	100	3	220	100	9	150	-	8	160	100	9	190	100
20-24 HP	3	110	100	7	150	100	3	90	100	5	128	-	3	159	100	9	180	100
25-29 HP	-	-	-	2	175	100	2	120	100	1	150	-	1	180	100	3	168	100
30-39 HP	1	90	100	1	175	100	1	180	100	-	-	-	5	169	100	4	165	100
40-49 HP	1	90	100	1	175	100	2	135	100	1	120	-	1	130	100	4	200	100
OVER 50 HP	1	90	100	-	-	-	-	-	-	-	-	-	-	-	-	2	210	100
TOTAL RICE MILLS	18	-	100	19	-	100	13	-	100	21	-	-	29	-	-	37	-	100
RURAL ELECTRIFICATION PUBLIC	2	300	100	-	-	-	1	360	-	1	390	-	10	360	100	2	375	100
TAHU FACTORY (15-19 HP)	3	190	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ICE FACTORY(18 HP)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	180	100
WATER PUMP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	360	100
PLYWOOD/BAMBOO (HANDICRAFT (64 HP)	-	-	-	-	-	-	-	-	-	-	-	-	1	210	-	-	-	-
ROOF TILE INDUSTRY (76 HP)	-	-	-	-	-	-	-	-	-	-	-	-	1	210	-	-	-	-
TAPIOCA FACTORY (151 HP)	-	-	-	-	-	-	1	330	YES	-	-	-	-	-	-	-	-	-
POPSICLE FACTORY (60 HP)	-	-	-	-	-	-	1	360	YES	-	-	-	-	-	-	-	-	-
CINEMA (21.5 HP)	-	-	-	1	180	YES	1	150	YES	-	-	-	-	-	-	-	-	-
PRIVATE (34 HP)	-	-	-	-	-	-	1	240	-	-	-	-	-	-	-	-	-	-
IRRIGATION PUMPS	-	-	-	3	150	100	-	-	-	-	-	-	-	-	-	-	-	-
T O T A L	23			23			18			22			41			41		

RECAP OF CENTRAL JAVA PROJECTS
(PROJECT ASSUMPTIONS - 15th YEAR OF OPERATIONS)

PROJECT	STUDY	NO. DESAS	RESIDENT'L LOAD		S.COMM. LOAD		STREET LIGHTS PER DESA	IRRIGAT'N. LOAD			GRAIN MILLS			WATER SYSTEMS			MISC. CONS.		SYSTEM LOSS %	LOAD FACTOR %	POWER COST (c KWH)	AVG.KWH(c) SELLING PR.	
			Cons.	KWH	Cons.	KWH		Pumps	KW	HRS	Mills	KW	HRS	No.	KW	HRS	NO.	KWH				RSDL.	MISC.
PEMALANG:	PROJECT PAPER	101	48700	59	2460	360	23	35	11	100	28	18	320	758	.4	90	46	5000	11	32	7.0	12.5	4.3
	PLN REV'N.	103	43600	51.85	2630	155.6	23	10	27	335	33	20	135	780	.4	90	27	6250	11	32	7.0	12.5	5.8
PURWOKERTO:	PROJECT PAPER	35	26900	59	1485	360	22	35	11	100	28	18	320	270	.4	90	46	5000	11	32	7.0	12.5	4.3
	PLN REV'N.	35	28600	48.8	1716	146.4	23	15	7.5	335	30	15	162	270	.4	90	22	6250	11	32	7.0	12.6	5.8
MAGELANG:	PROJECT PAPER	83	36350	59	2000	360	23	35	11	100	36	18	320	630	.4	90	8	6250	11	32	7.0	12.5	4.3
	PLN REV'N.	83	29450	48.8	1770	146.4	23	-	-	-	42	14	162	630	.4	90	28	6250	11	32	7.0	12.6	5.8
WONOGIRI:	PROJECT PAPER	74	30000	57	1565	366	23	35	11	100	29	18	320	592	.4	90	238	2500	11	32	7.0	12.5	4.3
	PLN Rev'N.	54	28400	48.8	1700	146.4	23	15	7.4	335	21	20	135	405	.4	90	15	6250	11	32	7.0	12.6	5.6
BANTUL:	PROJECT PAPER	21	36000	59	2000	366	23	35	11	100	60	18	320	450	.4	90	46	5000	11	32	7.0	12.5	4.3
	PLN REV'N.	21	31300	55	1875	165	23	15	7.5	335	100	16	135	165	.4	90	11	6250	11	32	7.0	12.5	5.8
SRAGEN:	PROJECT PAPER	47	27000	57	1500	360	23	35	11	100	25	18	320	407	.4	90	238	2500	11	32	7.5	12.5	4.3
	PLN REV'N.	49	29000	48.8	1700	146.4	23	15	8	335	37	24	135	375	.4	90	28	6250	11	32	6.7	12.6	5.6
TOTALS:	PROJECT P.	361	204950		11010			210			206			3107			622						
AVG.				58.3		362	23		11	335		18	320		.4	90		4208	11	32	7.0	12.5	4.3
	PLN REV'N.	345	190350		11381			70			263			2625			131						
[illegible]				50.4		151	23		11.5	100		15.2	144		.4	90		6250	11	32	7.0	12.6	5.8

PART II

DESIGN AND COSTING OF PLANT

II. DESIGN AND COSTING OF PLANT

A. The Distribution Plant.

The basic circuitry design used is to provide electric service to the designated "project" area in accordance with the site selection criteria discussed elsewhere. The areas studied were not necessarily defined by geographic or physical boundaries and in many instances there are unserved areas of similar density on the periphery. Furthermore, field inspection also revealed that many sections of the three phase 20 KV line will be a "feeder" line for service areas beyond the project. In this context, the design engineer may wish to question the wisdom of tapering the conductor size down if there is the likelihood of near future extension into the periphery areas.

The density is of the order of 75 consumers per kilometer of line (120 per mile). About 70% of the primary line has secondary underbuild. This ratio appears somewhat higher than anticipated by the Team. The total kilometers of low-voltage secondary generally exceeds the distance of the primary (11.55 KV) lines. People live in close proximity in Desa and Villages leaving as much tillable land as possible for agriculture.

The Team estimated a lesser line loss than used in the studies. About 65% of the distribution transformer KVA will be in 25 KVA size. There will probably be about twice as much KVA in sizes larger than 25 KVA compared to KVA in sizes smaller than 25. Using the core and "copper" losses of the 25 KVA size would be a conservative estimate of losses. Losses due to squared current times resistance in the line would be negligible in early years and minimum in the later study years. Technical operational engineering will in fact monitor the system in future years to ascertain the most economical operation. (See Table on Computed Revised Losses).

An evaluation was made of the proposed installed distribution transformer KVA in relation to the diversified demand at the metering points. The ratio obviously high (and necessarily so) in the early years is expected to drop to 3 to 1 by the 5th year and then decrease to the order of 2 to 1 by the 15th year. With distribution transformers accounting for approximately 15% of the distribution plant investment and up to 90% of the system losses it is incumbent to use prudent judgment not to install and energize excessive sizes of transformers.

The "standard" kilometer method used in estimating construction costs contains 16 to 17 poles per kilometer for the large conductor size 3 ϕ lines compared to 12 to 13 poles per kilometer for the 1 ϕ lines. Since it is probable that a higher percentage of the 1 ϕ lines will have secondary underbuild, it would appear that there is a margin for pessimism in the costs of the multiphase lines. By the use of relative long ruling span staking design for the multiphase lines, it would appear that lesser units and lesser costs could be realized.

Attention is called to the fact that material prices were obtained several months ago and were not expected to be valid after March 1978. Inflation will undoubtedly add to the prices by the time firm Material Contracts can be executed for construction materials.

Some of the three phase 20 KV lines included in these report studies have been constructed from USAID funds using painted tubular steel poles and specifications not contemplated in this study. Since not all areas have been field-checked recently, it is not possible to specifically identify each instance, but to suggest that the A & E firm satisfy themselves as to what each study area will require.

B. The General Plant.

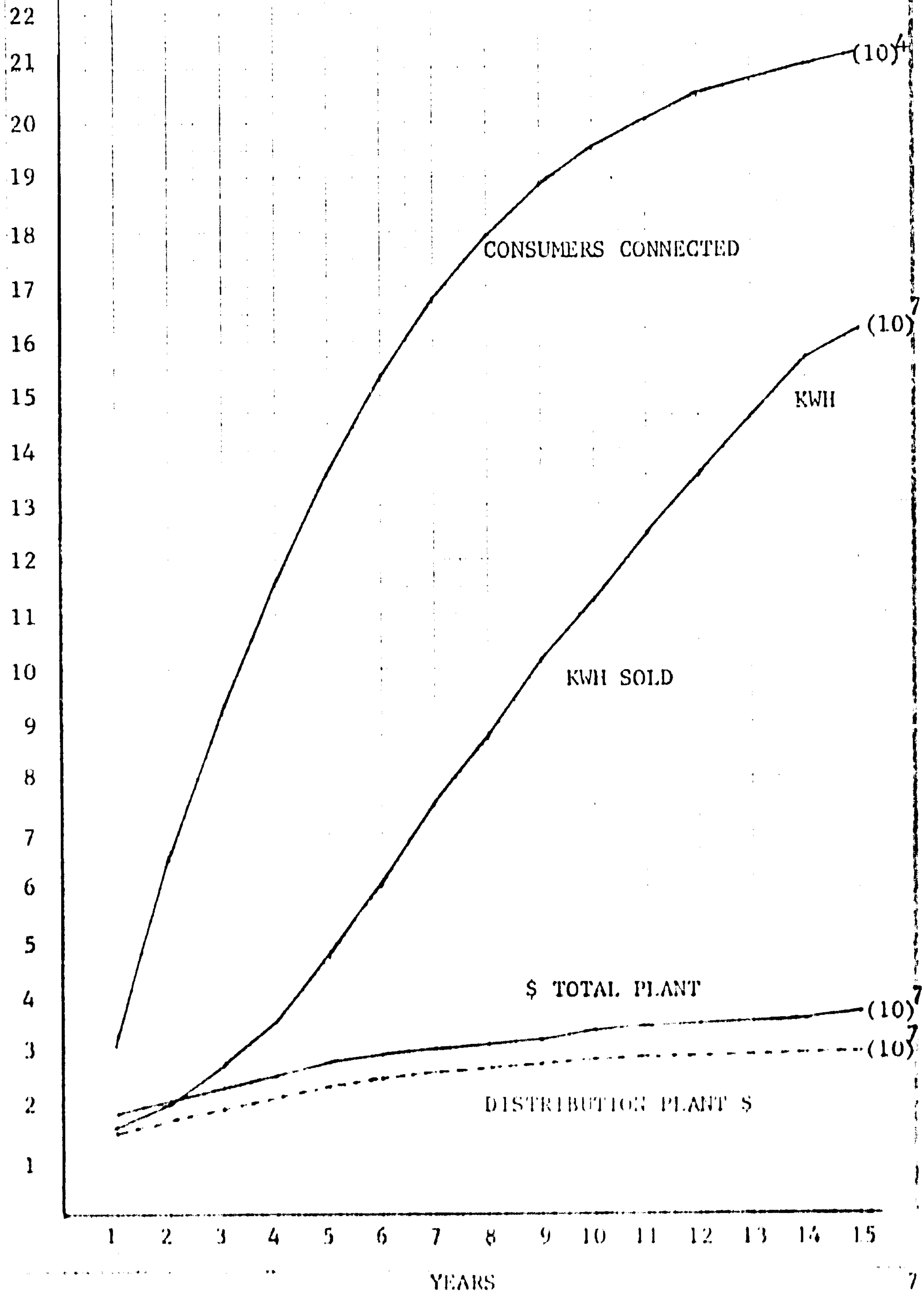
Over $7 million is included in the six project studies prepared by PLN including $344,000 for contingencies for General Plant. Since PLN is an on-going organization having, in general, the District and sub-District offices staffed and equipped with office and communication equipment for their nominal operations, the team questions the need for six additional general plants of headquarters, warehouses, staff-housing, communications equipment, transportation, laboratory and office equipment, plus contingencies. A careful evaluation is suggested with a view of using most, if not all, of these funds for line construction to provide electrical service to additional rural consumers.

C. Conclusion.

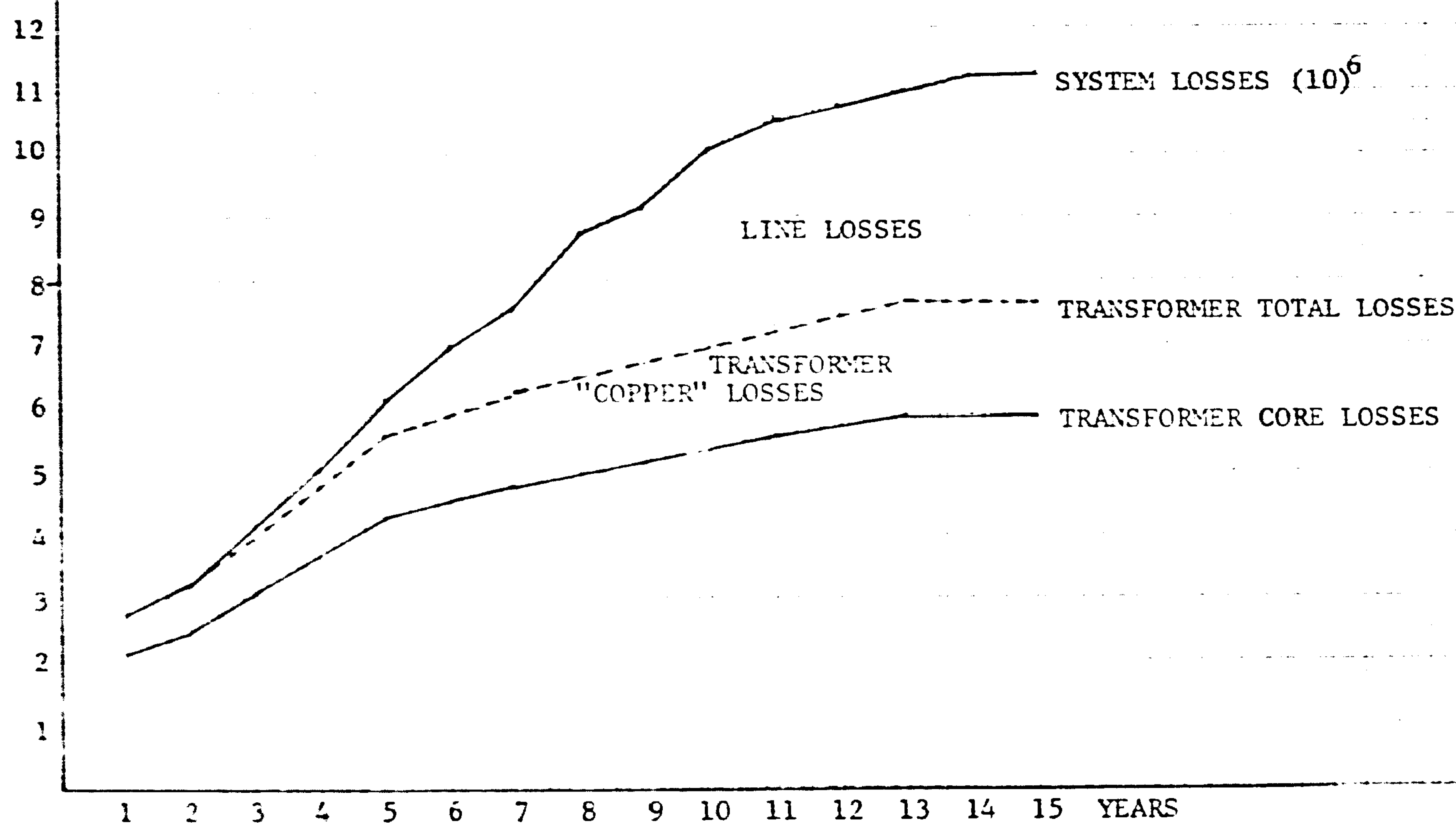
In total it would appear that the estimate for rural distribution lines is reasonable based on prices obtained for this report and should be generally adequate for ascertaining anticipated loan amounts. A "change of purpose" should be considered to transfer most or all of the general plant funds to distribution plant which should absorb some inflation costs due to delay in implementation.

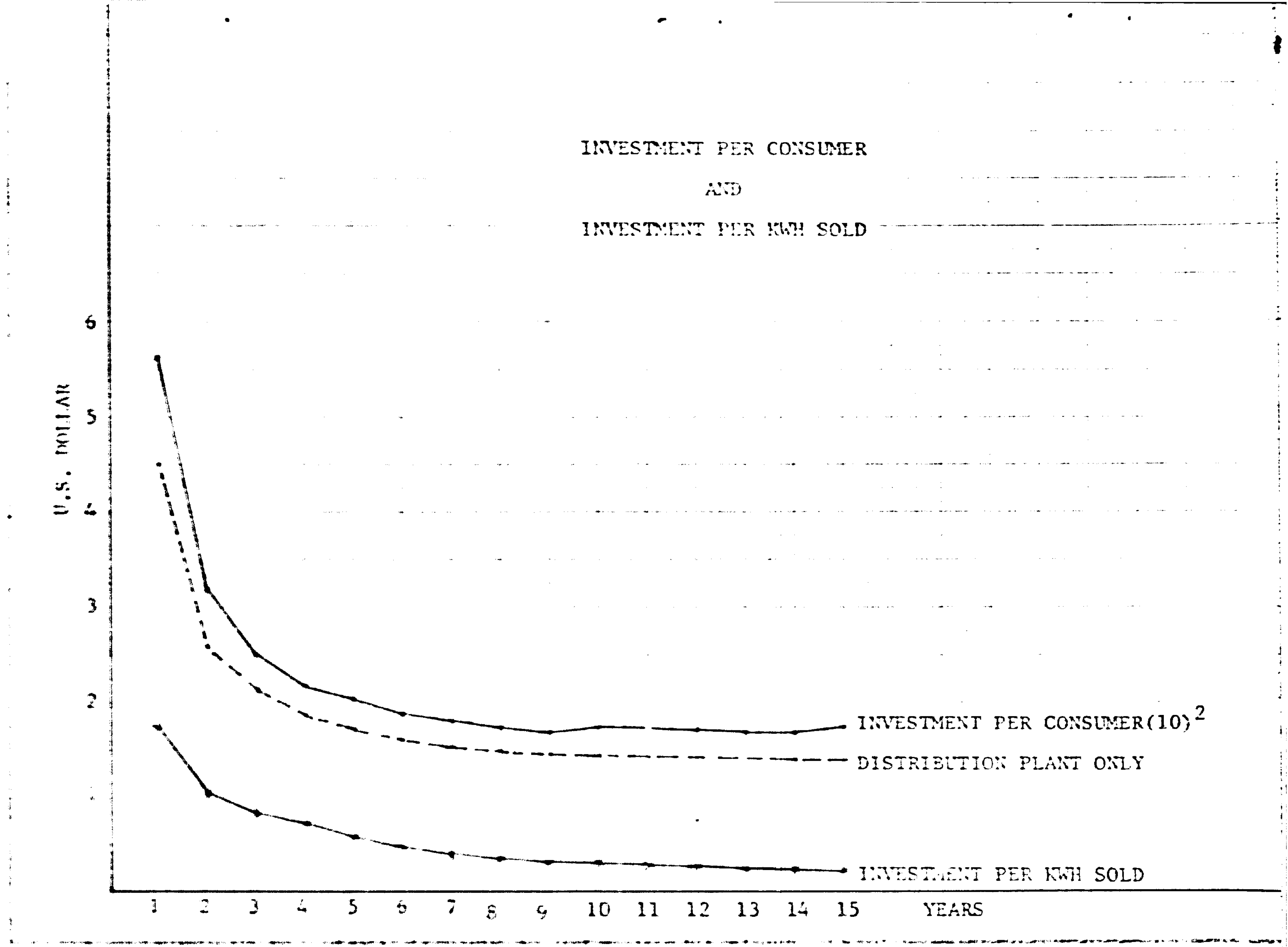
PLANT AND LOAD

BASIC ASSUMPTIONS OF SIX PLN SYSTEMS

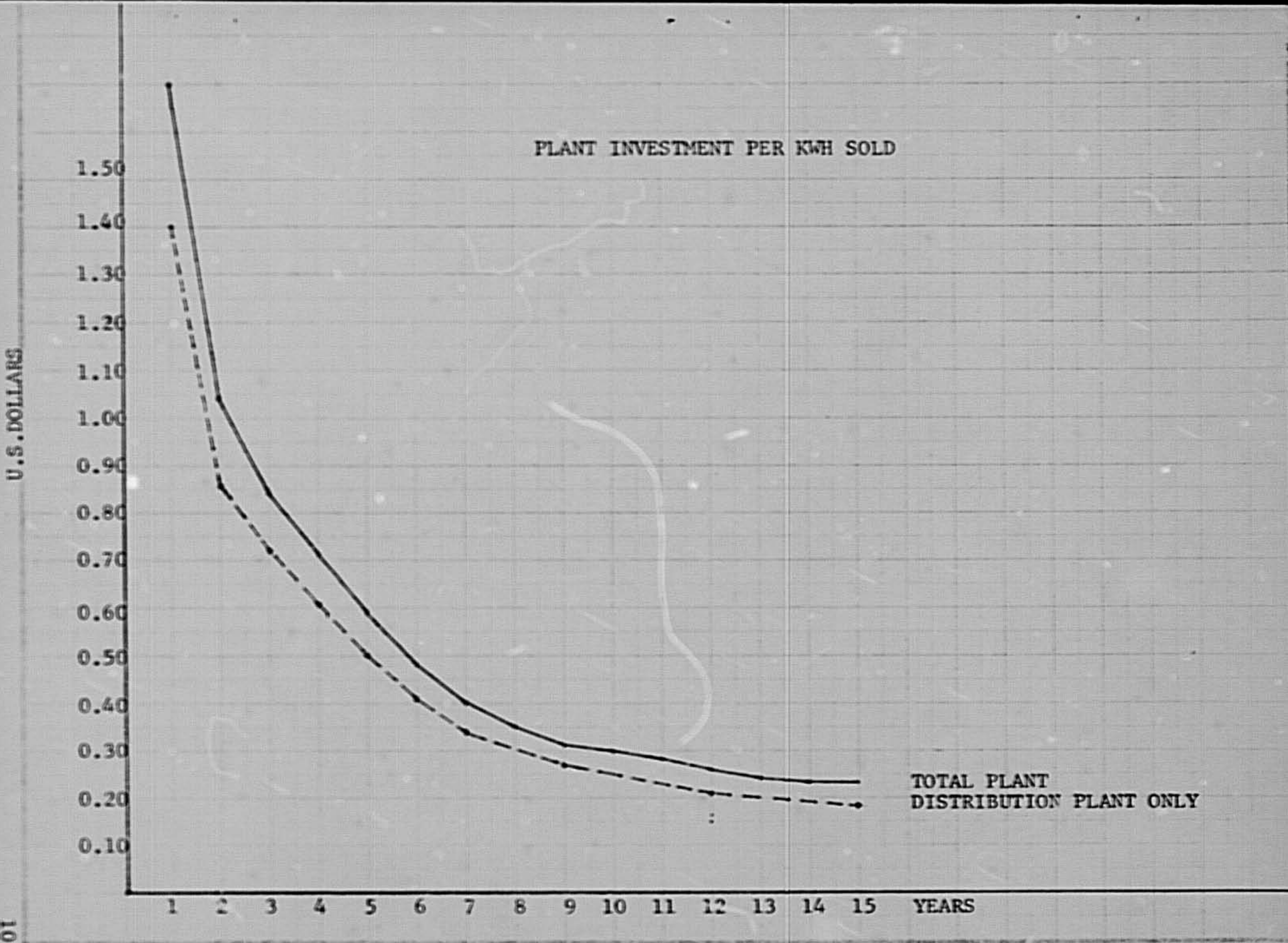


COMPUTED ANNUAL SYSTEM LOSSES IN MWH





INVESTMENT PER CONSUMER
AND
INVESTMENT PER KWH SOLD
U.S. DOLLAR
6
5
4
3
2
INVESTMENT PER CONSUMER(10)^2
DISTRIBUTION PLANT ONLY
INVESTMENT PER KWH SOLD
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
YEARS



PLANT INVESTMENT PER KWH SOLD
U.S. DOLLARS
1.50
1.40
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
YEARS
TOTAL PLANT
DISTRIBUTION PLANT ONLY

CONSUMERS SERVED $(10)^3$							
YR	JOGYA	WONOGIRI	BANYUMAS	PEKALONGAN	MAGELANG	SRAGEN	TOTALS
1	5346	5098	3665	8712	5409	4615	32,845
2	10730	9938	9284	15257	10423	9771	65,403
3	15043	13852	13605	21496	14710	14126	92,832
4	18532	16932	17358	27056	18360	17830	116,068
5	21501	19554	20581	32064	21262	21253	136,215
6	23939	21918	23273	36524	23656	24266	153,576
7	25928	24019	25440	39958	25774	26672	167,791
8	27604	25858	27187	42518	27628	28388	179,183
9	29020	27390	28514	44350	29212	29582	188,068
10	30173	28616	29425	45702	30531	30373	194,890
11	31107	29635	30166	46821	31590	30938	200,257
12	31928	30444	30607	47683	32390	31392	204,444
13	32636	31019	30941	48341	32978	31739	207,654
14	33240	31422	31191	48847	33406	32005	210,111
15	33737	31703	31390	49276	33726	32217	212,049

K.W. DEMAND							
YR	JOGYA	WONOGIRI	BANYUMAS	PEKALONGAN	MAGELANG	SRAGEN	TOTALS
1	1300	1370	1160	2600	1550	1390	9,370
2	2500	2410	2430	4180	2520	2600	16,640
3	4200	3130	3250	5430	3380	3500	22,890
4	4900	3600	3860	6410	3970	4080	26,820
5	6000	4450	4200	7220	4880	5150	33,400
6	7200	5330	5820	9650	5800	6170	39,970
7	8500	6310	6820	11340	6820	7300	47,160
8	8800	6780	7310	12050	7320	7220	49,480
9	9300	7180	7670	12500	7760	8150	52,560
10	9700	7340	7750	12580	7940	8210	53,520
11	9900	7560	8210	13270	8500	8660	56,400
12	10300	8170	8420	13670	8860	9000	58,420
13	10800	8650	8880	14390	9370	9400	61,510
14	11000	8830	9020	14630	9570	9600	62,750
15	11430	9070	9300	15100	9900	9900	64,700

MWH SOLD							
YR	JOGYA	WONOGIRI	BANYUMAS	PEKALONGAN	MAGELANG	SRAGEN	TOTALS
1	1888	1483	1249	2814	1677	1505	10,616
2	3748	2803	2825	4861	2930	3029	20,196
3	5248	2909	4049	6765	4214	4362	27,547
4	6627	4796	5135	8531	5287	5438	35,814
5	8603	6364	6950	11333	6925	7317	47,492
6	10861	8052	8773	14550	8755	9318	60,309
7	13599	10104	11020	18138	10916	11678	75,455
8	15630	11982	12914	21288	12930	12757	87,501
9	18016	13903	14853	24199	15024	15787	101,782
10	19782	15493	16353	26544	16750	17321	112,293
11	22024	17385	18142	29332	18805	19143	124,831
12	23861	18207	19480	31630	20485	20640	135,003
13	25834	20689	21217	34380	22387	22476	146,983
14	27574	22046	22497	36500	23874	23901	156,392
15	28399	22653	23167	37674	24738	24464	161,095

PLANT INVESTMENT $(10)^3$							
YR	JOGYA	WONOGIRI	BANYUMAS	PEKALONGAN	MAGELANG	SRAGEN	TOTALS
1	3019	3282	2563	3696	2901	2999	18,460
2	3403	3622	2945	4261	3255	3421	20,907
3	3747	3934	3305	4832	3607	3799	23,224
4	4052	4193	3612	5324	3896	4189	25,266
5	4437	4550	4098	5884	4259	4603	27,831
6	4614	4737	4292	6209	4454	4797	29,103
7	4774	4904	4447	6426	4626	4989	30,166
8	4890	5032	4558	6597	4757	5097	30,931
9	5022	5163	4666	6737	4894	5198	31,680
10	5392	5525	5004	7119	5313	5540	33,893
11	5488	5624	5070	7235	5405	5606	34,431
12	5558	5683	5110	7303	5466	5653	34,773
13	5619	5731	5144	7378	5517	5696	35,085
14	5649	5755	5162	7405	5540	5717	35,228
15	5881	5975	5377	7638	5763	5991	36,625

PRIMARY DISTRIBUTION LINES (KM)							
YR	JOGYA	WONOGIRI	BANYUMAS	PEKALONGAN	MAGELANG	SRAGEN	TOTALS
1	201	256	131	273	202	215	1278
2	201	256	132	273	202	215	1279
3	201	256	132	273	202	215	1279
4	201	256	133	273	202	215	1280
5	201	256	133	273	202	215	1280
6	201	256	134	273	202	215	1281
7	201	256	134	273	202	215	1281
8	201	256	135	273	202	217	1284
9	201	257	136	273	202	218	1287
10	201	257	136	273	202	221	1290
11	201	258	137	273	202	223	1294
12	201	259	138	273	202	225	1298
13	201	260	138	273	202	227	1301
14	201	261	139	273	202	229	1305
15	201	261	139	273	202	231	1307

UNDERBUILD SECONDARY LINE (KM)							
YR	JOGYA	WONOGIRI	BANYUMAS	PEKALONGAN	MAGELANG	SRAGEN	TOTALS
1	150	191	93	197	146	108	885
2	150	191	94	197	146	108	886
3	151	191	94	197	147	108	888
4	151	191	95	198	147	108	890
5	151	191	95	198	148	108	891
6	152	191	96	198	148	108	893
7	152	191	96	200	149	108	896
8	152	191	97	200	149	109	898
9	154	192	98	200	149	110	903
10	154	192	98	200	149	111	904
11	154	193	99	200	150	112	908
12	156	194	100	200	151	113	914
13	156	195	100	200	151	114	916
14	156	196	101	200	152	115	920
15	158	196	101	201	152	116	924

TRANSFORMER K.V.A.							
YR	JOGYA	WONOGIRI	BANYUMAS	PEKALONGAN	MAGELANG	SRAGEN	TOTALS
1	8400	6260	6500	10860	6720	7000	45740
2	9800	7200	7720	12820	7940	8160	53640
3	12000	8960	9800	15980	9760	10300	66800
4	14400	10660	11640	19300	11600	12340	79940
5	17000	12620	13780	22680	13640	14600	94320
6	17600	13560	14620	24100	14640	14600	99120
7	18600	14360	15340	25000	15520	16300	105120
8	18800	14680	15500	25160	15880	16410	106430
9	19800	15720	16420	26540	17000	17320	112800
10	20600	16340	16840	27340	17720	18000	116840
11	21600	17300	17760	28780	18740	18800	122980
12	22000	17660	18040	29260	19140	19200	125300
13	22800	18140	18600	30200	19800	19800	129340
14	22800	18140	18600	30200	19800	19800	129340
15	22800	18140	18600	30200	19800	19800	129340

SECONDARY LINE (KM)							
YR	JOGYA	WONOGIRI	BANYUMAS	PEKALONGAN	MAGELANG	RAGEN	TOTALS
1	146	129	136	94	137	139	78
2	164	147	158	130	154	162	915
3	180	163	175	164	170	182	1034
4	193	177	189	190	183	196	1128
5	204	189	200	210	195	206	1204
6	213	198	208	225	205	212	1261
7	220	206	214	235	213	216	1304
8	226	212	218	243	219	219	1337
9	232	216	221	249	224	221	1363
10	237	219	223	253	227	223	1382
11	241	221	224	256	229	224	1395
12	244	222	225	258	230	225	1404
13	244	222	225	260	230	225	1406
14	244	222	225	260	230	225	1406
15	244	222	225	260	230	225	1406

COMPUTED LOSSES CALCULATED FROM TRANSFORMER KVA (1) AND REVISED POWER COST (2)								
YR	Trans. KVA	MWH Core Losses	MWH "Copper" Losses	MWH Line Losses	MWH Total Losses	MWH Sold	Revised MWH Purchases	Revised(2) Power Cost
1	45,740	2,085	631	44	2,760	10,616	13,376	570
2	53,640	2,444	745	42	3,231	20,196	23,427	998
3	66,800	3,040	920	172	4,132	27,547	31,679	1,344
4	79,940	3,644	1,104	266	5,014	35,814	40,828	1,739
5	94,320	4,292	1,305	577	6,174	47,492	53,666	2,286
6	99,120	4,511	1,375	1,048	6,634	60,309	66,943	2,852
7	105,120	4,792	1,454	1,299	7,545	75,455	83,000	3,536
8	106,430	4,844	1,472	2,434	8,750	87,501	96,251	4,100
9	112,800	5,142	1,559	2,458	9,159	101,942	110,942	4,726
10	116,840	5,326	1,621	3,159	10,106	112,293	122,399	5,214
11	122,980	5,597	1,699	3,314	10,610	124,831	135,441	5,770
12	125,300	5,712	1,734	3,354	10,800	135,003	145,803	6,211
13	129,340	5,895	1,787	3,342	11,024	146,983	158,007	6,731
14	129,340	5,895	1,787	3,565	10,947	156,392	167,339	7,129
15	129,340	5,895	1,787	3,595	11,277	161,095	172,372	7,343

(1) Assume 5.2 watts per KVA for core loss and 15.8 watts per KVA for "copper" losses in trans. Loss factor=0.11. (2)Pwr.Cst @ 17.7Rp (4.26¢)xKWH x $1,000.

REVISED EXPENSES				
YR	Revised(3) TOTAL EXPENSES	Add (4) for 8% Interest	2nd Rev. TOTAL EXPENSES	Revised Expenses per KWH
1	2,122	-0-	2,122	20.0¢
2	2,814	-0-	2,814	13.9¢
3	3,397	-0-	3,397	12.3¢
4	4,230	61	4,291	12.0¢
5	5,005	197	5,202	11.0¢
6	5,798	314	6,112	10.1¢
7	6,885	394	7,279	9.6¢
8	7,548	454	8,002	9.1¢
9	8,475	505	8,980	8.8¢
10	9,355	599	9,954	8.7¢
11	10,086	680	10,766	8.6¢
12	10,587	686	11,273	8.4¢
13	11,436	682	12,118	8.2¢
14	11,940	617	12,557	8.0¢
15	12,173	649	12,822	8.0¢

(3)Using power costs at 4.26¢ per KWH
(4)Assumes all capital funds borrowed after 3rd year will bear 8% interest.

PER UNIT CALCULATIONS

YR	INVESTMENT per KWH sold	INVESTMENT per Consumer	REVENUE per KWH	EXPENSES per KWH	PWR COST per KWH	EXPENSES less Pwr Cost/KWH	TRANS. KVA per KW Demand	
1	$1.74	562.03	12.26¢	21.23¢	6.61¢	14.62¢	4.88	
2	1.04	319.66	12.58	15.63	6.64	8.99	3.22	
3	0.84	250.17	13.04	14.64	7.22	7.43	2.92	
4	0.71	217.68	12.53	13.96	7.00	6.96	2.98	
5	0.59	204.32	12.43	12.76	7.03	5.73	2.82	
6	0.48	189.50	12.19	12.05	7.16	4.88	2.48	
7	0.40	179.78	12.29	11.64	7.20	4.44	2.23	
8	0.35	172.62	12.36	11.17	7.23	3.94	2.15	
9	0.31	168.45	12.12	10.95	7.27	3.68	2.15	
10	0.30	173.91	12.03	10.98	7.30	3.69	2.18	
11	0.28	171.93	11.96	10.90	7.42	3.48	2.18	
12	0.26	170.09	11.93	10.71	7.47	3.24	2.14	
13	0.24	168.96	11.84	10.81	7.59	3.22	2.10	
14	0.23	167.66	11.79	10.69	7.61	3.08	2.06	
15	0.23	172.72	11.74	10.87	7.87	3.00	2.00	

GENERAL PLANT INVESTMENT (x $1,000)

YR	JOGYA	WONOGIRI	BANYUMAS	PEKALONGAN	MAGELANG	SRAGEN	TOTALS
1	587	587	587	587	587	587	3522
2							
3							
4							
5	109	109	109	109	109	109	654
6							
7							
8							
9							
10	269	269	269	269	269	269	1614
11							
12							
13							
14							
15	204	204	204	204	204	204	1224
	1169	1169	1169	1169	1169	1169	7014

PART III

OPERATING EXPENSES

III. OPERATING EXPENSES.

A. Cost of Power.

The cost of wholesale power allocated to the rural projects by PLN was computed at a value ranging from 22 rupiahs (5.3¢) and increasing to 29 rupiahs (7.0¢) per KWH in the 15th year of operation - approximately 32% increase. During the same period the estimated load factor was assumed to improve by 100%. The increased load factor should decrease the average cost per KWH.

One basic premise was that the existing system capacity was "sold" and the rural projects included in these studies would buy power from the new generation plants at their costs as indicated in Section K of the Technical Reference Annex. The second premise was that the rural project loads would be so small in relation to the PLN system loads that there would be no appreciable effect on the system load factor and therefore power could be "sold" to the rural projects computed from generation and transmission costs at the overall system load factor. This was computed to be 16.1 rupiah per KWH. A 10% contingency was added, bringing the cost to 17.7 rupiah (4.26¢) per KWH.

This checks reasonably well with a steam plant in the U.S.A. known to have high labor cost and high maintenance cost due to fuel problems. This plant had a fuel cost per KWH of 1.134¢ compared to the 1.1414¢ cost used in the report. The O & M costs were under 6%. Adding 3% for depreciation and 8% for capital calculates the "fixed" cost to be 2.51¢ per KWH at 45% L.F. This then would compute to a total average generation estimated cost of 3.65¢ or 15 rupiah per KWH, indicating a liberal "power cost" for the revised computations.

B. Other Operating Expenses.

Plant depreciation expenses were calculated at a 3% annual rate on average net utility plant in the financial forecasts. On a combined basis this means that the six projects should attain a depreciation reserve level of approximately 35% of total plant at the end of the forecast period. This reserve level at first glance seems high, but appears realistic in view of the nature of system plant growth assumed in the studies.

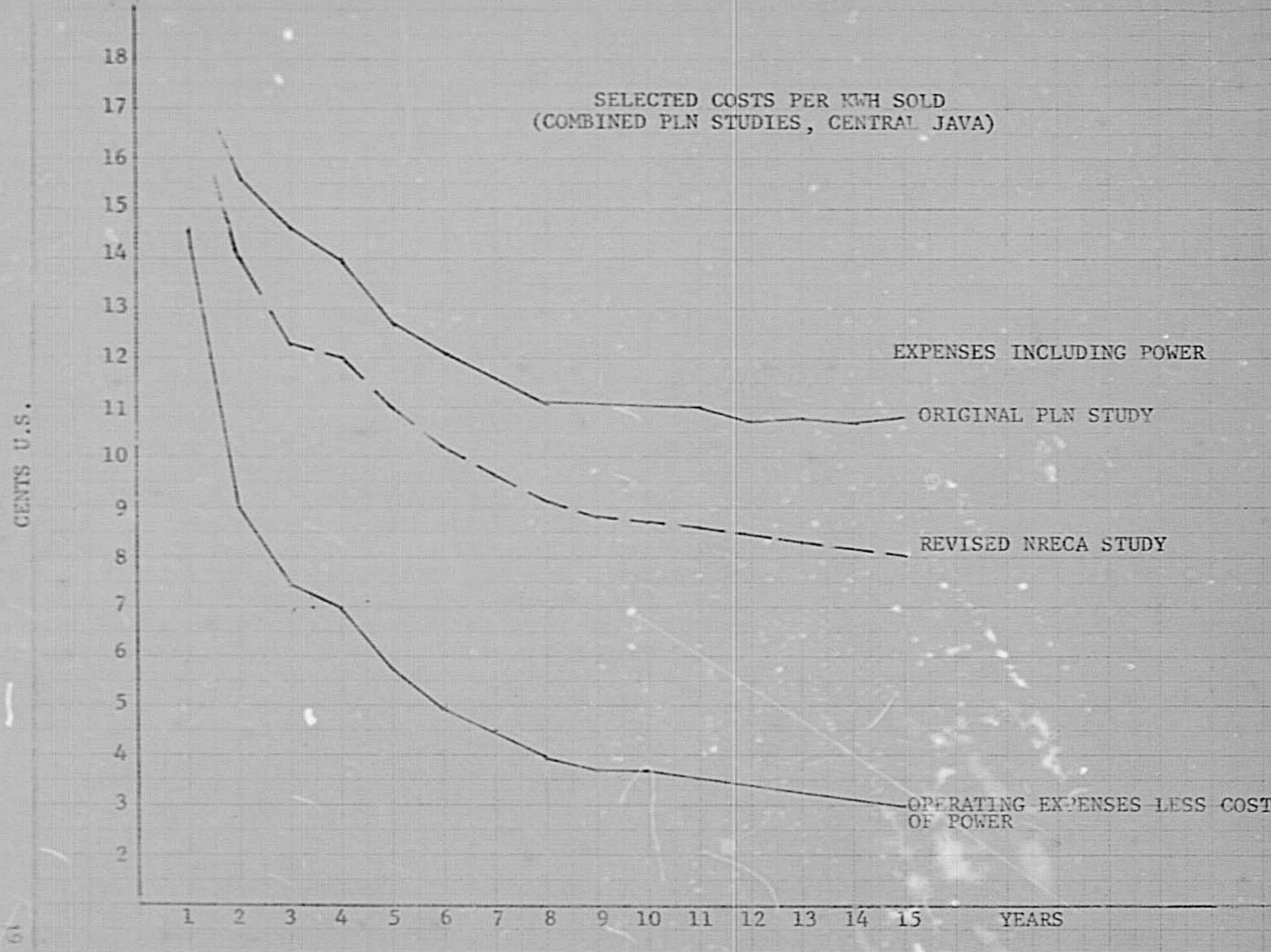
Operations and maintenance expenses for the combined projects are estimated to start at about 1.0% of plant during the first year of project operation and increase to about 2.5% of plant investment during the fifteenth year of operation. The magnitude and growth of these expense items appear realistic when compared to similar expenditures currently being experienced by rural systems in other countries.

Administrative and general expenses of the projects are estimated to run at about one-eighth of similar expenses currently being experienced by rural systems in the United States. Such deviation, however, can be explained by the difference in anticipated consumer density between the Central Java projects and the typical rural electric system in the United States. Consumer density for the six projects should approach 50 consumers per pole line kilometer five years after energization, as compared to an average consumer density of 3 for rural systems in the United States.

For study preparation, consumer accounting expenses were assumed to run about 40 US cents per consumer per month. This amount appears reasonable considering that a billing program involving local collection centers and consumer meter reading most likely will be implemented.

C. Conclusion.

Since operating statistics are not currently available to ascertain the validity of operating expense levels estimated and assumed in these studies, it is strongly recommended that a national standardized accounting system (similar to the Uniform System of Accounts in the United States) be immediately developed and implemented to monitor and control the trend of these expenses from the pre-construction period through energization and system operation. Also, during such period, periodic studies should be performed to determine actual costs and pricing to be attributed to power supplied to the projects from the PLN Central Java Grid.


SELECTED COSTS PER KWH SOLD
(COMBINED PLN STUDIES, CENTRAL JAVA)
CENTS U.S.
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
EXPENSES INCLUDING POWER
ORIGINAL PLN STUDY
REVISED NRECA STUDY
OPERATING EXPENSES LESS COST OF POWER
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
YEARS

ANALYSIS OF OPERATING EXPENSES FOR SIX PROJECTS ($1,000)

YR		O & M EXP*	Con's. Acctg.Exp	Accum. Deprec.	Consumers	Plant	Pole Line Kms	
1		210	280	511	32,845	18,460	2,059	
2		249	332	1101	65,403	20,907	2,194	
3		283	377	1762	92,832	23,224	2,313	
4		385	511	2490	116,068	25,266	2,408	
5		417	555	3286	136,215	27,836	2,484	
6		459	612	4140	153,576	29,103	2,542	
7		568	757	5030	167,791	30,166	2,585	
8		589	785	5947	179,183	30,931	2,621	
9		603	806	6886	188,068	31,680	2,650	
10		713	951	7869	194,890	33,893	2,672	
11		765	1013	8893	200,257	34,431	2,689	
12		775	1033	9932	204,444	34,773	2,702	
13		886	1182	10980	207,654	35,085	2,707	
14		89[illegible]	1194	12035	210,111	35,228	2,711	
15		899	1198	13114	212,049	36,625	2,713	

*Identical expenses incurred for administrative, general and sales exp.

ANALYSIS OF OPERATING EXPENSES FOR SIX PROJECTS (RATIOS)

YR		% O & M to Plant	$ A & G Exp/cons	$ Acctg. Exp/cons	% Depr. Res/Plnt	Cons. Density		
1		1.14	6.39	8.52	2.8	16.0		
2		1.19	3.81	5.08	5.3	29.8		
3		1.22	3.04	4.06	7.6	40.1		
4		1.52	3.32	4.40	9.6	48.2		
5		1.50	3.06	4.07	11.8	54.8		
6		1.58	2.99	3.98	14.2	60.4		
7		1.88	3.39	4.51	16.7	64.9		
8		1.90	3.29	4.38	19.2	68.4		
9		1.90	3.21	4.29	21.7	71.0		
10		2.10	3.66	4.88	23.2	72.9		
11		2.22	3.82	5.06	25.8	74.5		
12		2.23	3.79	5.05	28.6	75.7		
13		2.53	4.27	5.69	31.3	76.7		
14		2.54	4.25	5.68	34.2	77.5		
15		2.45	4.23	5.65	35.8	78.2		
	REA (US)	2.97	33.84	12.67	NA	2.[illegible]	1975 Averages	

PART IV

FINANCIAL FORECASTS

IV. FINANCIAL FORECASTS

A. Financial Evaluation.

15 year financial forecasts were prepared for each proposed project (See Volumes 3 through 8 of this report.) Key assumptions of the forecasts include soft project loans and an extensive housewiring loan program to make it possible for the rural poor to participate in the benefits of 24-hour, reliable electric service immediately upon system energization.

All forecasts were based on retail rate tariffs and power cost assumptions used in the Team's first feasibility report (North Central Klaten) prepared in August 1977. A critique of the latter assumption is found in Part III of this report, indicating that the assumed price of purchase power used in the current studies was unrealistically high. Even in view of this finding, adequate operating margins and cash flow are indicated in these studies to meet commonly accepted tests for project financial viability. Further, under these assumptions, the "break-even" point (where a TIER value of 1.0 is achieved) of combined project operations is expected to occur during the fifth year of operation, and positive cash margins are expected to be generated during the third year of project operations.

Sensitivity tests were made in order to ascertain the combined effect on margins when the interest rate on follow-up loans was increased to 8%, and the cost of power was reduced to 4.26¢ per KWH purchased, as suggested in Part III. Under these assumptions, financial viability is increased even further as the "break-even" point of combined project operations is moved back to the second year of project operations. Similarly, positive cash margins will then be generated during the second year of project operations. What remains crucial to project financial viability under these conditions, however, is the achievement of the scale economies indicated in the load forecast - specifically that of attaining 83,565 residential consumer connections during the third year of system operation and energizing 176,475 residential consumer connections by the tenth year.

It appears likely, however, that for whatever set of events should occur, financial viability will be met, and that most likely viability can be attained with a reduction of the rate tariffs assumed in the project financial forecasts. This item will be discussed more fully in Part V of this report.

B. Economic Evaluation.

In addition, an economic rate of return was calculated for the combined projects using the same assumptions and methodology suggested for such analysis as included in the USAID Project Paper prepared for these project loans.

Similarly, surplus benefits resulting from resource savings and increased economic activity were first estimated for each of the categories of consumers and then added to the estimated revenues taken from the financial forecasts in order to obtain a measure of the total economic benefits derived from electrification over the relevant 15 year period. By comparing this estimate of cost over the same period, the economic rate of return for these projects was estimated to be 22.8%. When applying the combined effect of an increase in loan interest rates and a reduction in purchase power costs, the economic rate of return for the projects increased to 25.3%.

Therefore, these estimated returns together with the recognition of the other economic and social benefits expected to result from rural electrification, as noted in the project paper, provide sufficient economic justification for project investment.

C. Loan Fund Summary.

As proposed in the project paper, USAID intends to make project loan funds available to meet approximately the first five year U.S. dollar construction needs of these projects. Based on the financial forecast prepared for this report, based on mid-1977 prices, total U.S. dollar plant loan needs for this five-year period for the six projects will amount to U.S. $12,435,811 and total Rupiah loan needs will amount to 4,316,978,000 (U.S. $10,402,356).

REVISED PROGRAM DEBT CALCULATIONS - USAID PROJECT LOANS ($1,000)
(10 YEAR GRACE AT 2% INTEREST, 20 YEAR AMORTIZATION AT 3% INTEREST)

YR		LT Debt B - Year	LT Debt D - Year	Level Payments	Interest	Amortization		
1		15,460	2,933	-	339	-		
2		18,460	2,447	-	394	-		
3		20,907	2,317	-	443	-		
4		23,224	-	-	464	-		
5		23,224	-	-	464	-		
6		23,224	-	-	464	-		
7		23,224	-	-	464	-		
8		23,224	-	-	464	-		
9		23,224	-	1,561	697	864		
10		22,360	-	1,561	671	890		
11		21,470	-	1,561	644	916		
12		20,553	-	1,561	617	944		
13		19,601	-	1,561	588	973		
14		18,628	-	1,561	559	1,002		
15		17,626	-	1,561	527	1,032		
		16,594	-	1,561	498	1,063		

REVISED PROGRAM DEBT CALCULATIONS - 8% FOLLOW-UP LOANS ($1,000)
(8% INTEREST 20 YEAR LOANS WITH NO GRACE PERIODS)

YR		LT Debt B - Year	LT Debt D - Year	Level Payments	Interest	Amortization		
1		-	-	-	-	-		
2		-	-	-	-	-		
3		-	-	-	-	-		
4		-	2,042	104	82	22		
5		2,020	2,565	336	264	72		
6		4,513	1,272	524	411	113		
7		5,672	1,063	632	496	136		
8		6,599	765	711	558	153		
9		7,211	749	773	607	165		
10		7,795	2,217	907	712	195		
11		9,817	538	1,027	807	220		
12		10,135	342	1,050	824	226		
13		10,251	312	1,060	833	227		
14		10,336	143	1,060	833	227		
15		10,252	1,397	1,115	876	239		

REVISED FORECAST FINANCIAL FLOWS
(AFTER POWER COST AND INTEREST ADJUSTMENTS) ($1,000)

YR	Forecast Interest	Revised Interest	Difference		Forecast Debt Svc	Revised Debt Svc	Difference	
1	339	339	-		339	339	-	
2	394	394	-		394	394	-	
3	443	443	-		443	443	-	
4	485	546	61		485	568	83	
5	531	728	197		531	800	269	
6	561	875	314		561	988	427	
7	566	960	394		566	1096	530	
8	568	1022	454		568	1175	607	
9	799	1304	505		1288	2334	1047	
10	784	1383	599		1288	2468	1188	
11	771	1451	680		1288	2588	1300	
12	755	1441	686		1288	2611	1323	
13	739	1421	682		1288	2621	1333	
14	775	1392	617		1447	2621	1174	
15	754	1403	649		1447	2676	1229	

REVISED FORECAST FINANCIAL FLOWS
(AFTER POWER COST AND INTEREST ADJUSTMENTS) ($1,000)

YR	Forecast A.Margins	Forecast G.Margins	Forecast C.Margins	Pwr.Cost Adjstmt	Plus Int.Adjst	Revised A.Margins	Revised G.Margins	Revised C.Margins
1	(952)	(102)	(441)	(132)	(132)	(820)	30	(309)
2	(616)	368	(26)	(343)	(343)	(273)	711	317
3	(442)	474	31	(639)	(639)	197	1113	670
4	(509)	704	219	(768)	(707)	198	1411	843
5	(155)	1172	614	(1055)	(858)	703	2030	1230
6	84	1499	938	(1468)	(1154)	1238	2653	1665
7	538	1994	1426	(1894)	(1500)	2038	3494	2398
8	1038	2523	1955	(2229)	(1775)	2313	4298	3123
9	1189	2927	1639	(2670)	(2166)	3355	5093	2759
10	1174	2941	1653	(2978)	(2379)	3553	5494	3026
11	1336	3131	1843	(3515)	(2835)	4171	5966	3378
12	1635	3429	2141	(3878)	(3192)	4827	6621	4010
13	1504	3291	2003	(4452)	(3770)	5274	7061	4440
14	1718	3548	2101	(4779)	(4162)	5880	7710	5089
15	1412	3245	1798	(5333)	(4684)	6096	7929	5253

AVERAGE NUMBER OF RESIDENTIAL CONSUMERS

YR	JOGYA	WONOGIRI	BANYUMAS	PEKALONGAN	MAGELANG	SRAGEN	TOTALS
1	4,900	4,500	3,150	7,550	4,500	4,000	28,600
2	9,900	9,000	8,400	13,425	9,000	8,750	58,475
3	13,900	12,600	12,400	19,050	12,865	12,750	83,565
4	17,150	15,450	15,900	24,175	16,225	16,200	105,100
5	19,900	17,850	18,900	28,800	18,860	19,400	123,710
6	22,150	20,000	21,400	32,925	21,000	22,200	139,675
7	23,975	21,900	23,400	36,050	22,875	24,400	152,600
8	25,500	23,550	25,000	38,300	24,500	25,925	162,775
9	26,800	24,900	26,200	39,900	25,875	26,950	170,625
10	27,850	25,950	27,075	41,000	27,000	27,600	176,475
11	28,700	26,800	27,650	41,875	27,875	28,050	180,950
12	29,450	27,450	28,000	42,500	28,500	28,400	184,300
13	30,100	27,875	28,250	42,925	28,925	28,650	186,725
14	30,650	28,150	28,425	43,225	29,200	28,825	188,475
15	31,100	28,325	28,550	43,475	29,375	28,950	189,775

AVERAGE NUMBER OF GRAIN MILLS AND IRRIGATION CONSUMERS

YR	JOGYA	WONOGIRI	BANYUMAS	PEKALONGAN	MAGELANG	SRAGEN	TOTALS
1	18	5	10	9	11	8	61
2	36	9	14	16	17	15	107
3	50	12	16	21	20	21	140
4	60	15	20	24	23	25	167
5	68	17	21	27	25	28	186
6	76	19	26	30	27	31	209
7	82	21	28	33	29	34	227
8	88	23	32	35	31	37	246
9	93	25	34	36	33	40	261
10	96	27	37	37	35	42	274
11	102	29	39	38	37	44	289
12	106	31	41	39	39	46	302
13	110	33	43	40	40	48	314
14	112	35	43	41	40	50	321
15	114	36	45	42	41	52	330

FORECAST AND REVISED PROGRAM FINANCIAL RATIOS

YR		Forecast TIER	Revised TIER		Forecast DSC	Revised DSC		
1		(1.81)	(1.42)		-	-		
2		(0.56)	0.31		-	-		
3		0.00	1.44		-	-		
4		(0.05)	1.36		-	-		
5		0.71	1.97		-	-		
6		1.15	2.41		-	-		
7		1.95	3.12		-	-		
8		2.83	3.75		-	-		
9		2.49	3.57		2.27	2.18		
10		2.50	3.57		2.28	2.23		
11		2.73	3.87		2.43	2.31		
12		3.08	4.35		2.66	2.54		
13		3.04	4.71		2.56	2.69		
14		3.22	5.22		2.45	2.94		
15		2.87	5.34		2.24	2.96		

FORECAST ECONOMIC BENEFITS ($1,000)

YR		Total Revenues	Rsdl Revenues	Surplus 1.07%	Agri Revenues	Surplus 0.21%	Total Benefits	
1		1302	881	943	99	21	2266	
2		2541	1798	1924	179	38	4503	
3		3591	2563	2742	246	52	6385	
4		4489	3228	3454	321	67	8010	
5		5905	4339	4643	369	77	10625	
6		7350	5442	5823	416	87	13260	
7		9273	7025	7517	479	101	16891	
8		10815	8222	8798	523	110	19723	
9		12334	9246	9893	562	118	22345	
10		13507	10350	11075	624	131	24713	
11		14937	11479	12283	660	139	27359	
12		16100	12372	13238	691	145	29483	
13		17398	13370	14306	758	159	31863	
14		18437	14172	15164	774	163	33764	
15		18918	14483	15497	805	169	34584	

ECONOMIC COSTS
(FORECAST ASSUMPTIONS) ($1,000)

YR	Revenues	Margins	Interest	Deprec.	Oper. Costs	Capital Addns.	Total Costs
1	-	-	-	-	-	10790	10790
2	-	-	-	-	-	4733	4733
3	1302	(952)	339	511	1404	2933	4337
4	2541	(616)	394	590	2173	2447	4620
5	3591	(442)	443	661	2929	2317	5246
6	4489	(509)	485	728	3785	2042	5827
7	5905	(155)	531	796	4733	2565	7298
8	7350	84	561	854	5851	1272	7123
9	9273	538	566	890	7279	1063	8342
10	10815	1038	568	917	8292	765	9057
11	12334	1189	799	939	9407	749	10156
12	13507	1174	784	983	10566	2217	12783
13	14937	1336	771	1024	11806	538	12344
14	16100	1635	755	1039	12671	342	13013
15	17398	1504	739	1048	14107	312	14419
16	18437	1718	775	1055	14889	143	15032
17	18918	1412	754	1079	15673	1397	17070

ECONOMIC COSTS
(ADJUSTED ASSUMPTIONS)

YR	Revenues	Margins	Interest	Deprec.	Oper. Costs	Capital Addns.	Total Costs
1	-	-	-	-	-	10790	10790
2	-	-	-	-	-	4733	4733
3	1302	(820)	339	511	1272	2933	4205
4	2541	(273)	394	590	1830	2447	4277
5	3591	197	443	661	2290	2317	4607
6	4489	219	525	728	3017	2042	5059
7	5905	724	707	796	3678	2565	6243
8	7350	1259	854	854	4383	1272	5655
9	9273	2059	939	890	5385	1063	6448
10	10815	2034	1001	917	6863	765	7628
11	12334	3386	1272	939	6737	749	7486
12	13507	3585	1351	983	7588	2217	9805
13	14937	4201	1421	1024	8291	538	8829
14	16100	4856	1412	1039	8798	342	9140
15	17398	5301	1394	1048	9655	312	9967
16	18437	5906	1366	1055	10110	143	10253
17	18918	6119	1380	1079	10340	1397	11737

12% NET PRESENT WORTH OF SIX PROJECTS
($ MILLIONS) (FORECAST ASSUMPTIONS)

YR	TOTAL COSTS	TOTAL BENEFITS	D.F. 12%	PW COSTS	PW BENEFITS	CASH FLOW	PW $ FLOW	
1	10.790	-	.893	9.635	-	-10.790	-9.635	
2	4.733	-	.797	3.772	-	- 4.733	-3.772	
3	4.337	2.266	.712	3.088	1.613	- 2.071	-1.475	
4	4.620	4.503	.636	2.938	2.863	- 0.117	-0.075	
5	5.246	6.385	.567	2.974	3.620	+ 1.139	+0.646	
6	5.827	8.010	.507	2.954	4.061	+ 2.183	+1.107	
7	7.298	10.625	.452	3.299	4.803	+ 3.327	+1.504	
8	7.123	13.260	.404	2.878	5.357	+ 6.137	+2.479	
9	8.342	16.891	.361	3.011	6.098	+ 8.549	+3.087	
10	9.057	19.723	.322	2.916	6.351	+10.666	+3.435	
11	10.156	22.345	.287	2.915	6.413	+12.189	+3.498	
12	12.783	24.713	.257	3.285	6.351	+11.930	+3.066	
13	12.344	27.359	.229	2.827	6.265	+15.015	+3.438	
14	13.013	29.483	.205	2.668	6.044	+16.470	+3.384	
15	14.419	31.863	.183	2.639	5.831	+17.444	+3.192	
16	15.032	33.764	.163	2.450	5.504	+18.723	+3.054	
17	17.070	34.584	.146	2.492	5.049	+17.514	+2.557	1.34 B/C
	162.190	285.774	7.121	56.741	76.223	123.575	+19.490	

24% NET PRESENT WORTH OF SIX PROJECTS
($ MILLIONS) (FORECAST ASSUMPTIONS)

YR	TOTAL COSTS	TOTAL BENEFITS	D.F. 24%	PW COSTS	PW BENEFITS	CASH FLOW	PW $ FLOW	
1	10.790	-	.806	8.697	-	-10.790	-8.697	
2	4.733	-	.650	3.076	-	- 4.733	-3.076	
3	4.337	2.266	.524	2.273	1.187	- 2.071	-1.086	
4	4.620	4.503	.423	1.954	1.905	- 0.117	-0.049	
5	5.246	6.385	.341	1.789	2.177	+ 1.139	+0.388	
6	5.827	8.010	.275	1.602	2.202	+ 2.183	+0.600	
7	7.298	10.625	.222	1.620	2.359	+ 3.327	+0.739	
8	7.123	13.260	.179	1.275	2.374	+ 6.137	+1.099	
9	8.342	16.891	.144	1.201	2.432	+ 8.549	+1.231	
10	9.057	19.723	.116	1.051	2.288	+10.666	+1.237	
11	10.156	22.345	.093	0.945	2.078	+12.189	+1.133	
12	12.783	24.713	.076	0.972	1.878	+11.930	+0.906	
13	12.344	27.359	.061	0.753	1.669	+15.015	+0.946	
14	13.013	29.483	.049	0.638	1.445	+16.470	+0.807	
15	14.419	31.863	.040	0.577	1.275	+17.444	+0.6[illegible]8	
16	15.032	33.764	.032	0.481	1.080	+18.372	+0.599	
17	17.070	34.584	.026	0.444	0.899	+17.514	+0.455	22.8% ER
	162.190	285.744	4.068	29.348	27.248	+123.584	-2.070	

24% NET PRESENT WORTH OF SIX PROJECTS
($ MILLIONS) (ADJUSTED ASSUMPTIONS)

YR		Total Benefits	Total Costs	D.F.24%	PW Benefits	PW Cost	PW $ FLOW	
1		-	10.790	.806	-	8.697	-8.697	
2		-	4.733	.650	-	3.076	-3.076	
3		2.266	4.205	.524	1.187	2.241	-1.054	
4		4.503	4.277	.423	1.905	1.809	+0.096	
5		6.385	4.607	.341	2.177	1.571	+0.606	
6		8.010	5.059	.275	2.203	1.391	+0.812	
7		10.625	6.243	.222	2.359	1.386	+0.973	
8		13.260	5.655	.179	2.374	1.012	+1.362	
9		16.891	6.448	.144	2.432	0.929	+1.503	
10		19.723	7.628	.116	2.288	0.885	+1.403	
11		22.345	7.486	.093	2.078	0.696	+1.382	
12		24.713	9.805	.076	1.878	0.745	+1.133	
13		27.359	8.829	.061	1.669	0.539	+1.130	
14		29.483	9.140	.049	1.445	0.448	+0.997	
15		31.863	9.967	.040	1.275	0.399	+0.876	
16		33.764	10.253	.032	1.080	0.328	+0.752	
17		34.584	11.737	.026	0.899	0.305	+0.594	
							+0.792	

30% NET PRESENT WORTH OF SIX PROJECTS
($ MILLIONS) (ADJUSTED ASSUMPTIONS)

YR		Total Benefits	Total Costs	D.F.30%	PW Benefits	PW COSTS	PW $ FLOW	
1		-	10.790	.769	-	8.298	-8.298	
2		-	4.733	.592	-	2.792	-2.792	
3		2.266	4.205	.455	1.031	1.913	-0.882	
4		4.503	4.277	.350	1.576	1.497	+0.079	
5		6.385	4.607	.269	1.718	1.239	+0.479	
6		8.010	5.059	.207	1.658	1.047	+0.611	
7		10.625	6.243	.159	1.689	0.993	+0.696	
8		13.260	5.655	.123	1.631	0.696	+0.935	
9		16.891	6.448	.094	1.588	0.606	+0.982	
10		19.723	7.628	.073	1.440	0.557	+0.883	
11		22.345	7.486	.056	1.251	0.419	+0.832	
12		24.713	9.805	.043	1.027	0.422	+0.605	
13		27.359	8.829	.033	0.903	0.291	+0.612	
14		29.483	9.140	.025	0.737	0.229	+0.508	
15		31.863	9.967	.020	0.637	0.199	+0.438	ERR=
16		33.764	10.253	.015	0.506	0.154	+0.352	25.3%
17		34.584	11.737	.012	0.415	0.141	+0.274	
							-2.751	

PLANT LOAN FUND SUMMARY
DISTRIBUTION PLANT (US $)

YR	JOGYA	WONOGIRI	BANYUMAS	PEKALONGAN	MAGELANG	SRAGEN	TOTALS
			CONSTRUCTION PERIOD				
	1,008,947	1,224,096	848,432	1,423,101	979,605	1,011,624	6,495,805
			OPERATING PERIOD				
1	334,047	250,528	252,478	373,302	275,015	294,000	1,779,370
2	231,844	202,366	226,530	337,042	213,941	251,428	1,463,151
3	216,254	193,849	224,341	351,553	219,170	238,318	1,443,485
			TOTALS				
	1,791,092	1,870,839	1,551,781	2,484,998	1,687,731	1,795,370	11,181,811

PLANT LOAN FUND SUMMARY
DISTRIBUTION PLANT (RUPIAH 1,000)

YR	JOGYA	WONOGIRI	BANYUMAS	PEKALONGAN	MAGELANG	SRAGEN	TOTALS
			CONSTRUCTION PERIOD				
	345,370	409,712	272,140	410,309	341,176	354,927	2,133,634
			OPERATING PERIOD				
1	82,121	68,701	69,973	96,185	74,289	79,852	471,121
2	63,199	57,167	64,343	94,455	57,993	70,871	408,028
3	53,211	49,035	56,454	90,993	55,210	59,284	364,1[illegible]
			TOTALS				
	543,901	584,615	462,910	691,942	528,668	564,934	3,376,970

PLANT LOAN FUND SUMMARY GENERAL PLANT (US$)							
YR	JOGYA	WONOGIRI	BANYUMAS	PEKALONGAN	MAGELANG	SRAGEN	TOTALS
			CONSTRUCTION PERIOD				
1	45,000	45,000	45,000	45,000	45,000	45,000	270,000
2	164,000	164,000	164,000	164,000	164,000	164,000	984,000
			OPERATING PERIOD				
1	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-
			TOTALS				
	209,000	209,000	209,000	209,000	209,000	209,000	1,254,000

PLANT LOAN FUND SUMMARY GENERAL PLANT (RUPIAH 1,000)							
YR	JOGYA	WONOGIRI	BANYUMAS	PEKALONGAN	MAGELANG	SRAGEN	TOTALS
			CONSTRUCTION PERIOD				
1	156,668	156,668	156,668	156,668	156,668	156,668	940,008
2	-	-	-	-	-	-	-
			OPERATING PERIOD				
1	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-
			TOTALS				
	156,668	156,668	156,668	156,668	156,668	156,668	940,008

PART V

RETAIL RATE DEVELOPMENT

V. RETAIL RATE DEVELOPMENT

The annual operating revenue anticipated from the six PLN studies, using PLN rates, would be on the order of $5,905,000 by 5th year, $13,507,000 by 10th year and nearly $19,000,000 by the 15th year, as indicated in the table "OPERATING REVENUE". The NRECA Team reasoned that the PLN retail rates appear excessively high and would not be conducive to the optimum rural economic growth since their rate would average about 12¢ (Rp 50) per KWH and did not decline appreciably with increased per capita usage.

A "cost of service" was then computed using (1) the revised power cost at [illegible].2¢ per KWH; (2) revised interest cost at 8% after 3rd year and (3) a suggested TIER increasing to 2.0 by the fifteenth year (See Table - "COMPUTATION OF THEORETICAL RESIDENTIAL RATE REQUIREMENTS"). These calculations indicate rate requirements of $5,202,000, $10,646,000 and $14,225,000 at fifth, tenth and fifteenth years, respectively. Note this is substantially less than the PLN rate revenue supra.

Further analysis ("ANALYSIS OF RURAL RESIDENTIAL RATES") indicates that approximately 75% of the total revenue comes from the rural residential customer classification. A retail residential rate was then structured to yield approximately 75% of the desired cost of service. This suggested residential rate would be:

First 20 KWH per month - - - Rp 1,000 ($2.41) minimum
Next 30 KWH per month @ Rp 40 each ($0.0964)
Next 50 KWH per month @ Rp 35 each ($0.0843)
Over 100 KWH per month @ Rp 30 each ($0.0723)

and there would be no connection charge per se nor would the use of load limiters be applied.

It is suggested that a further analysis of the other retail rate schedules might be in order.

The extremely high density of over 100 consumers per mile of line and an investment of approximately $175 per customer is conducive to successful rural electric utilities at comparatively low retail rates.

ANALYSIS OF RURAL RESIDENTIAL RATES

YR	No. Consumers	MWH Sales	Ann. Rev. ($1,000)	Average Yield	Ave. KWH Per Mo.	Res. Rev/ Tot. Rev.		
1	28,600	6,264	881	14.1¢	18.25	67.67%		
2	58,475	12,804	1,798	14.0¢	18.25	70.76%		
3	83,565	18,288	2,563	14.0¢	18.24	71.37%		
4	105,100	23,016	3,228	14.0¢	18.25	71.91%		
5	123,710	31,860	4,339	13.6¢	21.46	73.48%		
6	139,675	41,628	5,442	13.1¢	24.84	74.04%		
7	152,600	52,080	7,025	13.5¢	28.44	75.76%		
8	162,775	62,040	8,222	13.3¢	31.76	76.02%		
9	170,625	72,960	9,246	12.7¢	38.60	74.96%		
10	176,475	80,472	10,350	12.9¢	[illegible]0.0	76.63%		
11	180,950	89,8[illegible]	11,479	12.8¢	41.38	76.84%		
12	184,300	97,104	12,372	12.7¢	43.91	76.84%		
13	186,725	105,612	13,370	12.7¢	47.13	76.85%		
14	188,475	112,320	14,172	12.6¢	49.66	76.87%		
15	189,775	115,040	14,483	12.6¢	50.52	76.56%		

COMPUTATION OF THEORETICAL RESIDENTIAL RATE REQUIREMENTS
(Based on Revised Forecast)

YR	TIER Objective	Revised* Interest	Desired Margins	Revised** Pwr. Cost	Expenses -Int&Pwr	Desired Rate Yld	Desired Residential Yield	Rate "Ave/KWH"
1	0.2	339	(338)	570	1,213	1,784	1,338	21.4
2	0.4	394	(236)	998	1,422	2,578	1,934	15.1
3	0.6	443	(177)	1,350	1,604	3,220	2,415	13.2
4	0.8	546	(109)	1,739	2,006	4,183	3,137	13.6
5	1.0	728	-0-	2,286	2,188	5,202	3,902	12.2
6	1.1	875	88	2,852	2,385	6,200	4,650	11.2
7	1.2	960	192	3,536	2,783	7,471	5,603	10.8
8	1.3	1,022	307	4,100	2,880	8,309	6,232	10.0
9	1.4	1,304	522	4,726	2,950	9,502	7,127	9.77
10	1.5	1,383	692	5,214	3,357	10,646	7,985	9.92
11	1.6	1,451	871	5,770	3,572	11,664	8,748	9.74
12	1.7	1,441	1,009	6,211	3,621	12,282	9,212	9.49
13	1.8	1,421	1,137	6,731	3,997	13,286	9,965	9.44
14	1.9	1,392	1,253	7,129	4,036	13,810	10,358	9.22
15	2.0	1,403	1,403	7,343	4,076	14,225	10,669	9.27

* 8% after third year; ** Revised @ 4.26¢ per KWH

RESIDENTIAL RETAIL RATE COMPUTATIONS

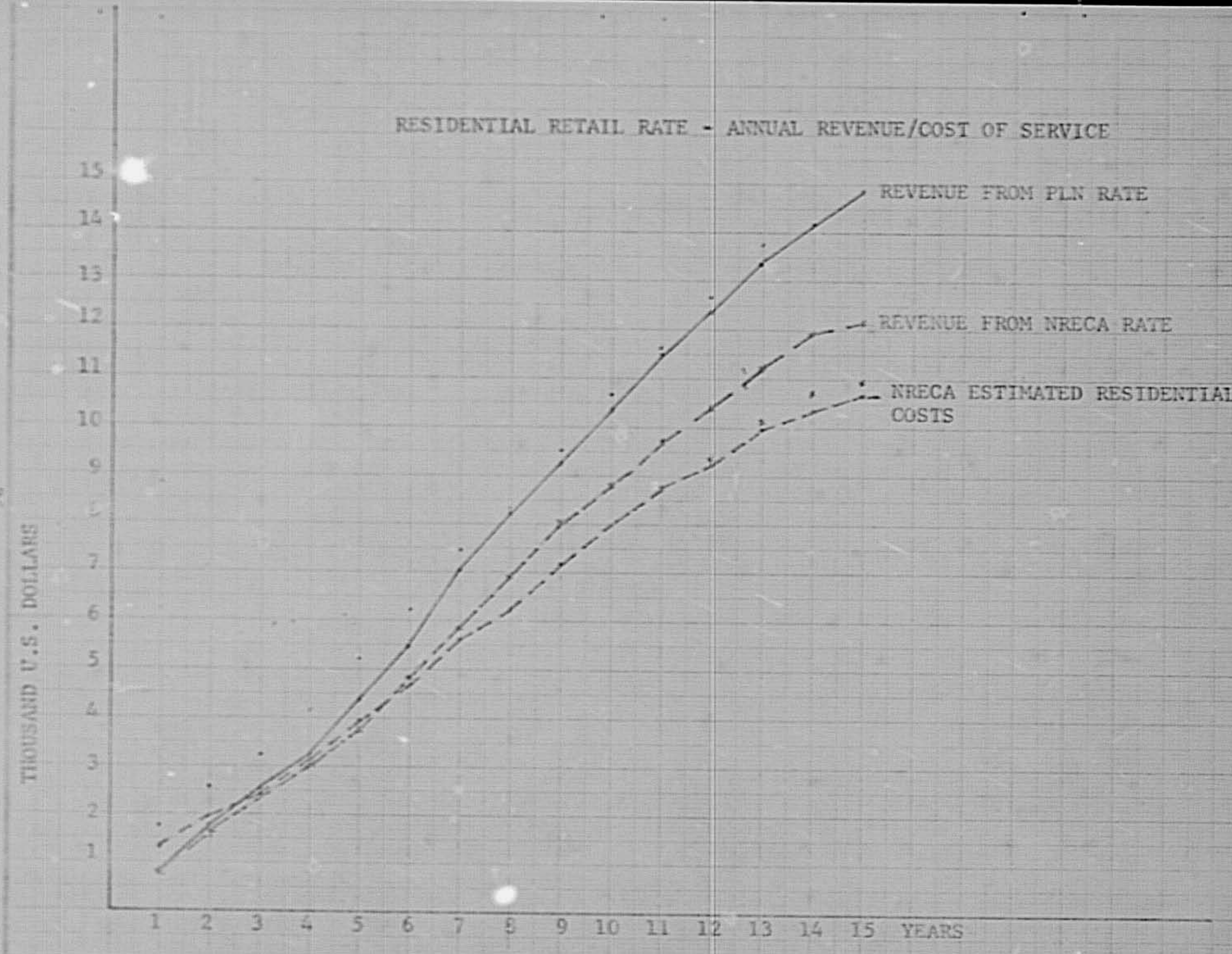
SUGGESTED RETAIL RESIDENTIAL RATE:

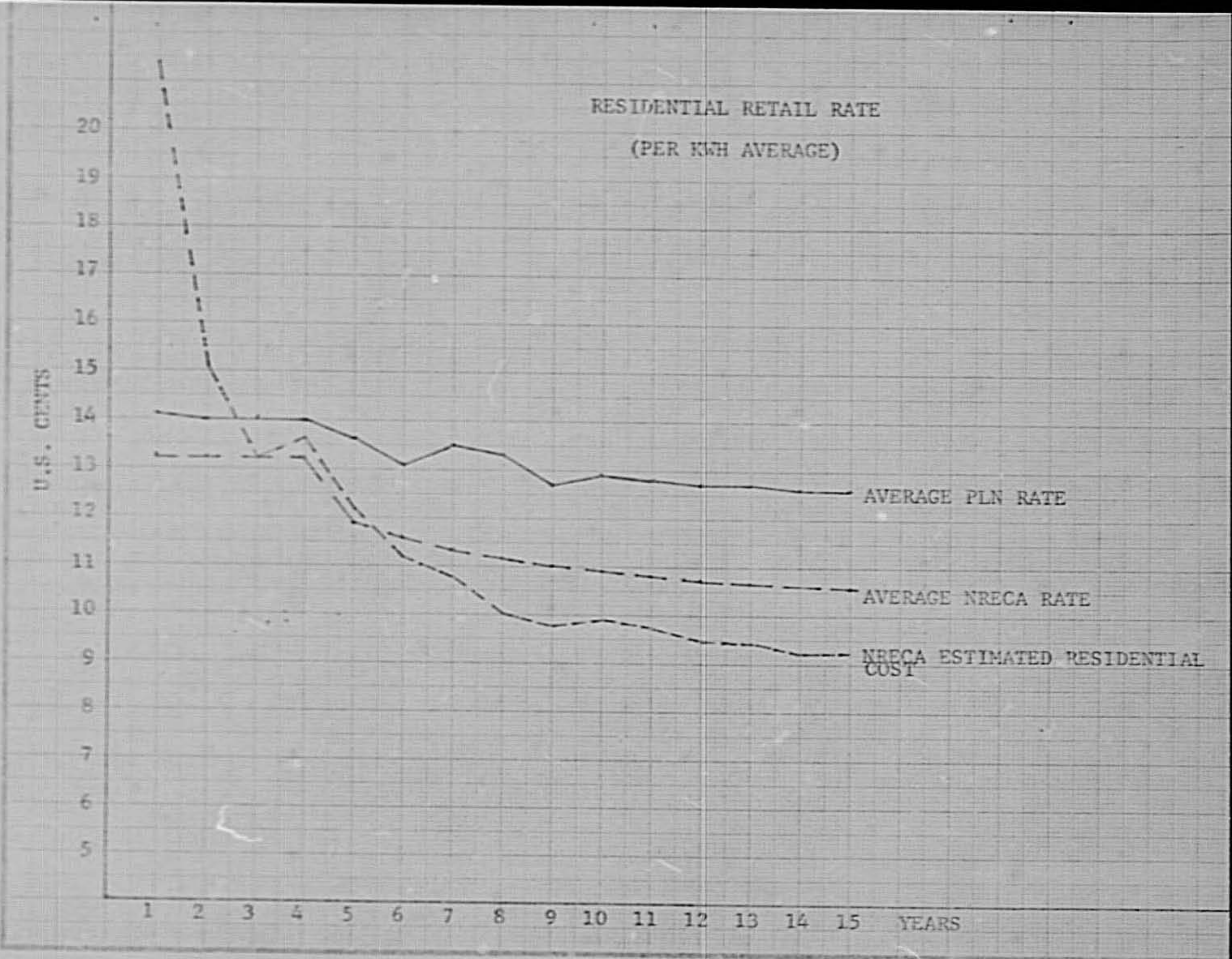
First 20 KWH per month - - - Rp 1000 ($2.41) minimum
Next 30 KWH per month @ Rp 40 (9.64¢) each
Next 50 KWH per month @ Rp 35 (8.43¢) each
Over 100 KWH per month @ Rp 30 (7.23¢) each

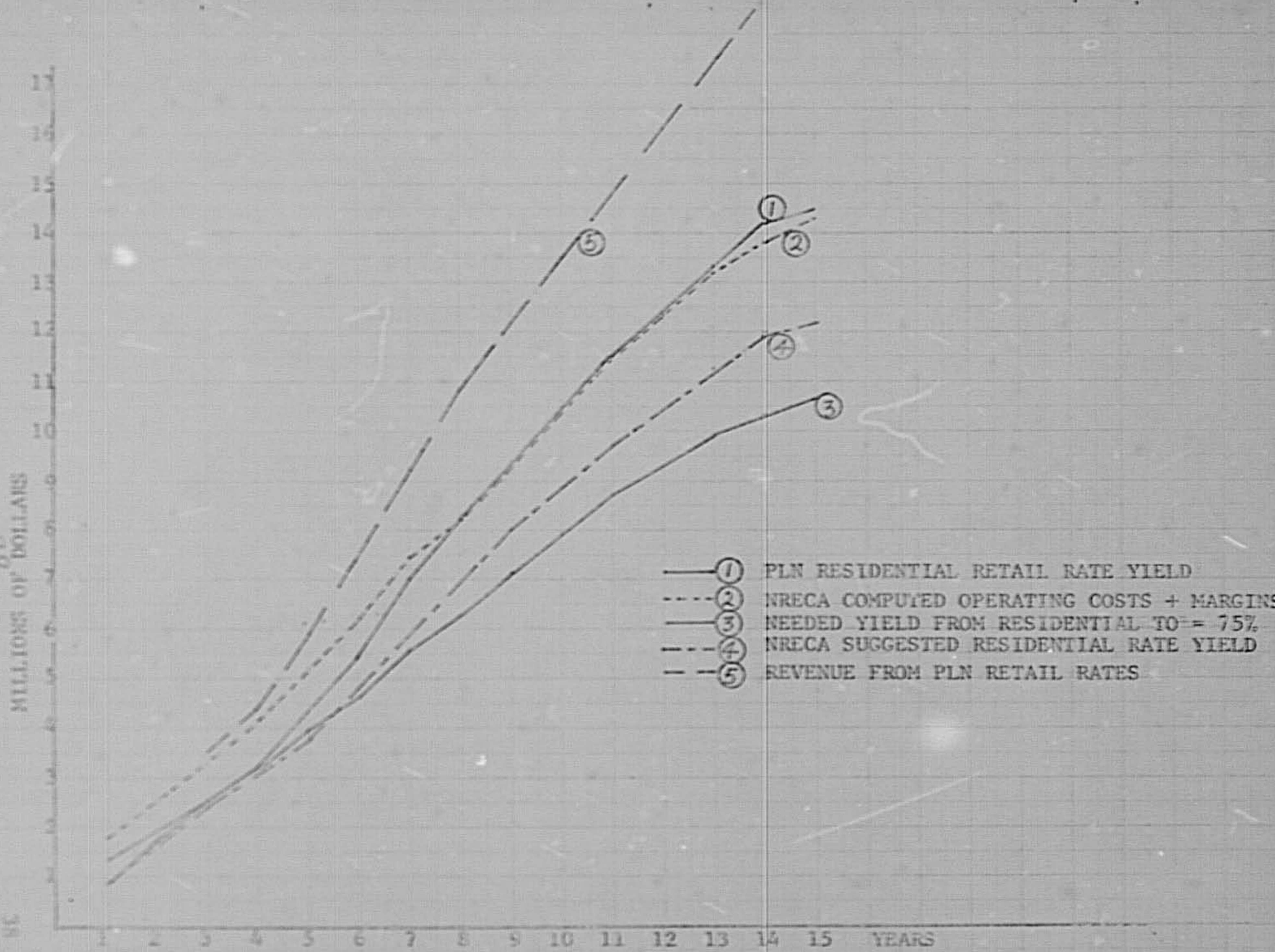
YR		Average KWH/mo.	Monthly Billing	Ave. ¢ per KWH	Residntl Consumers	Revenue/ Yr. AbvRt	PLN Rate Revenue	Reduction
1		18.25	$2.41	13.21	28,600	827(1)	881(1)	6.5%
2		18.24	2.41	13.21	58,475	1,691	1,798	6.3%
3		18.24	2.41	13.21	83,565	2,417	2,563	6.0%
4		18.25	2.41	13.21	105,100	3,039	3,223	6.2%
5		21.46	2.55	11.88	123,710	3,786	4,339	14.6%
6		24.84	2.88	11.59	139,675	4,827	5,442	12.7%
7		28.44	3.22	11.32	152,600	5,896	7,025	19.1%
8		31.76	3.54	11.15	162,775	6,915	8,222	18.9%
9		35.63	3.92	11.0	170,625	8,026	9,246	15.2%
10		38.0	4.15	10.9	176,475	8,788	10,350	17.8%
11		41.38	4.47	10.8	180,950	9,706	11,479	18.3%
12		43.91	4.71	10.73	184,300	10,417	12,372	18.7%
13		47.13	5.03	10.67	186,725	11,271	13,370	18.6%
14		49.66	5.27	10.61	188,475	11,919	14,171	18.8%
15		50.52	5.34	10.57	189,775	12,161	14,483	19.1%
TOTALS: (1) in $1,000 U.S.						101,686	118,969	Ave. 14.5%

RETAIL RATE COMPARISONS
LAMPUNG & KLATEN STUDIES

YR.	LAMPUNG Pwr.Cost/ KWH Sold	LAMPUNG Per.Resdl. KWH Sold	LAMPUNG Per Non-R KWH Sold	KLATEN Pwr.Cost/ KWH Sold	KLATEN Per.Resdl. KWH Sold	KLATEN Per Non-R KWH Sold
1	10.2	12.1	8.4	6.7	13.6	8.8
2	9.2	12.1	8.4	6.9	13.6	8.9
3	9.6	12.1	8.8	7.0	13.6	8.9
4	8.9	12.1	8.1	7.0	13.6	8.7
5	7.0	11.7	8.0	7.0	13.3	8.8
6	8.5	11.5	7.9	7.2	13.2	8.6
7	7.2	11.3	7.8	7.2	13.0	8.4
8	6.4	11.1	7.8	7.3	12.8	8.4
9	5.8	11.0	7.7	7.3	12.7	8.3
10	5.8	10.7	8.1	7.3	12.7	8.3
11	5.5	10.5	7.6	7.5	12.6	8.2
12	5.2	10.4	7.6	7.5	12.6	8.1
13	5.1	10.2	7.5	7.6	12.5	7.8
14	5.0	10.1	7.6	7.6	12.5	7.7
15	4.8	10.1	7.5	7.9	12.5	7.7


RESIDENTIAL RETAIL RATE - ANNUAL REVENUE/COST OF SERVICE
REVENUE FROM PLN RATE
REVENUE FROM NRECA RATE
NRECA ESTIMATED RESIDENTIAL COSTS
THOUSAND U.S. DOLLARS
YEARS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15


RESIDENTIAL RETAIL RATE
(PER KWH AVERAGE)
U.S. CENTS
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
AVERAGE PLN RATE
AVERAGE NRECA RATE
NRECA ESTIMATED RESIDENTIAL COST
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 YEARS


MILLIONS OF DOLLARS
YEARS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
PLN RESIDENTIAL RETAIL RATE YIELD
NRECA COMPUTED OPERATING COSTS + MARGINS
NEEDED YIELD FROM RESIDENTIAL TO = 75%
NRECA SUGGESTED RESIDENTIAL RATE YIELD
REVENUE FROM PLN RETAIL RATES

PART VI

SUPPLEMENTARY TABLES

OPERATING REVENUE (US $ 1,000)							
YR	JOGYA	WONOGIRI	BANYUMAS	PEKALONGAN	MAGELANG	SRAGEN	TOTALS
1	228	186	152	349	205	182	1302
2	452	358	356	614	384	377	2541
3	633	503	513	859	539	544	3591
4	789	615	653	1081	673	678	4489
5	1021	805	877	1415	878	909	5905
6	1284	1002	1107	1705	1097	1148	7350
7	1598	1255	1367	2274	1351	1428	9273
8	1850	1475	1594	2646	1585	1665	10815
9	2106	1702	181[illegible]	2985	1824	1902	12334
10	2295	1886	1991	3255	2016	2062	13507
11	2554	2104	2192	3576	2248	2263	14937
12	2777	2281	2343	3831	2429	2439	16100
13	2978	2479	2532	4144	2639	2617	17398
14	3191	2634	2671	4375	2797	2769	18437
15	3284	2701	2738	4479	2880	2836	18918

POWER COST (US $ 1,000)							
YR	JOGYA	WONOGIRI	BANYUMAS	PEKALONGAN	MAGELANG	SRAGEN	TOTALS
1	101	102	86	194	115	104	702
2	205	194	192	337	203	210	1341
3	365	272	281	471	293	304	1989
4	464	336	359	597	370	381	2507
5	605	448	459	797	457	515	3341
6	781	579	631	1029	630	670	4320
7	983	730	797	1289	789	844	5432
8	1135	870	938	1521	939	926	6329
9	1314	1014	1083	1737	1096	1152	7396
10	1449	1135	1198	1914	1227	1265	8192
11	1655	1299	1355	2124	1405	1430	9258
12	1790	1418	1461	2336	1536	1548	10089
13	1967	1575	1615	2579	1705	1711	11152
14	2107	1688	1719	2748	1824	1826	11908
15	2236	1782	1822	2958	1946	1936	12678

ANNUAL RESIDENTIAL REVENUE ($000)							
YR	JOGYA	WONOGIRI	BANYUMAS	PEKALONGAN	MAGELANG	SRAGEN	TOTALS
1	162	135	94	236	134	120	881
2	328	270	250	410	268	263	1,798
3	460	378	365	594	383	383	2,563
4	568	464	473	754	483	486	3,228
5	765	613	649	1,016	647	669	4,339
6	954	775	832	1,205	816	860	5,442
7	1,203	975	1,042	1,691	1,028	1,086	7,025
8	1,386	1,153	1,227	1,985	1,202	1,269	8,222
9	1,608	1,133	1,405	2,260	1,388	1,452	9,246
10	1,751	1,476	1,544	2,470	1,539	1,570	10,350
11	1,967	1,647	1,702	2,724	1,716	1,723	11,479
12	2,145	1,782	1,818	2,917	1,850	1,860	12,372
13	2,319	1,933	1,963	3,158	2,010	1,987	13,370
14	2,494	2,050	2,071	3,330	2,127	2,100	14,172
15	2,571	2,094	2,113	3,391	2,175	2,139	14,483

ANNUAL GRAIN MILLS & IRRIGATION REVENUE ($000)							
YR	JOGYA	WONOGIRI	BANYUMAS	PEKALONGAN	MAGELANG	SRAGEN	TOTALS
1	27	18	17	12	9	16	99
2	49	38	25	22	14	31	179
3	67	54	28	33	19	45	246
4	92	75	38	40	23	53	321
5	105	86	41	47	28	62	369
6	117	96	51	53	30	69	416
7	135	111	56	62	36	79	479
8	146	120	65	67	39	86	523
9	154	126	69	71	46	96	562
10	173	142	79	79	49	102	624
11	180	147	83	84	57	109	660
12	188	152	89	88	60	116	691
13	206	169	97	96	67	123	758
14	209	172	97	100	68	128	774
15	213	178	101	109	70	134	805

YR	JOGYA	WONOGIRI	BANYUMAS	PEKALONGAN	MAGELANG	SRAGEN	ANNUAL TOTALS
			MONTHLY RESIDENTIAL MWH SALES				
1	98	79	55	141	79	70	6,264
2	198	158	148	251	158	154	12,804
3	278	222	218	356	226	224	18,288
4	343	272	280	452	286	285	23,016
5	458	372	393	636	392	404	31,860
6	598	480	514	840	504	533	41,628
7	767	613	655	1,072	641	683	52,080
8	893	735	780	1,272	764	726	62,040
9	1,045	857	901	1,460	890	927	72,960
10	1,142	955	996	1,603	994	1,016	80,472
11	1,292	1,072	1,106	1,780	1,115	1,122	89,844
12	1,414	1,164	1,187	1,915	1,208	1,204	97,104
13	1,535	1,271	1,288	2,082	1,319	1,306	105,612
14	1,655	1,351	1,364	2,204	1,402	1,384	112,320
15	1,711	1,382	1,393	2,254	1,434	1,413	115,044

YR	JOGYA	WONOGIRI	BANYUMAS	PEKALONGAN	MAGELANG	SRAGEN	ANNUAL TOTALS
			MONTHLY GRAIN MILLS & IRRIGATION MWH SALES				
1	30	10	18	31	12	19	1,440
2	58	18	26	48	18	37	2,460
3	79	26	29	74	25	44	3,324
4	110	32	39	91	29	64	4,380
5	125	38	43	104	36	76	5,064
6	139	43	52	120	39	84	5,724
7	158	50	58	137	47	96	6,552
8	169	52	68	148	50	103	7,080
9	180	61	72	150	59	116	7,656
10	204	66	84	156	64	122	8,352
11	213	74	89	159	74	132	8,892
12	221	78	94	161	79	138	9,252
13	243	86	104	168	88	148	10,044
14	248	91	105	171	90	154	10,308
15	252	95	110	176	93	160	10,620

OPERATING EXPENSES (US $ 1.000)							
YR	JOGYA	WONOGIRI	BANYUMAS	PEKALONGAN	MAGELANG	SRAGEN	TOTALS
1	352	384	301	502	359	356	2254
2	501	514	446	703	488	505	3157
3	697	626	571	891	612	638	4033
4	665	756	714	1116	757	790	4998
5	1040	897	881	1370	906	866	6050
6	1250	1062	1064	1651	1081	1158	7266
7	1513	1278	1290	2001	1299	1400	8781
8	1680	1437	1444	2254	1465	1497	9777
9	1906	1631	1633	2532	1671	1772	11145
10	2106	[illegible]	1805	2790	1864	1951	12333
11	2334	2013	1993	3038	2082	2141	13601
12	2487	2139	2103	3254	2218	2264	14465
13	2725	2350	2310	3572	2446	2485	15888
14	2874	2477	2423	3758	2575	2612	16719
15	3004	2578	2529	3969	2699	2727	17506

OPERATING EXPENSES LESS POWER COSTS (US $ 1.000)							
YR	JOGYA	WONOGIRI	BANYUMAS	PEKALONGAN	MAGELANG	SRAGEN	TOTALS
1	251	282	215	308	244	252	1552
2	296	320	254	366	265	295	1816
3	332	352	290	420	319	334	2047
4	401	420	355	519	367	409	2491
5	435	449	393	573	419	451	2719
6	469	483	433	622	451	488	2946
7	530	548	493	712	510	556	3349
8	545	567	506	733	526	571	3448
9	592	617	550	795	575	620	3749
10	657	[illegible]	607	876	637	692	[illegible]
11	659	[illegible]	638	914	677	711	4343
12	697	721	642	918	682	716	4374
13	758	775	[illegible]	993	751	774	4736
14	767	793	704	1010	751	786	[illegible]
15	770	726	707	1011	[illegible]	793	4530

O & M EXPENSES ($1,000)*

YR	JOGYA	WONOGIRI	BANYUMAS	PEKALONGAN	MAGELANG	SRAGEN	TOTALS
1	34	39	29	41	33	34	210
2	41	44	35	50	39	40	249
3	46	49	40	58	44	46	283
4	62	65	55	80	60	63	385
5	67	69	60	88	64	69	417
6	73	75	68	97	70	76	459
7	90	92	84	121	87	94	568
8	93	96	87	126	90	97	589
9	95	98	89	129	93	99	603
10	113	116	105	152	110	117	713
11	121	124	113	162	120	125	765
12	123	127	114	163	122	126	775
13	142	145	130	186	139	144	886
14	143	146	131	188	141	145	894
15	144	147	132	189	141	146	899

*Identical expenses for administrative, general and sales expenses

CONSUMER ACCOUNTING EXPENSES ($1,000)

YR	JOGYA	WONOGIRI	BANYUMAS	PEKALONGAN	MAGELANG	SRAGEN	TOTALS
1	45	52	39	55	44	45	280
2	54	59	46	67	52	54	332
3	61	65	53	77	59	62	377
4	82	87	73	10[illegible]	79	84	511
5	89	92	79	117	86	92	555
6	98	100	90	129	94	101	612
7	120	123	112	161	116	125	757
8	124	128	116	167	120	130	785
9	127	131	119	172	124	133	806
10	151	155	140	202	147	156	951
11	162	166	150	215	154	166	1013
12	165	169	152	217	162	168	1033
13	189	193	174	248	186	192	1182
14	191	195	175	251	188	194	1194
15	192	196	176	252	188	194	1198

ACCRUED MARGINS ($000)

YR	JOGYA	WONOGIRI	BANYUMAS	PEKALONGAN	MAGELANG	SRAGEN	TOTALS
1	(124)	(198)	(149)	(153)	(154)	(174)	(952)
2	(49)	(156)	(90)	(89)	(104)	(128)	(616)
3	(64)	(121)	(58)	(32)	(73)	(94)	(442)
4	(76)	(141)	(61)	(35)	(84)	(112)	(509)
5	(19)	(92)	(4)	45	(28)	(57)	(155)
6	34	(53)	43	54	16	(10)	84
7	85	23	77	273	52	28	538
8	170	38	150	392	120	168	1,038
9	198	71	184	453	153	130	1,189
10	189	69	186	465	154	111	1,174
11	220	91	199	538	166	122	1,336
12	290	142	240	577	211	175	1,635
13	262	123	222	572	193	132	1,504
14	317	157	248	617	222	157	1,718
15	280	123	209	510	181	109	1,412
							9,264

GROSS CASH MARGINS ($000)

YR	JOGYA	WONOGIRI	BANYUMAS	PEKALONGAN	MAGELANG	SRAGEN	TOTALS
1	14	(45)	(31)	17	(21)	(36)	(102)
2	111	17	48	110	50	32	368
3	115	68	99	195	99	86	474
4	119	62	112	219	104	88	704
5	193	126	189	325	176	163	1,172
6	259	179	251	353	232	225	1,499
7	315	264	290	581	273	271	1,994
8	404	285	367	706	346	415	2,523
9	473	361	437	819	419	418	2,927
10	469	364	444	836	424	404	2,941
11	505	390	461	913	444	418	3,131
12	575	441	502	952	488	471	3,429
13	547	421	482	945	470	426	3,291
14	607	463	515	1,000	504	459	3,548
15	570	430	476	892	465	412	3,245

INTEREST EXPENSES ($000)

YR	JOGYA	WONOGIRI	BANYUMAS	PEKALONGAN	MAGELANG	SRAGEN	TOTALS
1	55	61	47	68	53	55	339
2	64	69	55	80	62	64	394
3	72	76	63	91	69	72	443
4	78	81	69	102	75	80	485
5	85	87	77	112	82	88	531
6	89	93	82	118	85	94	561
7	89	96	82	118	85	96	566
8	89	98	82	118	85	96	568
9	126	137	115	166	121	134	799
10	124	135	113	163	117	132	784
11	122	132	111	160	117	129	771
12	119	129	109	157	114	127	755
13	117	127	106	153	112	124	739
14	121	134	112	161	116	131	775
15	117	131	109	156	114	127	754

DEBT SERVICE PAYMENTS ($000)

YR	JOGYA	WONOGIRI	BANYUMAS	PEKALONGAN	MAGELANG	SRAGEN	TOTALS
1	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-
9	205	220	185	267	197	214	1,288
10	205	220	185	267	197	214	1,288
11	205	220	185	267	197	214	1,288
12	205	220	185	267	197	214	1,288
13	205	220	185	267	197	214	1,288
14	226	250	209	300	217	245	1,447
15	226	250	209	300	217	245	1,447

PROJECT: BANYUMAS & CILACAP

YR	Consumer Served	KWH Sold	MW Demand	Annual L.F. %	Cumul.Pl't Investm't	KVA Trans.	Op.Rev. (US$1000)	Op. Exp. (US$1000)
1	3,665	1,249	1.16	16	2,563	6,500	152	301
2	9,284	2,825	2.4[illegible]	17	2,945	7,720	356	446
3	13,605	4,049	3.25	18	3,305	9,800	5[illegible]3	571
4	17,358	5,135	3.86	19	3,612	11,640	653	714
5	20,581	6,950	4.90	20	4,098	13,780	877	881
6	23,273	8,773	5.82	21	4,292	14,620	1,107	1,064
7	25,440	11,020	6.89	22	4,447	15,340	1,367	1,290
8	27,187	12,914	7.31	24	4,558	15,500	1,594	1,444
9	28,514	14,853	7.67	26	4,666	16,420	1,817	1,633
10	29,495	16,353	7.75	28	5,004	16,840	1,991	1,805
11	30,166	18,142	8.21	29	5,070	17,760	2,192	1,993
12	29,607	19,480	8.42	30	5,110	18,040	2,343	2,103
13	30,941	21,217	8.88	31	5,144	18,600	2,532	2,310
14	31,191	22,497	9.02	32	5,162	18,600	2,671	2,423
15	31,390	23,167	9.30	32	5,377	18,600	2,738	2,529

PROJECT: PEKALONGAN & PEMALANG

YR								
1	8,712	2,[illegible]14	2.6	16	3,696	10,869	349	502
2	15,257	4,861	4.18	17	4,261	12,829	614	703
3	21,496	6,765	5.43	18	4,832	15,989	859	891
4	27,05[illegible]	8,531	6.41	19	5,324	19,309	1,081	1,116
5	32,064	[illegible]1,333	7.99	20	5,884	22,689	1,415	1,370
6	36,524	14,550	9.65	21	6,209	24,109	1,705	1,651
7	39,958	18,138	11.34	22	6,426	25,009	2,274	2,001
8	42,518	21,288	12.05	24	6,597	25,169	2,646	2,254
9	44,350	24,199	12.50	26	6,737	26,549	2,985	2,532
10	45,702	26,544	12.58	28	7,119	27,349	3,255	2,790
11	46,821	29,332	13.27	29	7,235	28,789	3,576	3,038
12	47,683	31,630	13.67	30	7,303	29,269	3,831	3,254
13	48,341	34,380	14.39	31	7,378	30,209	4,144	3,572
14	48,847	36,500	14.63	32	7,405	30,209	4,37[illegible]	3,758
15	49,276	37,674	15.1	32	7,638	30,209	4,479	3,969

PROJECT: BANYUMAS & CILACAP (cont'd.)

YR	Pwr. Cost (US$1,000)	KM of Line	3ϕ Vϕ KM	1ϕ KM	Secondary KM	Secndry. UB	Oper. Exp. Less Pwr.	
1	86	360	32	99	136	93	215	
2	192	384	32	100	158	94	254	
3	281	401	32	100	175	94	290	
4	359	417	32	101	189	95	355	
5	489	428	32	101	200	95	392	
6	631	438	32	102	208	96	433	
7	797	444	32	102	214	96	493	
8	938	450	32	103	218	97	506	
9	1083	455	32	104	221	98	550	
10	1198	457	32	104	223	98	607	
11	1355	460	32	105	224	99	638	
12	1461	463	32	106	225	100	642	
13	1615	463	32	106	225	101	695	
14	1719	465	32	107	225	101	704	
15	1822	465	32	107	225	101	707	

PROJECT: PEKALONGAN & PEMALANG (cont'd.)

YR								
1	194	564	64	209	94	197	308	
2	337	600	64	209	130	197	366	
3	471	634	64	209	164	197	420	
4	597	463	64	209	190	198	519	
5	797	681	64	209	210	198	573	
6	1029	696	64	209	225	198	622	
7	1289	708	64	209	235	200	712	
8	1521	716	64	209	243	200	733	
9	1737	722	64	209	249	200	795	
10	1914	726	64	209	253	200	876	
11	2124	729	64	209	256	200	914	
12	2336	731	64	209	258	200	918	
13	2579	733	64	209	260	200	993	
14	2748	733	64	209	260	200	1010	
15	2958	734	64	209	260	201	1011	

PROJECT: JOGYAKARTA

YR	Cnsmrs. Served	MWH Sold	MW Demand	Annual L.F.	Plant Investm't	KVA Trans.	x(10)^3 Oper.Rev	x (10)^3 Oper.Exp.
1	5,346	1,888	1.3	16	3,019	8,400	228	352
2	10,730	3,748	2.5	17	3,403	9,800	452	501
3	15,043	5,248	4.2	18	3,747	12,000	633	697
4	18,532	6,627	4.9	19	4,052	14,400	789	865
5	21,501	8,603	6.0	20	4,437	17,000	1,021	1,040
6	23,939	10,861	7.2	21	4,614	17,600	1,284	1,250
7	25,928	13,599	8.5	22	4,774	18,600	1,598	1,513
8	27,604	15,630	8.[illegible]	24	4,890	18,800	1,850	1,680
9	29,020	18,016	9.3	26	5,022	19,800	2,104	1,906
10	30,173	19,782	9.7	28	5,392	20,600	2,295	2,106
11	31,107	22,024	9.9	29	5,488	21,600	2,554	2,334
12	31,928	23,861	10.3	30	5,558	22,000	2,777	2,487
13	32,636	25,834	10.[illegible]	31	5,619	22,800	2,987	2,725
14	33,240	27,574	11.0	32	5,649	22,800	3,191	2,874
15	33,737	28,399	11.43	32	5,881	22,800	3,284	3,004

PROJECT: WONOGIRI

YR								
1	5,098	1,483	1.37	16	3,282	6,260	186	384
2	9,938	2,803	2.41	17	3,622	7,200	358	514
3	13,852	2,909	3.13	18	3,934	8,960	503	624
4	16,932	4,796	3.60	19	4,193	10,660	615	756
5	19,554	6,364	4.48	20	4,550	12,620	805	897
6	21,918	8,052	5.33	21	4,737	13,560	1,009	1,062
7	24,019	10,104	6.31	22	4,904	14,360	1,255	1,278
8	25,858	11,982	6.78	24	5,032	14,680	1,475	1,437
9	27,390	13,903	7.18	26	5,163	15,720	1,702	1,631
10	28,616	15,493	7.34	28	5,525	16,340	1,886	1,817
11	29,635	17,385	7.86	29	5,624	17,300	2,104	2,013
12	30,444	18,907	8.17	30	5,683	17,660	2,281	2,139
13	31,619	20,689	8.65	31	5,731	18,140	2,479	2,350
14	31,422	22,046	8.83	32	5,755	18,140	2,636	2,477
15	31,703	22,653	9.07	32	5,975	18,140	2,701	2,578

PROJECT: JOGYAKARTA (cont'd.)

YR	$x(10)^3$ Pwr.Costs	Line KM	3ϕ & Vϕ KM	1ϕ KM	Secondary KM	Secondary UB	Op.Exp.$(10)^3$ lessPwr.	
1	101	347	82	119	146	150	251	
2	205	365	82	119	164	150	296	
3	365	381	82	119	180	151	332	
4	464	394	82	119	193	151	401	
5	605	405	82	119	204	151	435	
6	781	414	82	119	213	152	469	
7	983	421	82	119	220	152	530	
8	1,135	427	82	119	226	152	545	
9	1,314	433	82	119	232	154	592	
10	1,449	438	82	119	237	154	657	
11	1,645	442	82	119	241	154	689	
12	1,790	445	82	119	244	156	697	
13	1,967	445	82	119	244	156	758	
14	2,107	445	82	119	244	156	767	
15	2,234	445	82	119	244	158	770	
						158 ÷	201=78.6	%

PROJECT: WONOGIRI (cont'd.)

YR								
1	102	385	82	174	129	191	282	
2	194	40[illegible]	82	174	147	191	320	
3	272	419	82	174	163	191	352	
4	336	433	82	174	177	191	420	
5	448	445	82	174	189	191	449	
6	579	454	82	174	198	191	483	
7	730	462	82	174	206	191	548	
8	870	468	82	174	212	191	567	
9	1,014	473	82	175	216	192	617	
10	1,135	476	82	175	219	192	682	
11	1,299	479	82	176	221	193	714	
12	1,418	481	82	177	222	194	721	
13	1,575	482	82	178	222	195	775	
14	1,684	483	82	179	222	196	793	
15	1,782	483	82	179	222	196	796	
						196 ÷	261 = 75	%

PROJECT: MAGELANG

YR	Consumers Served	MWH Sold	KW Demand	Annual L.F.	Cumm. Pl. Invst	KVH Trans.	Oper. Revenue	Oper. Expenses
1	5,409	1,677	1.55	16	2,901	6,720	205	359
2	10,423	2,930	2.52	17	3,255	7,940	384	488
3	14,710	4,214	3.38	18	3,607	9,760	539	612
4	18,360	5,287	3.97	19	3,896	11,600	673	757
5	21,262	6,925	4.88	20	4,259	13,640	878	906
6	23,656	8,755	5.80	21	4,454	14,640	1,097	1,081
7	25,774	10,916	6.82	22	4,626	15,520	1,351	1,299
8	27,628	12,930	7.32	24	4,757	15,880	1,585	1,465
9	29,212	15,024	7.76	26	4,894	17,000	1,8[illegible]4	1,671
10	30,531	16,750	7.94	28	5,313	17,720	2,018	1,864
11	31,590	18,805	8.50	29	5,408	18,740	2,248	2,082
12	32,390	20,485	8.86	30	5,466	19,140	2,429	2,218
13	32,978	22,387	9.37	31	5,517	19,800	2,639	2,446
14	33,406	23,874	9.57	32	5,540	19,800	2,797	2,575
15	33,726	24,738	9.90	32	5,763	19,800	2,880	2,699

PROJECT: SRAGEN

YR								
1	4,615	1,505	1.39	16	2,999	7,000	182	356
2	9,771	3,029	2.60	17	3,421	8,160	377	505
3	14,126	4,362	3.50	18	3,799	10,300	544	638
4	17,830	5,438	4.08	19	4,189	12,340	678	790
5	21,253	7,317	5.15	20	4,603	14,600	909	966
6	24,266	9,318	6.17	21	4,797	14,600	1,148	1,158
7	26,672	11,678	7.30	22	4,989	16,300	1,428	1,400
8	28,388	12,757	7.22	24	5,097	16,410	1,665	1,497
9	29,582	15,787	8.15	26	5,198	17,320	1,902	1,772
10	30,375	17,321	8.21	28	5,540	18,000	2,062	1,951
11	30,938	19,143	8.66	29	5,606	18,800	2,263	2,141
12	31,392	20,640	9	30	5,653	19,200	2,439	2,264
13	31,739	22,476	9.4	31	5,696	19,800	2,617	2,485
14	32,005	23,901	9.6	32	5,717	19,800	2,769	2,612
15	32,217	24,464	9.9	32	5,991	19,800	2,836	2,727

PROJECT: MAGELANG (cont'd.)

YR	Power Costs	KM of Line	Bo & Vo KM	lo KM	Secondry KM	Secondary U.B.	Op.Exp. less Pwr.	
1	115	485	59	143	137	146	244	
2	203	502	59	143	154	146	285	
3	293	519	59	143	170	147	319	
4	370	532	59	143	183	147	387	
5	487	545	59	143	195	148	419	
6	630	555	59	143	205	148	451	
7	789	564	59	143	213	149	510	
8	939	570	59	143	219	149	526	
9	1,096	575	59	143	224	149	575	
10	1,227	578	59	143	227	149	637	
11	1,405	581	59	143	229	150	677	
12	1,536	583	59	143	230	151	682	
13	1,705	583	59	143	230	151	741	
14	1,824	584	59	143	230	152	751	
15	1,946	584	59	143	230	152	753	

PROJECT: SCRAGEN (cont'd.)

YR								
1	104	1,262	95	120	139	108	252	
2	210	1,285	95	120	162	108	295	
3	304	1,305	95	120	182	108	334	
4	381	1,319	95	120	196	108	409	
5	515	1,329	95	120	206	108	451	
6	670	1,335	95	120	212	108	488	
7	844	1,339	95	120	216	108	556	
8	926	1,344	96	121	219	109	571	
9	1,152	1,350	97	122	221	110	620	
10	1,269	1,355	98	123	223	111	682	
11	1,430	1,359	99	124	224	112	711	
12	1,548	1,363	100	125	225	113	716	
13	1,711	1,366	101	126	225	114	774	
14	1,826	1,369	102	127	225	115	786	
15	1,934	1,372	103	128	225	116	793	

RURAL ELECTRIFICATION FEASIBILITY STUDIES

FOR

CENTRAL JAVA, INDONESIA

VOLUME 2

TECHNICAL REFERENCE ANNEX

NRECA INTERNATIONAL CONSULTING SERVICES

February 1978

PREPARED UNDER

TASK ORDER NO. 5

CONTRACT NO. AID/pha - 1090

PROJECT NO. 498-11-995-249

BETWEEN THE

UNITED STATES OF AMERICA

AGENCY FOR INTERNATIONAL DEVELOPMENT

AND THE

NATIONAL RURAL ELECTRIC COOPERATIVE ASSOCIATION

WASHINGTON, D.C.

March 1, 1977

PIO/T 498-249-3-60279 and 498-249-3-6478013

March 2, 1977

TECHNICAL REFERENCE ANNEX

TABLE OF CONTENTS

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INDONESIAN TERMS USED IN THIS REPORT

Bupati	Head of a kabupaten.
Camat	Head of a kecamatan.
Desa	Village or town.
Kabupaten	Administrative district below province level.
Kampung	Local district within a desa or town.
Kecamatan	Administrative district below kabupaten level.
Lurah	Official in charge of a desa or town.
Pusat	District center or headquarters.

CURRENCY AND MEASUREMENT EQUIVALENTS

US$1	=	415 Indonesian rupiah
Rp 1	=	US$.00241
1 mill	=	US$.001
1 kilometer	=	.6214 mile (about 5/8 mile)
1 mile	=	1.61 kilometers

ABBREVIATIONS

ADB	Asian Development Bank.
A & E	Architect and Engineering Firm.
AMPS	Ampere.
BAPPEDA	Provincial Economic Development Officer.
BAPPENAS	Planning Board of the Government of Indonesia.
BIMAS	Agriculture Credit Program.
BKK	Badan Kredit Kecamatan.
BRI	Bank Rakyat Indonesia.
CFC	National Rural Utilities Cooperative Finance Corporation (U.S.A.).
CIDA	Canadian International Development Agency.
COOP	Cooperative.
CP	Condition Precedent.
DGC	Directorate General of Cooperatives.
DSC	Debt Service Coverage.
GNP	Gross National Product.
GOI	Government of Indonesia.
GWH	Gigawatt hour, or a billion watt hours.
HP	Horsepower.
IDA	International Development Agency.
IBRD	World Bank.
IFB	Invitation for Bid.
IGGI	Intergovernmental Group for Indonesia, the Indonesian Foreign Aid consortium.
IPB	Institut Pertanian Bogor - the Agricultural College.
KM	Kilometer.
KV	Kilovolt or a thousand volts.

KVA	Kilovolt-Ampere.
KW	Kilowatt.
KWH	Kilowatt hour, or a thousand watt hour.
LEKNAS	National Institute of Economics and Social Research.
L.F.	Load Factor.
MW	Megawatt, or one million watts.
NEA	National Electric Administration of the Philippines.
NRECA	National Rural Electric Cooperative Association (U.S.A.).
OMT	Organizational, Management and Technical Team.
PACD	Project Assistance Completion Date.
BPS	Indonesian Control Bureau of Statistics.
PDO	Project Development Office of the Directorate General of Cooperatives.
PID	Project Identification Document.
PLN	Perusahaan Umum Listrik Negara, The National Electric Power Agency.
PP	The Project Paper.
PRP	Project Review Paper.
REA	Rural Electrification Administration (U.S. Department of Agriculture).
STM's	Technical High School.
TIER	Times Interest Earned Ratio.
USAID	United States Agency for International Development.
V	Volt.
VA	Volt-Ampere, approximately one watt.
W	Watt.

6

PART A

EXPLANATION AND USE

OF

TECHNICAL REFERENCE ANNEX

A. EXPLANATION AND USE OF TECHNICAL REFERENCE ANNEX

This document consists of base information, estimates and calculations compiled by the NRECA Feasibility Study Team and USAID/Jakarta personnel prior to the preparation of the six subject financial forecasts found in Volumes 3 through 8 of this report.

The document includes salient information which describes how the six project areas were chosen, what steps were taken in study formulation, and how plant costs and design strategies were developed that subsequently set out the parameters for forecast preparation. Accordingly, the document should be read in concert with Volumes 3 through 8.

The document should also be read in concert with the "Summary Evaluation" document (Volume 1) of this report for reference to matters discussed in that document. Primary reference in this connection should be made to the power cost and the retail rate sections of the Annex.

In short, this Annex is primarily designed as a reference document; accordingly, the reader should peruse the table of contents of the Annex for specific data sought. The Annex, however, is also arranged to assist those readers who desire to read the entire Annex from beginning to end for background purposes.

PART B

PROJECT BACKGROUND

B. PROJECT BACKGROUND

1. GENERAL.

The Government of Indonesia has determined that electric service shall be an integral part of its development program for all the people on its 3,000-and-more islands. Rural electrification is to be one of the essential elements in the implementation of this policy.

Assistance in this undertaking has been requested of the United States Agency for International Development, and USAID has expressed interest in such a project. Patterns and experience for full rural electrification are available in the USAID-assisted program in the Philippines as well as in the 42-year-old success of the Rural Electrification Administration and nearly 1,000 rural electric cooperatives in the United States.

USAID contracted with the National Rural Electrification Cooperative Association (NRECA) to make a pre-feasibility study to determine what potential existed for establishment of government-assisted consumer-owned electric distribution systems in Indonesia. The report of the NRECA Study Team, published in May 1976 as RURAL ELECTRIFICATION FOR INDONESIA, concluded that there were many densely populated rural areas within and beyond the reach of the national power grid system which could support area coverage rural electric utilities.

The findings and recommendations of that study were based on the premise that such systems would be economically constructed and operated in areas where the topography, concentrations of population, and the economic base, offer a satisfactory climate for such an undertaking. It was recognized that if adequate capital financing and administrative capabilities were provided, then the principle requirements would exist for a rural electrification program which could bring better living conditions for millions of the Nation's poor people as well as economic benefits to the country at large.

The islands of Indonesia stretch 3,300 miles from east to west and 1,000 miles from north to south, covering an area which makes this the sixth largest nation in the world. The population of 140,000,000 makes Indonesia the fifth most populous among the nations. The wealth of forests and agricultural land, of minerals and water resources is still largely untouched.

Indonesia's people have not, as a whole, been able to benefit from this wealth of resources. It has been demonstrated that rural electrification is essential in opening the country's wealth to development and in spreading its benefits to the great percentage of the population which is impoverished.

More than three-fourths of the families on these islands depend on farming and other rural endeavors, and yet it is in these rural areas where poverty is most widespread. It is interesting to note that fewer than one out of a hundred rural families have electricity, in contrast to Jakarta where it is used by 24 out of 100.

The State Electricity Enterprise, Perusahaan Umum Listrik Negara (PLN), has been making good use of the considerable water power potential on Java, Sumatra, and other islands. Petroleum is both abundant and cheap as an energy source for electricity in Indonesia. As the world demand for petroleum continues to grow and known reserves decrease, this fuel will soon have to give way to alternative sources of energy. Gas has not been fully exploited but this, too, has finite limitations. Fortunately, resource exploration indicates ample supplies of coal which can be developed to fuel new large generating stations in coordination with the country's hydro generating plants.

The generation of electricity is not seen, therefore, as so much of a problem as rural distribution systems in developmental planning for the people of Indonesia.

As a result of the encouraging pre-feasibility report in 1976, the Government of Indonesia has expressed continuing interest in USAID assistance for rural electrification and asked that feasibility studies be prepared for ten distribution systems which could be observed as pilot projects in anticipation of an expanding program for service to rural areas. Financial assistance in terms of low-interest, long-term financing is being sought from USAID and other bilaterial foreign assistance donor countries for this initial stage, depending upon a finding of satisfactory feasibility.

It was requested by the Government of Indonesia that three sites, Central Lampung, East Lombok, and Luwu on Sulawesi, be studied in full by NRECA for cooperative-type electric systems on islands other than Java. It was determined, then, that NRECA feasibility studies would be prepared for seven area coverage projects in Java which could be tied into the PLN grid.

USAID contracted with NRECA to field a team of rural electrification specialists with many years of experience in engineering, economics, and rural life to prepare feasibility studies to provide a basis for a project proposal for a rural electrification loan. A six-member team arrived in Jakarta in mid-March and began immediate field study of possible sites proposed by PLN and by the Directorate General for Cooperatives in the Ministry for Transmigration, Manpower, and Cooperatives.

Their investigation and analysis has depended heavily on information supplied by Indonesian sources and upon guidelines from both the Government of Indonesia and USAID. Preparation of the feasibility studies is predicated on the experience of these rural electriciation specialists in various countries of the world in addition to the Philippines and the United States.

This report covers the last six of the ten project studies prepared by the NRECA Team. Three of these are for consideration by the DGC and seven are for PLN. Field notes, basic data, and maps have been prepared for all areas, and this information is being placed in USAID files for future use.

There are many, many other areas in Indonesia where similar projects could be undertaken with excellent prospects for success. It is recommended that the Directorate General for Cooperatives and PLN collaborate on a joint national power survey to determine the most feasible approach to a program of total nation-wide rural electrification. Enormous resources of manpower and money will be required to electrify Indonesia. It is essential, therefore, that before such heavy commitments are made for rural electrification, the very best plan of action be agreed upon and adopted.

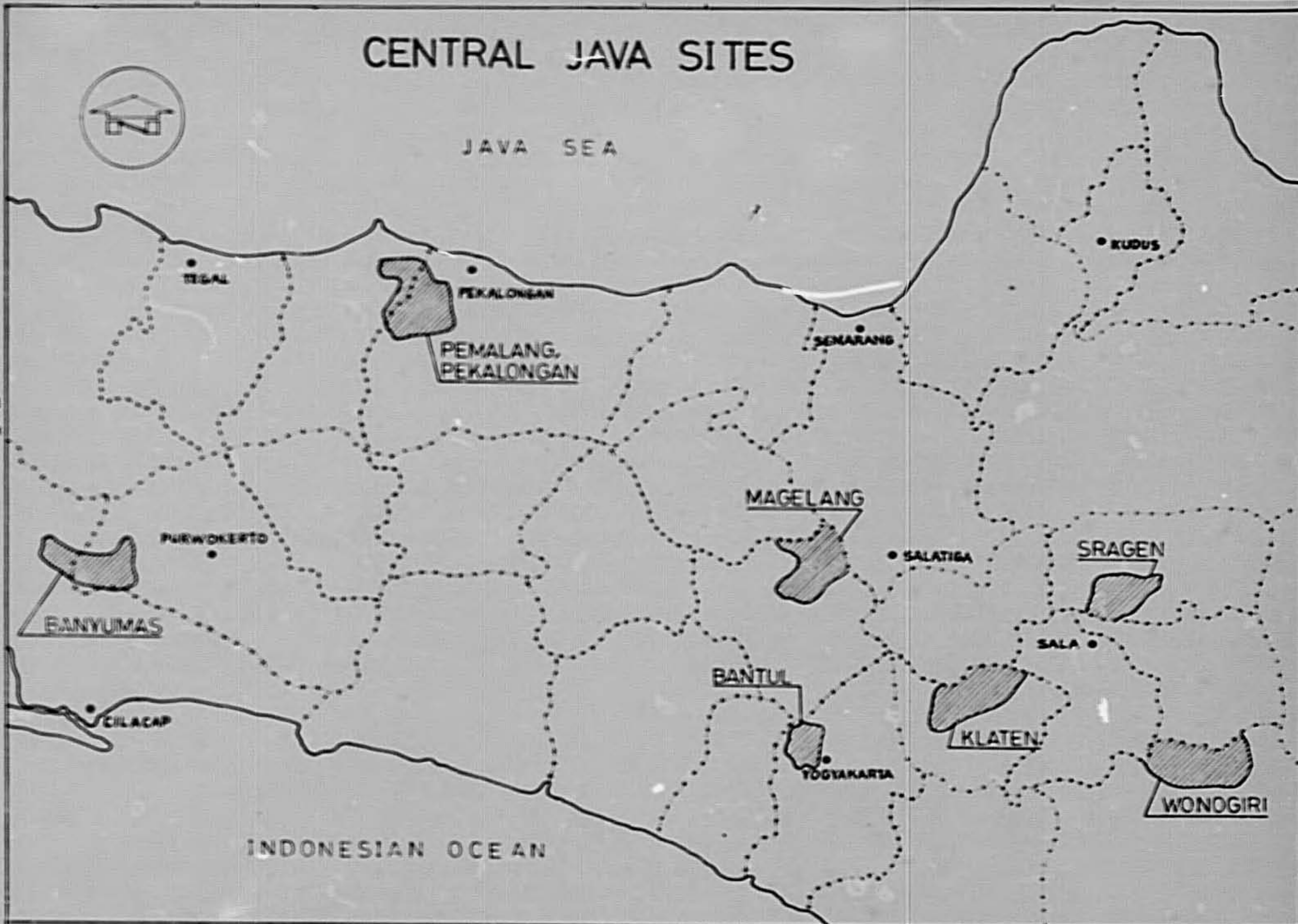
?. SITE SELECTION AND SITE DESCRIPTIONS.

When the NRECA Team was requested by PLN and USAID/JAKARTA during mid-May 1977 to assist PLN in the preparation of seven engineering and feasibility studies for area coverage rural electric distribution systems, PLN and USAID/J jointly had decided to locate these seven systems in Central Java. The NRECA Team supports this decision for project regional implementation for the technical considerations involved, which included excess generation capacity in the PLN Wilayah XIII system, and compatibility in system design integration.

Shortly after project identification was made on a regional basis, NRECA Team members were requested during early June 1977 to assist PLN and USAID/J in field reconnaissance study of the selected areas to geographically determine priorities in the seven project sites for project evaluation. Based on local and technical considerations, first priority for project study was given to the Klaten site. Accordingly, this was the first area for which a study was prepared (August, 1977). During this process of site **selatin** adequate consideration was given to areas where a reasonably strong and growing demand for electric service can be expected, and where the resulting benefits of electrification can justify the costs. Moreover, each site selected has extremely high population densities, where incomes and living standards are improving, supported by reasonably good road systems.

LOCATIONS OF PROJECT SITES

B-5


CENTRAL JAVA SITES
JAVA SEA
TEGAL
PEKALONGAN
PEMALANG, PEKALONGAN
SEMARANG
KUDUS
PURWOKERTO
BANYUMAS
MAGELANG
SALATIGA
SRAGEN
SALA
BANTUL
KLATEN
WONOGIRI
YOGYAKARTA
CILACAP
INDONESIAN OCEAN

Klaten.

Klaten, selected for one of the first pilot rural service districts by PLN, is a rich agricultural area spread out at the base of Mt. Merapi. It has an economy based on rice, sugar, tobacco, coconuts, and cassava, with some cloves, peanuts and coffee. About half of the farmlands are irrigated rice paddies and sugarcane fields. Most of the irrigation is by gravity flow but there are some pumps. Two or three crops a year are produced on the irrigated land.

The designated service area is north of the city of Klaten, and located between the two old sultanates of Surakarta and Yogyakarta. This is reported to be one of the most densely populated rural sections of Java and perhaps in the world. About 51,000 families live in 98 adjoining villages. Of the whole population, 87% are reported to be farm families or farm laborers. Others own or work in cottage industries or are construction laborers. More than two-thirds of the small industries or businesses engage in processing agricultural produce.

Pemalang/Pekalongan.

This area as its name implies covers a significant portion of the rural populated areas of two districts which lie on the north costal plain of Central Java about 90 km west of Semarang. Economically it is a rice and sugarbowl but it is also famous for colorful handprinted batik and bamboo handicrafts.

The proposed rural electrification will be constructed to serve 109 villages, midway between the two districts each with an average of 33[illegible] total houses. The population of this discrete area is 242,120 people, consisting of 52,176 families. The population density if 1141 people/sq. km. These villages are connected by serviceable dirt roads and are without electricity except for the village of Kajen which has a 50 KV generator supplied by the Provincial Government.

The people in this project area live in 8,787 permanent houses and 27,848 semi permanent houses. It is estimated that 62% are farmers, 30% are farm laborers, 3% are construction laborers, 1% are industry laborers, 2.5% are merchants, 1.5% are government employees and 1% are pensioners. There are 252 cottage industries which collectively employ 1,252 laborers. By general classification 23% of these industries are agriculture processing, 22% are textile fabrication and weaving industry, 15% are metal industry, 23% are wood processing and wood carving industry, 0.5% are chemical industry, and 9.8% are considered as "other".

An estimated 38% of the total land area is irrigated paddy/rice and sugarcane fields. The irrigation system is under-developed and generally gravity flow, but there are also 81 water pumps in operation and some farms produce two or three crops a year. It is felt that the provision of electricity to this area would cause a significant increase in the numbers of irrigation pumps. There are 76 rice storage houses, 47 rice mills, 16 agriculture cooperatives and 52 credit agencies to serve the area's farmers. The principal agriculture crops are rice, sugarcane, maize, peanuts and cassava.

The proposed electrification service area has 92 village offices, 73 meeting halls and 8 clinics staffed with 6 doctors, 41 nurses, and 14 midwives. There are also 242 traditional local practitioners of medicine. Besides that, there are 238 schools staffed with 1,253 teachers who instruct 36,859 pupils. It is estimated that 27% of the population have graduated from elementary school, 4% from Jr. high school and 2% from high school. There are also 344 mosques and churches in this proposed service area.

The Ministry of Interior data show that the people own 3,637 radios and 340 television sets, which are run by batteries or from small generators. The present kerosene consumption in this service are is estimated to be 902,946 litres/ month.

Magelang.

Magelang is located in the center of Central Java. It lies in a valley between Mount Sumbing and Mount Merbabu and alongside the busy trunk road which winds its way through the mountains from Semarang to Yogyakarta. Magelang is wellknown because of the existence in the area of a number of Hindu Temples dating from the 9th Century which attract a lot of tourists. It is also the home of the Indonesian Military Academy and was an anti-colonist stronghold during the revolution against the Dutch.

The proposed rural electrification project will be constructed to serve some 84 villages to the east of the city of Magelang. This area is entirely rural as the average total houses in each village is 366. The population of this area is 175,630 people consisting of 29,437 families. Population density is 1002 people/sq.km. The villages are connected by an excellent road network but the area is presently devoid of electricity.

The people in this proposed service area live in 2,310 permanent houses and 27,961 semi permanent houses. It is estimated that 70% are farmers, 17% are farm laborers, 3% are construction laborers, 1% are merchants, 0.5% are government employees and 9.5% are pensioners. There are 108 cottage industries which collectively employ 628 laborers. By general classification 65% of these industries are agriculture processing, 2.6% are textile fabrication and weaving, 9.5% are metal works, 10.4% are wood carving and wood processing industry, 0.2% are tobacco/cigarette industry and 7.8% are listed as "others".

An estimated 32% of the total land area is irrigated paddy/rice and sugarcane fields. The existing irrigation system is underdeveloped and generally gravity flow but there are presently some 14 water pumps in operation in four villages around Grabag and some farms do produce two or three crops a year. There are 22 rice storage houses, 31 ricemills, 5 Agriculture Cooperatives and 11 credit agencies to serve the area's farmers. The principal agriculture crops are rice, maize, sugar, tobacco, cassava and soybean. Peanuts, cloves and coffee are also grown in this area.

The proposed rural electrification service area has 83 village offices, 39 meeting halls and 7 clinics staffed with 3 doctors, 13 nurses, and 5 midwives. There are also 176 traditional local practitioners of medicine. Beside the above there are 190 schools staffed with 1141 teachers who instruct 22,688 pupils. It is estimated that 20% of the population have graduated from elementary school and 3% from Jr. high school. There are also 307 mosques and churches in this area.

According to 001 data the people own 2760 radios and 93 television sets, which are run by batteries or from small generators. The present kerosene consumption in this proposed service are is approximately 691,249 liters per month.

Yogyakarta/Bantul.

Bantul District is located just to the west of Yogyakarta, and is a part of a special area which is still ruled by a Sultan. Sultan Hamengkubuwono IX is also presently Vice President of the Republic of Indonesia. President Suharto was also born in this area. Bantul District produces high quality batik material, stone carvings, ceramics and other handicrafts.

The proposed electrification project will be constructed to serve 21 villages in the northern half of Bantul District. A village in the special area of Yogyakarta is administratively larger than in other districts of Central Java. So while each village in this area has an average of 1,266 houses, the villages are really clusters of hamlets, each hamlet having 300 to 400 houses. The project will serve 60-80 of these hamlets. The population of this area is 169,964 people consisting of 36,840 families. These families live in 18,395 permanent houses and 8,154 semi permanent houses. The population density is 1,403/sq. km.

The villages are connected by two asphalt roads leading out from Yogyakarta and a network of dirt village roads that are in generally good condition. There was no electricity in the area during summer, 1977 except at Godeyan where there is a small private company which sells electricity to about 200 customers in four hamlets. The President's village was also electrified. It is estimated that 60% are farmers, and farm laborers, 24% are other wage laborers, 8.5% are salaried professional workers including government employees, 5.5% are merchants and 1.5% are pensioners. There are 1,104 known cottage industries within this proposed service area which collectively employ some 7,260 laborers. The land area used for growing rice and sugarcane fields are, like the Klaten area, intensively farmed with little space or water wasted. The irrigation system is mainly gravity flow, but there are presently 117 water pumps in operation and this number will no doubt increase with electrification as there are seven separate streams which flow through Bantul District. According to a recent survey there are 72 rice storage houses, 120 ricemills, 6 Agriculture cooperatives and 33 credit agencies now in operation to serve the farmers in this area. Besides rice and sugarcane the other principal crops are coconuts, corn and soybean.

The proposed rural electrification service area has 107 village offices, 22 meeting halls and 5 clinics staffed with 20 doctors, 38 nurses and 16 midwives. There are also 163 traditional local practitioners of medicine. Education facilities include some 181 schools staffed with 1,622 teachers who instruct 33,410 pupils. There are also 136 mosques and churches in this area.

According to Ministry of Interior data the people own 7,952 radios and 499 television sets, which are run by batteries or from small generators. The present kerosene consumption in this proposed service are is approximately 788,273 liters per month.

Wonogiri.

Wonogiri lies on the southern base of the 3,265 meter bulk of Mount Lawu, approximately 30-40 km. south of Surakarta. President Suharto grew up in a small village about 10 km. further to the south.

The proposed rural electrification project will be constructed to serve 54 villages that are scattered within 3-4 km. on either side of the main highway connecting Wonogiri to Pacitan in the Province of East Java. The area is entirely rural. The average number of houses in each of these villages is 647. The population of the proposed service area is 167,081 people consisting of 29,995 families. The density if 872 persons/sq.km.

The 1974 edition of Guide to Java describes the main access road as "... a punishing 30 km. stretch of pot-holed road ... bearable only once". PLN, NRECA, USAID field trips confirmed however, that all of the villages are reachable by jeep and that the area is devoid of electricity. The level of economic activity on the surface also appeared to be less than in all the other Central Java sites except Sragen. Moreover, estimates based upon social economic surveys and polls of the village leaders indicate that 62% of the inhabitants in this area can afford electricity under the program described and will desire to connect up.

The people in this proposed service area live in 2,665 permanent houses and 32,292 semi permanent houses. It is estimated that 60% are farmers, 24% are farm laborers, 2% are construction laborers, 6% are industry laborers, 3% are merchants, 5% are pensioners, 1.4% are government employees and 3.6% are others. There are 384 cottage industries, which collectively employ 2,051 laborers. By general classification 22% of these industries are agriculture processing, 4.7% are textile fabrication and weaving industry, 26% are metal works, 9.4% are wood carving and saw mills, 26% are non metalic or earth industry, 8.7% are listed as "others".

An estimated 17% of the total land area is irrigated paddy/rice and sugarcane fields. The irrigation system is under developed and general gravity flow, but there are also 9 water pumps in operation in this service area. A significant increase in the numbers of irrigation pumps is expected after electrification. There are presently 34 rice storage houses, 8 agriculture cooperatives, 19 ricemills, and 10 credit agencies to serve the area's farmers. The principal agriculture crops are upland and lowland rice, sugarcane, corn and cassava.

The proposed Wonogiri service area has 48 village offices, 33 meeting halls and 7 clinics, staffed with one doctor, 12 nurses, and 8 midwives. There are also 170 local medical practitioners. Educational facilities total 112 schools staffed with 853 teachers who instruct 27,143 pupils. It is estimated that 37% of the population have graduated from elementary school, 4.3% from J high school and 2% from high school. There are also 49 mosques and churches in this area.

The Ministry of Interior data show that the people own 4,072 sets of radios and 119 television sets, which are run by batteries or from small generators. The present kerosene consumption for this area is estimated to be 688,128 liters per month.

Sragen.

Sragen is located 20-30 kilometers north of Surakarta and is on the edge of the draught prone "critical area" of Central Java. However, the Bengawan Solo river and other smaller tributaries flow through the proposed service area so that electrically powered irrigation pumps could possibly turn the existing grey, dry upland rice and cassava fields into lush green rice paddies.

The proposed rural electrification project will be constructed to serve 47 villages with a total population of 139,278 people consisting of 29,528 families. The population density is 872 people per square kilometer. The area is entirely rural.

The people in this service area live in 5,157 permanent houses and 24,570 semi permanent houses. There is one 350 seat theater at the village of Gemolong which is in the center of the project area. Gemolong also has a 50 KVA diesel generator provided by the Provincial Government which provides electricity to about 75 customers, The rest of the area is devoid of electricity. It is estimated that 60% are farmers, 26% are farm laborers, 3% are cottage industry laborers with 0.2% small industry owners, 2% are merchants, 6% are salaried including government employees and 2% are pensioners. There are 87 known cottage industries which collectively employ 1,526 laborers. By general classification 19% of these industries are agriculture processing, 26% are textile weaving industry, 3% are tobacco industry, 9% are metal industry, 15% are craft/non-metal industry, 12% are sawmills and wood processing, 2% are rubber plastic and chemical industry, 18% are "others".

An estimated 45% of the total land area is rainfed paddy rice and sugarcane fields. The irrigation system is generally underdeveloped and where existing, gravity low, but there are also 191 water pumps in operation in this service area. This number will surely increase with electrification. There are 109 rice storage houses, 51 ricemills, 8 agriculture cooperatives, and 202 credit agencies to serve the area's farmers.

The rural electrification service area has 36 village offices, 32 meeting halls and 5 clinics staffed with 3 doctors, 23 nurses, and 11 midwives. There are also 153 traditional local practitioners of medicine. Educational facilities total 142 schools with 1,030 teachers who instruct 21,693 pupils. It is estimated that 22% of the inhabitants of this area have graduated from elementary school. 5% from Jr. high school and 3% from high school. There are also 142 mosques and churches in this service area.

According to Ministry of Interior data the people own 2,524 radios and 110 television sets which are run by batteries or from small generators. The present kerosene consumption in this service area is 640,174 liters per month.

Banyumas/Cilacap.

This area is located about 15 km. west of Purwokerto in Central Java. It consists of some 36 villages which lie within 3 or 4 kilometers on either side of a 60 kilometer stretch of the main road which connects Purwokerto and Banjar/Tjiamis in West Java.

Traveling west from Purwokerto, the elevation rises from 20 meters to about 400 meters above sea level and the terrain becomes hilly with much of the road paralleling the Tji Haur river. The area is entirely rural with the central village, Wangon, having only 1,274 houses and the rest of the villages averaging only 842 houses. The population is 156,975 consisting of 30,313 families. The density of 791 people/sq.km. is the lowest of all the proposed Java sites. The 1974 edition of Guide to Java describes Wangon ".. .as the cleanest and prettiest town in Central Java with neat houses set well back of the road behind white-washed fences of split bamboo .. .". Wangon has a small generator provided by the military which provides electricity to some 24 customers. The rest of the area is devoid of electricity but PLN has constructed a 20 KV line from the 20 MW substation at Purwokerto to the edge of the area so all that is required is a 40 KM extension of this line and the construction of a distribution network.

It is estimated that 84% of the people are farmers or farm laborers, 8% are salaried workers including school teachers, military and government employees, 5% are merchants and the rest pensioners and "others". They live in 29,001 semi permanent houses and 913 permanent houses. They shop at some 565 stores. They enjoy two movies houses, each having 500-600 seats. There are 226 known cottage industries in the proposed service area which collectively employ 2,644 laborers.

However, the economy is based upon agriculture, particularly rice, corn, cassava, sweet potatoes and peanuts. Cloves are also grown as a lucrative cash crop. An estimated 32% of the farmable land area in the proposed service area is rice fields but most of that is non-irrigated rain fed. However,there are some 44 water pumps and this n number will surely increase with electrification. There are 38 rice storage houses, 22 ricemills,5 agriculture cooperatives and numerous credit agencies to serve the area's small farmers.

The 36 villages have 29 offices, 28 meeting halls and 6 clinics staffed with 3 doctors, 13 nurses and 9 midwives. There are also 152 other more traditional medical practitioners. Education facilities total some 122 school with 770 teachers who instruct some 24,219 pupils. There are 219 mosques and churches in the area.

According to Ministry of Interior data, the people own 2,317 radios and 82 television sets, which are run by batteries or from small generators. The present kerosene consumption within the proposed service area is estimated to be 672,594 liters per month.

3. STUDY DEVELOPMENT.

Following the identification of the proposed project sites during June 1977, a number of inter-related surveys, studies and analyses were made that led up to the completion of this report and its six subject feasibility study estimates. Chronologically these events took place.

During June and July 1977 following site selection, a field survy study covering the salient social and economic factors relating to the establishment of area coverage rural electricity in the seven sites took place. A separate USAID project grant was made available to conduct this research under the guidance of Dr.F.Okada (USAID contract Anthropologist) and Mr. Philip Costas (of the NRECA Study Team), assisted by a faculty task team from the Department of Social Economics, Bogor Agricultural University (IPB), Bogor, Indonesia. The IPB team also included 16 field intervierers. For detailed information concerning the IPB study, refer to the "Social Soundness Analysis"study prepared by Dr. Okada included as part of USAID's Project Paper "Indonesia Rural Electriciation I", dated August 1977.

Based on data received from this study,and village profile, mapping and technical information provided by PLN for the seven sites, preliminary engineering designs were prepared and costed-out during July for the seven sites, excluding Klaten,by the NRECA Team. Additional data was gathered for the Klaten study during this time in order to complete that study during August.

During August 1977,under the guidance of the NRECA Team with the assistance of USAID/J staff preliminary 15 year Financial Forecasts were prepared for the remaining six Central Java sites. Summary information of this preliminary studies were included in the USAID Project Paper. Based on the assumptions used for these studies, all six sites indicated financial, economic viability and social soundness.

During September, PLN conducted load surveys in the six remaining sites, and interviewed all operators of diesel generators in excess of 10 h.p. The purpose of the survey was to determine the extent and operating cost characteristics of such generation, and the potential load it would place on the new projects.

During October, a training seminar on the preparation of feasibility study was conducted in Semarang for 40 PLN staff and engineers by the NRECA Team and representatives of USAID/J. During the seminar all the analyses and forms used by the NRECA Team in the Klaten report were reviewed and work sessions were held using these forms, applying them on two of the six remaining Central Java sites. Concurrent with the work sessions a team from PLN reviewed and critiqued the forms in depth, and prepared a "draft feasibility study"manual for PLN use based on these forms.

In November, a twelve man team from Wilayah XIII was detailed, under the guidance of the NRECA Team, to conduct the engineering analysis and financial calculations to complete studies for the six remaining sites.

Their work was monitored by NRECA Team and additional field trips were made to the project sites to ascertain facilities in place and under construction, in order to comment on the system engineering designs being developed by the PLN Team for the six sites.

By December, these studies were completed by the PLN Team and presented to NRECA Team and USAID/J electrical engineers for review. Review sessions were then held with PLN Pusat and Wilayah XIII staff in Jakarta, where it was determined that certain engineering design assumption used in the studies required revisions. Such changes were also discussed at a second feasibility study training seminar held in Bali during December.

During January, 1978 the suggested revision to the six studies were made by the PLN Team in Semarang. Draft copies of the revised studies were brought to Menado, North Sulawesi in late January, where they were analysed during a third PLN feasibility study training seminar. At this seminar 50 PLN representatives from Pusat and all operating and transmission regions attended. Feasibility study terminology, criteria, engineering standards, operating structure and financial policy for a PLN nationwide program were discussed. Recommendations culminating from these discussions later were presented to the PLN Board of Director for consideration. Also during the seminar, feasibility studies prepared by the Wilayah VII staff and other regions of the country were received by the participants,and a partially computerized program to assist PLN feasibility study preparation was presented for participant use.

Finally in February, 1978 the final revised PLN studies for the six remaining Central Java sites were presented to the NRECA Team, in order for them to compile this report. In review, it can easily be seen that an extended period of thought and rethought was taken during the period when these studies were prepared,affording an unique learning experience for all involved.

PART C

DISTRIBUTION SYSTEM ENGINEERING

C. DISTRIBUTION SYSTEM ENGINEERING.

1. General.

Implementation of rural electrification projects must be based on lowest feasible system investment to obtain maximum benefits. This means that general system guidelines should be followed to assure adequate voltage and reliable service as economically as possible.

Further, many of the older distribution system design and construction criteria now used in Indonesia should not be considered in designing and constructing these new rural distribution systems.

Conditions in Indonesia affecting the design and construction of rural lines are similar to those encountered in other countries, therefore standards and criteria used in like areas of those countries can be safely used in Indonesia. In Java and some other locations rural population density is unusually high, but in general the clustering appears to be in villages. This may cause right-of-way clearing and staking problems, but the high density is an advantage rather than a problem in system design.

With high consumer density, but small demand per consumer and initial low revenue anticipated, it becomes the responsibility of the project engineer to utilize every tool and method at his command to build low-cost, safe systems, with a lifespan and reliability commensurate with the need for good rural service and moderate rates.

2. Type of System.

Elements of distribution systems should be servicable for long periods of time. Therefore, they should be designed with much thought given for future requirements. Since consumers and additional loads will not develop on any fixed pattern, as much flexibility as possible must be considered so that if loads "shift" the distributing system can also "shift" with least expenditure.

Systems should also be built simple and straightforward, without operating restrictions, so that operational errors will be minimal. Present-day system components (transformers, poles, insulators, conductors, sectionalizing equipment, etc) are very reliable and when properly utilized obviate the necessity of duplicate distributing facilities. Emergency capacity in various parts of the system should be provided by short-time overloads (as defined in Part D)on a single contingency basis, without redundancy.

Radial feeder systems should be used, preferably fed from a regulated bus. However, existing feeders suitably protected to isolate faults on the new system may be used to feed it, provided satisfactory regulation and capacity are available on the existing feeders.

Three-phase or "V" phase feeders and laterals should be built from bulk power buses to points where it is feasible to divide the loads beyond. From these points, single-phase lines should be constructed along with single-phase taps from the three-phase system to serve consumer loads.

Three-phase and "V" phase construction should be held to a minimum consistent to load growth and voltage drop.

The existing systems in Indonesia are 50 hertz, and this usage is too extensive to consider a change. Voltage standards for the Indonesian Archipelago were set by the Director General for Power and Electricity, Ministry of Public Works and Power, by Decrees Nos. 08/K/70 and 09/K/70. Primary voltage of 20 KV (nominal) with a maximum of 24 KV is now being used extensively and does not require introduction of another class or size of equipment and materials.

Secondary voltages are being changed from 127/220 V to 220/380 V (nominal). Use of this new standard voltage is almost mandatory for any new rural construction, because motors, appliances, lighting equipment and bulbs are being marketed for 220/380 V service. The new voltage a also reduces consumers' wiring costs.

For residential and small commercial loads, 10 KVA and below, the service voltage should be 220 V, two-wire, single-phase. For loads of 50 KVA and below, 220/440 V. three-wire, single phase should be used with individual motor size limited to 10 HP. However, for miscellaneous, commercial and industrial loads, 25 KVA and above, 220/380 V, four-wire, three-phase should be used, if individual motors 15 HP minimum or other three-phase equipment, 25 KVA or mor are to be installed.

All new rural distribution systems should be overhead wood pole line, with bare aluminum conductors, standard fittings, pole-type transformers, overhead services, and meters. The system should be four-wire wye, with multi-grounded common nuetral. There must be effective grounding as defined by the National Electrical Safety Code, ANSI C2-1977.

3. System Design Criteria.

Complete and detailed design criteria which would apply to rural distribution systems suitable for Indonesia were developed and will be found in **Part D.**

4. Implementing the Engineering and Construction.

Large outlays of money for system design can be avoided by using already available standard design/criteria, construction specifications and drawings, and approved materials. All of these have been thoroughly field-tested in close to a thousand rural electric cooperatives, and are available from the Rural Electrification Administration in the U.S.A.

With feasibility study maps showing prospective consumers and suggested routing of lines it is believed that minimal electrical design engineering will be needed. In fact only a voltage drop diagram (REA Bulletin 45-1) to determine phasing and wire size with a sectionalizing diagram (REA Bulletin 62-1) to determine location, size, and type of automatic sectionalizing devices, appear to be necessary. However, a great amount of skilled field (survey) engineering will be required to properly stake lines and designate construction units with due regard to economy and safety.

In implementing distribution and tranmission construction projects for PLN, many Indonesians have been trained and instructed both in Indonesia and abroad by foreign engineering and construction firms handling these projects. Using some of this personnel, it would appear that adequate engineering skills to handle rural system work, described above is available. Further, with some supervision from out-of-country sources in the initial years, these locally trained personnel should be able to perform the required service.

Since all the work will be done in Indonesia, the major portion on job site, it is believed two foreign advisors who are experienced design engineers for supervising general system design, and material procurement, along with one experienced field engineer for each rural system under construction will be adequate to handle the work, along with Indonesian personnel.

Presently, in certain areas, local contractors or owner's personnel are constructing overhead electric lines, under foreign engineers' supervision. It is reasonable to assume if all materials are furnished, that local contractors or owner's personnel could construct strong, safe, systems in approximately 50 km. segments per contract. The supervising field engineer assigned to each rural system along with his Indonesian fieldmen could supervise and manage such contract construction.

It is recommended that local contractors or owner's personnel should construct lines, as described above, and that the systems own service crews should run service lines and install meters since this phase of the work involves consumer contact, etc.

These suggested methods would make maximum use of local personnel, construct quality systems at minimum cost, and would in some 3 to 5 years enable local personnel to construct system without assistance from foreign advisors.

PART D

BASIC DISTRIBUTION SYSTEM CRITERIA

D. BASIC DISTRIBUTION SYSTEM CRITERIA

ELECTRICAL DESIGN CONSIDERATIONS

1. Frequency.

Any new rural distribution system in Indonesia should be 50 hertz, to conform with existing usage.

2. Distribution Voltage (Nominal).

a. By Decrees No. 08/K/70 and 09/K/70 of the Director General of Power and Electricity, Ministry of Public Works and Electric Power, voltage standards for distribution system in Indonesia have been established. The primary voltage of 20 KV (nominal) with a maximum of 24 KV is the most attractive voltage to be used for rural projects. This voltage is now being used extensively in Indonseia and does not require introduction of another class or size of equipment and materials. Further, the reduction in voltage drop and losses for the same loading, wire size, and line length more than offsets the slight additional costs of using this higher voltage over a 7.2/12.47 KV primary syste, Voltage drop and losses at 11.55/20 KV are 0.3888 compared to 1.0 at 7.2/12.47 KV primary. Increase in capacity or line length using the same voltage drop and wire size are 2.572 at 11.55/20 KV compared to 1.0 at 7.2/12.47 KV primary.

The system may be safely operated near the maximum primary voltage (13.8/23.9 KV) since manufactured equipment and desined insulation levels are 125 KV BIL minimum. This higher level of voltage will increase system capability and capacity at no increase in cost.

b. Secondary voltages in all areas of Indonesia are being changed from 127/220 V, four-wire, three-phase to 220/380 V (nominal) four-wire, three-phase. Motors, appliances, equipment, lighting fixtures, and lamp bulbs are being marketed for the 220/380 V service making the use of this standard voltage attractive if not mandatory. Further, use of this voltage will reduce consumers' wiring costs. Single-phase systems should be two-wire 220 V, and three-wire 220/440 V. Three-phase systems should be four-wire 220/380 V.

3. Service Voltages (Nominal) with Use and Maximum Loadings.

a. 220 V, two-wire, single-phase should be used for miscellaneous residential and commercial loads, 10 KVA and below. Maximum individual motor size is 10 HP.

b. 220/440 V, three-wire, single-phase should be used for miscellaneous residential and commercial loads, 50 KVA and below. Maximum individual motor size is 10 HP.

c. 220/380 V, four-wire, three-phase should be used for miscellaneous commercial and industrial loads, 25 KVA and above, provided individual motors 15 HP minimum or other three-phase equipment, 25 KVA or more, are installed. Maximum load at this voltage is 500 KVA.

d. Industrial or commercial loads of 500 KVA or more should be given special consideration on a case by case basis. They may be served at primary voltage (11.55/20 KV, four-wire, three-phase) or 220/380 V, four-wire, three-phase, dependent of rate structure and availability of large transformers.

4. Insulation Level, Creepage Distance, Etc.

a. Insulation for the primary system must withstand normal operating voltages and switching surge voltages without flashover or failure. Sufficient impulse insulation strength (BIL) must also be provided so that the system can be protected by suitable lightning arresters. Further, insulators and bushings, in air must have adequate creepage distance so that there will be practically no 50 hertz leakage current. At altitudes over 1,000 meters or in contamincated areas creepage should be provided.

b. Since standard equipment has been developed for this voltage class (14,400 V, line-to-ground) and has been in service and proven world-wide for many years, the system should be designed to meet these insulation parameters, using standards for material and equipment specified by the American National Standards Institute, New York City, U.S.A., and in REA Bulletin 43-5, Rural Electrification Administration, Washington, D.C., U.S.A.

(1) Basic insulation level (BIL) - distribution class, 125 KV.

(2) Switching surge voltage - three times normal line-to-ground voltage.

(3) Minimum creepage distance (approximately 1 inch/1000 volts) - 13 inches.

(4) Extra insulation to be provided at line angles and deadends to preclude flashover due to increased values of surge voltage caused by reflection.

(5) No increase in standard creepage distance for systems constructed below 1,000 meters in areas relatively free from contamination. Should it be determined that sections of the system require increased creepage distance they should be considered for each individual case.

(6) Equipment used will be according to the standards noted and meeting these insulation and creepage values:

(a) Line insulation, pin insulators - use ANSI Class 56-1, insulators.

Leakage distance	13 inches (33 cm.)
Wet flashover	60 KV
Dry flashover	95 KV
Critical impulse flashover	150 KV

(b) Line insulation, angles and deadends, suspension insulators - use two insulator units per deadend, ANSI Class 52-4.

Wet flashover	90 KV
Dry flashover	155 KV
Critical impulse flashover	255 KV

(c) Equipment bushing insulation, distribution class - ANSI-C57.12 series.

Bushing creepage distance 17.75 inches (45 cm.)
Withstand voltages

10 seconds wet	36 KV
1 minute dry	42 KV

Impulse withstand voltage (BIL) 125 KV

(d) Transformer winding insulation distribution class - ANSI-C57.12 series.

Impulse withstand voltage (BIL), full wave	125 KV
Impulse, chopped wave	145 KV
Minimum flashover time 2.25 micro-seconds	
Low frequency dielectric	40 KV

(e) Secondary and service system will be designed using material and equipment for less than 300 V phase-to-ground, according to ANSI standards:

i. Insulators (spools) for secondary conductors will be ANSI class 53-2 and 53-4 with these electrical values:

Low-frequency dry flashover	25 KV
Low-frequency wet flashover, vertical	12 KV
horizontal	15 KV

ii. Insulators (spools) for service conductors will be ANSI class 53-1 with these electrical values:

Low-frequency dry flashover		20 KV
Low-frequency wet flashover,	vertical	8 KV
	horizontal	10 KV

iii. Covering on phase conductors of multiplex service cables should be cross-linked polyethylene (XLP), with minimum thickness of covering:

#2 AWG and smaller	0.45 inches (1.15 mm)
#1/0 AWG through #4/0 AWG	0.60 inches (1.52 mm)

Covering shall be capable of withstanding continously, from conductor to ground, applied voltage of 1000 V at 50 hertz for 5 minutes.

5. Voltage Levels, Spreads, and Drops.

a. ANSI C84.1 presents standards for maintaining adequate voltage levels at service and utilization points. These points are defined as:

(1) "Service point" - the point at which systems of supplier and user are connected (kwh meter).

(2) "Utilization point" - the line terminal of the equipment using energy (lamp socket, convenience outlet, motor terminals, etc.).

b. Lighting and appliances can operate on a fairly broad spread of voltage above and below their rated voltages. Of course, when the spread is held closer to the rated or nominal voltage, better operation will be achieve. Accordingly the following voltage ranges have been selected as acceptable system voltage levels and spreads.

VOLTAGE RANGES (220 V base)

	Minimum	Maximum
Utilization point	198	231
Service point	203	231

c. Using the above acceptable service point range (203-231 V), the corresponding permissible voltage spreads at various points on the distribution system may be determined by using voltage drops indicated below for each segment of the system. The total drop permitted at point of service under maximum load conditions should be the maximum voltage delivered to the customer nearest the bulk power supply point (substation) and the minimum voltage delivered to the customer fartherest from the substation. Regulating equipment used on the system will have a voltage regulating relay with a bandwidth setting that can control feeder voltage to plus or minus 1.0 V (220 V base). Therefore, maximum voltage drop which may be allocated to the various parts of the distribution system will be (231-203) - (2 x 1.0) = 26.0 V. The following drops may allow some variations in regulator settings.

VOLTAGE DROPS - MAXIMUM LOAD CONDITIONS

System Component	Maximum Voltage Drop (220 V base)	Percent Voltage Drop (approximate)
Substation or plant regulated bus (output) to primary terminals of last distribution transformer	14.0	6.37
Distribution transformer	3.0	1.36
Secondary and service	6.5	2.95
Total at consumer's meter	23.5	10.68
Consumer's interior wiring	5.0	2.27
Total at utilization point	28.5	12.95

VOLTAGE LEVELS AND SPREADS - 220 V BASE

Location	Voltage Levels (volts)		Voltage Spread
	Minimum	Maximum	(volts)
Substation transformer (unregulated)	208	242	34
Substation or plant bus (regulated)	226.5	231	4.5
Distribution transformer primary terminals (last transformer)	214.5	231	16.5
Service point (consumer's meter)	203	231	28
Point of utilization	198	231	33

d. The above normal voltage levels, especially those at point of service and point of utilization, are the basis for system design; and the system should be operated within these limits so that the consumer's equipment will give satisfactory service. These levels are based on the following:

(1) Substation or plant outgoing bus voltage is regulated with a voltage bandwidth setting not exceeding 1 V on a 220 V base.

(2) Values used in above tables are center values of the regulator bandwidth.

(3) Only sustained voltages apply to table values. Variations of short duration (switching, motor starting, etc.) are not considered.

(4) Input voltages to bulk power supply point (subtation) are kept within prescribed limits so that regulating equipment can operate its prescribed limits, ± 10% of normal operating voltage.

6. Feeder Loading.

In determining feeder loadings, initial construction cost and quality of service desired are the most important factors to be considered. These considerations generally tend to oppose each other, in that lower construction costs will dictate heavily loaded feeders, while improved service requires more feeders lightly loaded. A compromise which allows initial costs, losses, and voltage regulation to determine the loading has proven to be an adequate solution.

In rural areas where initial load density on the order of 10 to 12 KVA per square kilometer with an annual load growth of 5%, it appears that feeder loading will be determined by voltage drop and desired reliability. Reliability will be determined by feeder length and number of sectionalizing points. Feeders, of course, would be voltage limited and with allowable voltage drops described above in Section 5.a, 4/0 AWG-AAAC three-phase, four-wire feeder operating at 90% power factor and 13.8/23.9 KV with uniformly distributed load will have a capacity of 80925 KW-kilometers.

With a feeder rating of 6.0 MW the feeder would have a length of approximately 25 kilometers from source to last transformer. Assuming a rectangular feeder area with a main feeder 17 kilometers in length with laterals on each side of the main, 8 kilometers in length would make a feeder area of some 272 square kilometers. The load would be approximately 22.06 KVA/square kilometer which would be satisfactory for 15 years based on 5% annual growth of an initial load of about 11 KVA per square kilometer.

The above loads are total loads per square kilometer and a coincidence factor should be applied when calculating definitive conductor sizes to feed an area.

Actual physical layout of a system, with bulk power points located outside the service area, could change feeder areas which in turn could change optimum wire size and feeder loading. However, for purpose of this study actual feeder areas and layouts are used. To provide for emergencies or short-time overload conditions, feeders or lines may be operated up to 90% of the thermal capability of the conductor, without loss of service life of the conductor.

7. Transformers and Secondary Systems.

The initial load density in KVA/square kilometers enumerated above may be also stated as being about 14 KVA/line kilometer. This initial load density may be used for design of the secondary system provided a growth factor and coincidence factor is applied. The optimum transformer spacing could then be determined by the maximum length of a given secondary conductor operating with the maximum permissible voltage drop (6.5 V). With an initial load density of 14 KVA/line kilometer and a coincidence factor of 0.90 and with an annual growth rate of 5%, the load density in 15 years would be $14 \times 0.9 \times (1 + 0.05)^{15} = 26.19$. KVA/line kilometer. A 25 KVA transformer may be adopted as a base size unit.

It may be assumed that a balanced uniform load on a three-wire secondary will be fed two ways from each transformer and that a peak rating of 150% of the individual transformer rating can be safely used for design. With this assumption and using a 25 KVA transformer (22.5 KW at 90% power factor), optimum transformer spacings with various size conductors may be:

UNIFORM DISTRIBUTED LOAD

Wire Size	Voltage Drop Volts (220 V base)	KW-Meters 90% P.F. 3-wire, Single-phase	Load KW (1/2 the 150% rating of 25KVA transformer)	Optimum Length of Secondary (meters)	Optimum Trans-former Spacing (meters)
# 4 AAAC	5.5	3170	18.75	169	338
# 2 AAAC	5.5	4745	18.75	256	512
#1/0 AAAC	5.5	7116	18.75	380	760

To maintain a reasonable balance between number of transformers and secondary conductor size and to allow use of one size larger transformer (37.5 KVA) over base size (25 KVA), three-wire secondary system of #1/0 AAAC phase wires with neutral sized according to primary system requirements should be used. Maximum length of secondary system (transformer to last consumer) should not exceed 380 meters. Transformers should be located using the moment arm method to find a load center.

Along primary lines, effort should be made to place transformers on the optimum spacing of approximately 750 meters. In this way transformers may be changed out as the load develops to a maximum of 34.5 KVA units without relocating or respacing. When load increases beyond the 37.5 KVA capability another transformer may be installed between existing units cutting the secondary confuctors on intermediate poles. This will give additional capacity with minimum expense.

Transformer selection should be according to:

(a) Thermal capability (maximum load without damage to insulation),
(b) Voltage drop (adequate voltage under maximum load), and
(c) Economics (annual costs).

Single-phase transformer installations meeting this criteria should be sized according to this table:

Rating 65°C (KVA)	Maximum Peak Load * Permitted (KVA)	Minimum Economic Loading (KVA) 30% Load Factor Annual Average Load	Minimum Economic Loading KVA (peak)
10	15.8	-	-
15	23.7	4.9	16.3
25	39.5	5.4	18.0
37.5	59.25	10.3	34.3
50	79	11.8	39.3

* According to ASNI C57.92, with an ambient temperature of 40°C a peak of 1.58 rating is permitted for one hour following 50% equivalent load in percent of rated KVA every 24 hours with no loss of transformer life expectancy.

8. Services.

Services for residential and small commercial customers should be multiplex, self-supporting, service drop cable. Cable should have a bare ACSR neutral messenger, with stranded all-aluminum cross linked polyethylene insulated (600 V) phase conductors. Duplex cable should be sized 6 AWG and 4 AWG. Triplex and quadruplex cable should be sized 4, 2, 1/0, or 2/0 AWG.

Choice of number of service wires should follow maximum loadings give in Section 3 above, "Service Voltages (Nominal) with the Use and Maximum Loadings".

9. Voltage Regulation.

Bulk power source (substation bus) should be regulated by tap changing under load equipment, integrally a part of the step-down transformers. Generating plants will regulate their 20 KV buses by varying machine voltages. Step-up transformers will be furnished with off load high tension-taps. It is anticipated in the initial stage design of the rural system that no line type regulating equipment will be needed since line lengths and loads tend to keep the system within acceptable voltage limits.

When system loads and line lengths grow to the extent that acceptable voltage limits are exceeded, then line regulators generally applied with shunt capacitor banks should be installed. Single-phase, outdoor, step-type, platform mounted units should be used, banked for three-phase operation, with by-pass switches.

10. Capacitor Banks.

Line-type shunt capacitor banks, switched and unswitched, may be used to improve power factor thereby reducing losses. The initial system should be designed for growth, and while capacitors will improve voltage and increase line capacity, in the early years use of capacitor banks solely for this purpose appears to be unnecessary and the installation expense does not appear justified.

As load grows in future years, capacitor installation for voltage improvement and capacity release should be considered and compared with costs of additional feeder construction, or additional substation capacity.

Total capacity of fixed capacitor banks on a feeder or substation bus should not be more than required to correct power to a value approaching unity, at light load conditions.

Total capacity of switched capacitor banks on a feeder or substation bus should not be more than the additional quantity of capacitors required to correct power factor at peak load to a value approaching unity.

Capacitor banks should be group protected by expulsion fuse cut-outs, and lightning arresters, one per phase with co-ordinated fuse links. Fuses should have a continuous rating of not less than 1.35 times rated bank current, with a total clearing characteristic not exceeding zone 1 standard capacitor case rupture curves as shown in NEMA Std. CP-1. Fault currents at point of capacitor installation should be ascertained and fuse clearing times carefully checked with case rupture curves.

The application of capacity banks to the system should be made in conjunction with voltage regulating equipment, if such equipment is required.

11. Lightning Protection (Arresters).

Selection of arrester voltage ratings should be based on line-to-ground (not line-to-neutral) voltages existing on the system under fault conditions.

The system to be protected is solidly grounded with four-wire, multigrounded, common neutral lines. The voltage impressed across the unfaulted phases line-to-ground will, therefore, be only a percentage of the line-to-line voltages, under fault conditions.

Based on IEEE Transactions Paper 71TP-452, which details experience and practice for selecting arrestor ratings, an 18 KV arrester should be used on four-wire, multigrounded, common neutral distribution lines, maximum voltage 13.8/23.9 KV.

Use of 18 KV arresters commercially produced according to ANSI C62.1 will provide acceptable protection for 125 KV BIL distribution equipment.

In locating arresters on the distribution system, all line leads and ground leads connecting the arrester to the system and the protected equipment must be as short as possible to reduce the impedance paths of surge current during lightning discharge. Voltage across leads could completely nullify the protective characteristics of the arrester; therefore, precautions should be taken to keep leads short.

Location	Remarks
Overhead transformers	Connect to each source high voltage phase wire. Ground lead solidly interconnected to common neutral, transformer tank and transformer secondary neutral.
Capacitor banks unswitched	Connect to each source high voltage phase wire of banks with 500 KVAR rating or less. Banks of higher capacity do not need protection since a surge of magnitude to charge the bank is unlikely. Ground leads solidly interconnected to common neutral, capacitor cases and bank ground.
Capacitor banks switched	Same as for capacitor banks unswitched, except install on all banks regardless of capacity.

Regulators, line type	Mount on regulators and connect to each high voltage phase, line and load side. Ground lead solidly connected to common neutral and equipment ground.

It is believed that with high speed breakers set for an instantaneous reclosure that arresters placed along the lines for line protection are not required.

12. Fused Cut-outs and Fuses.

Open, drop-out expulsion type fused cut-outs should be used, rated 100 amps, minimum, 26 KV maximum, 125 KV BIL, 7000 amps. symmetrical and 6000 amps. assymetrical interrupting capacity (minimum).

Fused cut-outs should be used for capacitor bank protection, protection of single-phase taps at main feeder tap points, and sectionalizing points,

Fuses should be NEMA ratings type "T" to obtain satisfactory coordinating characteristics.

13. Sectionalizing and Switching.

Coordinated automatic sectionalizing devices should be used on all primary distribution circuits. Automatic reclosing devices should be used where appropriate.

Radial three-phase feeders and major three-phase taps, which cannot be looped, may use three single-phase reclosers of appropriate size as required to protect important areas.

Fused cut-outs should be used on single-phase taps for coordinated protection of the system. Cut-outs should be equipped with hooks so that they will be "load break" when used with a portable load break tool. No fused cut-outs should be used in a three-phase circuit. However, cut-outs equipped with solid disconnecting switch blade may be used in lightly loaded three-phase circuits for manual sectionalizing.

A sectionalizing plan for each feeder should be made using acceptable methods to determine short circuits and sectionalizing points.

In applying sectionalizing devices, it should be remembered that the "sectionalizing factor", a factor less than unity, directly affects the service reliability of the feeder. Depending upon circuit length the following general considerations will be helpful. Since each feeder configuration presents different problems, good judgement must be exercised in each case to achieve best results.

a. Four reclosers or other automatic sectionalizing devices in series on a circuit usually are considered adequate, depending upon line length, in order to obtain reliable coordination. Non-automatic devices such as disconnect switches, spaced between automatic devices, will be helpful in system operations to minimize circuit outage during permanent faults.

b. Branch lines connected to the main circuit vary in their importance to service reliability depending upon length and at what point they are connected to the main circuit. They are the most vulnerable to faults affecting service reliability. Therefore, every branch circuit should be sectionalized regardless of length or connected load. The objective of sectionalizing branch circuits is to protect the main trunk circuit against permanent outage.

c. Lateral circuits connected to branch circuits are usually referred to as second, third, or fourth line sections and have a successively lesser possibility of impairing service reliability. They can be correspondingly longer in length or exposure before a sectionalizing device is justified.

d. Any branch or lateral circuit exposed to unusually hazardous conditions should be sectionalized with an automatic device.

e. Where a main trunk line is bifurcated (extending in two different directions), automatic sectionalizing devices, preferably reclosers, should be used to sectionalize each of the circuits at the junction point.

f. All sectionalizing locations should be easily accessible.

g. Sectionalizing devices should be located so as to minimize service interruption to important loads; i.e., if a sectionalizing device is to be located near an important load, it should be placed beyond that load.

h. When any changes are made to the system, such as additions or revisions of line or increase in size of the substations, a supplementary study should be made to keep the sectionalizing program up to date and to see that rating of devices is still adequate. Periodic checks of peak loads on sectionalizing devices should be made, to ensure that overloads do not occur with load growth.

14. Grounding.

All poles should have a ground assembly (driven or butt wrapped) with the common system neutral tied to this assembly.

A minimum of three driven grounds per kilometer will be used to make the system "effectively grounded" according to NESC rules. Driven grounds should be 5/8" x 8" - 0" galvanized rods and should have a resistance of less than 10 ohms individually, isolated and not connected to the grounding system, after installation. If this resistance is not obtained, additional sections should be driven to a greater depth. Driven grounds should be used at all poles on which transformers, capacitor banks, regulators, reclosers, switches or arresters are installed. Driven grounds are also to be used at all secondary deadends.

In addition to above grounding all down guys without strain insulators are to be connected to the common neutral system. All down guys are to be securely bonded to their anchor rods, using anchor rod bonding clamps.

15. Conductors, Type and Kind, Economic Size.

Present pricing determinations indicate that AAC (all Aluminum Cable) and AAAC (Al. 6201 Alloy Cable) bare conductors should be used for primary and secondary lines.

Considering kwh losses and estimated construction costs, using annual cost rates and growth factors applicable to rural systems, it is believed that the following sizes may be accepted as standards for use as line conductors on rural systems in Indonesia. It further uses conductors which have been extensively utilized in Central Java, thus precluding introducing another type and size of conductors.

Use	Phase	Size of Conductors	
		Phases	Neutral
Main feeders	3	477/KCMIL	4/0 AWG
Main feeders	3	4/0 AWG	1/0 AWG
Laterals	3	2 AWG	4 AWG
Taps	1	2 AWG	4 AWG
Taps	1	4 AWG	4 AWG

For service conductors these sizes should be adequate:

Size	Type	KW-Meters
# 6	Duplex	175
# 4	Duplex	275
# 4	Triplex	600
# 2	Triplex	900
# 2	Quadruplex	1,200
# 1/0	Quadruplex	2,000

Mechanical Design Considerations.

All mechanical design should be in accordance with REA Bulettin 160-2, "Distribution Line Design (Mechanical)." This REA Bulletin is based on ANSI Bulletin C-2-1977 Electric Code of the U.S.A. However, certain changes described below should be made in loadings to conform with Indonesian weather conditions.

All construction should be in accordance with REA Form 803, "Specifications and Drawings for 14.4/24.9 KV Line Construction."

Both of the above published documents have been tried and tested, updated from experience, and have been the basis of constructing hundreds of thousands of kilometers of low investment, high reliability, economical electric lines.

Indonesian Conditions.

From available weather records of Indonesia a maximum design wind velocity (actual) of 80 kilometers per hour (22.25 meters/second) appears to be satisfactory. This is equivalent to approximately 50 miles per hour. Using acceptable pressure-velocity formula, these wind pressures may be used for an "Indonesian Loading Zone" in the line design standards mentioned above.

Cylindrical surfaces:

$$P = 0.0025V^2 = 0.00025(50)^2 = 6.25 \text{ pounds/sq. ft.}$$

Flat surfaces:

$$P = 0.0004V^2 = 0.004(50)^2 = 10 \text{ pounds/sq. ft.}$$

Design temperatures according to Indonesian conditions may be:

Maximum tensions in conductors - 60°F (15°C)
Minimal vertical clearances - 90°F (33°C)

With the modifications above and no ice loading, REA Bulletin 160-2 can be used for mechanical line design in Indonesia. This can be obtained from: Rural Electrification Administration, U.S. Department of Agriculture, Washington 20250, D.C., U.S.A.

PART E

MATERIALS AND EQUIPMENT

E. MATERIALS AND EQUIPMENT.

1. Source, Type, Procurement, and Handling.

Adequate supply of proper materials and equipment is essential to timely and low-cost construction. All materials and equipment must conform to predetermined standards and specifications to assure high quality and safe construction, compatibility of components, and lowest pricing through large orders.

A detailed "List of Approved Materials" has been developed over a period of many years by the Rural Electrification Administration, in Washington, D.C., for the rural electric systems in the U.S.A. With very few changes, to accomodate differences in Indonesian frequencies and required transformer ratings, these standards should be used. The publication is REA Bulletin 43-5.

Standard identification of items facilitates the use of standard invitation-to-bid forms and simplifies price comparison on bidding by suppliers, stocking, handling, etc.

Warehousing the quantity of materials to be used in this electrification program promises to be a monumental task, so careful scheduling of deliveries is worth consideration.

Certain materials must be obtained from overseas sources. However, investigation has determined that limited amounts of other materials of sufficient size and quality may be obtained locally. One objective for an extended rural electrification program would be the creation of a market to utilize new lines of production in Indonesia. This would provide additional job opportunities.

Analysis, comments, and suggested source and type of some materials and equipment are detailed below.

2. Poles.

A survey of the wood pole potential available in Indonesia was made to determine the feasibility of using wood poles for supports for the rural electric lines. Conventionally, steel poles have been used for this purpose in the majority of the Indonesian construction. However, steel poles represent a total import of the basic material with only a small percentage of value added by local manufacture. Wood poles, on the other hand, represent utilization of a domestic renewable resource of Indonesia which requires only about 20 percent imported commodity (wood preservative) to convert it into a long-lasting wood pole. Further, the production of wood poles is a rural industry. Poles are grown in rural areas and their manufacture and treatment can be accomplished in the same areas. Thus, the production of wood poles would increase the gross income of rural people and in turn enable these people to have more cash available to spend in equipping their homes to use electric service.

Indonesia has a transmigration program in operation. One of the first problems of transmigration is to provide employment for the moved citizens. By establishing a new industry in these areas, these people could be self-sufficient. This would hopefully be an incentive to transmigration. With these factors, the survey of the wood pole concept was explored.

One of the other prime factors to be considered was the cost savings which could be accomplished. Steel poles cost in the neighborhood of US$150 to US$200. Wood poles hopefully could be produced for 1/3 to 1/4 this amount. Steel poles required periodic maintenance to prolong their useful life. They should be heavily painted prior to installation and repainted on a 3-to-5-year cycle. The painting of steel poles is conventionally an external protection. However, corrosion inside the steel pole should not be ignored. To achieve the maximum life from a steel pole, it should be painted internally with an apoxy-type paint to prevent this internal corrosion.

In a similar fashion, wood poles must be properly treated initially and given periodic supplemental treatments at the ground line to extend this useful life. These concepts are amply proven in the U.S.A.

The factors to be considered are:

a. Types of wood available.

b. The strength of these wood species when converted into poles.

c. The harvesting capability available.

d. The treatability of the wood.

e. Treating and manufacturing capability available.

f. Anticipated production capability.

g. Cost data.

Many species of wood are available in Indonesia in the natural ecosystem. However, in natural situation the density of a specific species population is low and several different species are usually mixed considerably per hectare. This presents sorting and handling problems. Un-Unless a demand exists for the majority of the species, the harvesting and sorting of unusable species or selective cutting of species is costly per pole and complicates the selection process.

The alternative is to use plantation-grown trees where a specific tree species has been planted and grown as a crop. This narrows the selection process providing the species is suitable in other respects. It should be remembered that in a plantation system, poles are cut from immature trees. The plantations are usually managed to grow much larger trees for lumber, veneer logs, pulp, etc. In some cases, regulations have been written to restrict the cutting of these young trees for poles. Therefore, the concurrence of the forestry department must be obtained.

Of the woods available, the best prospect is rasamala (altingia excelsa). The average breaking strength is 9,000 psi. This is a plantation-grown tree in West Java. Many of the plantations have grown past the pole stage, but quantities of pole-sized timber are available. Harvesting is by manual means, and transportation to the road site is by manpower or by animal power. Harvesting will be limited to the dry season and will not be available during rice harvests.

This wood, when dried, is conventionally treated to 2.5 cm penetration. In our opinion, this is a marginal treatment for poles in the tropics. There are two plants which we visited in West Java, which are not treating rasamala using a cold penta chlorophenol solution. In order to treat with cold pcp the poles must be air dried to fiber saturation. This drying therefore limits the production time to the dry season.

One treating plant in Cikampek, West Java, has two cylinders -- a 15 m. x 2 m. cylinder for pcp and a 12 m. x 2 m. cylinder for cca. Usually they treat poles in their 15 m. cylinder at the rate of about 50 poles per charge. They can treat one charge per shift. Presumably they can run 3 shifts per day and average 4 days per week. The maximum production will therefore be 600 poles per week for 6 months out of the year of 15,600 poles per year. This is the total maximum production and does not provide for any major breakdowns or delays caused by harvesting or force majeure. While they have not done so to date, they can treat poles in the 12 m. cylinder with cca.

The other treating plant is located at Cipatat, West Java. This plant also treats rasamala with pcp in a 24 m. x 1,9 m. cylinder. Many of the comments on the Cikampet plant are applicable here. Their capacity is 60-80 poles per charge. The maximum capacity for this plant would be:

70 poles average per charge.
3 charges per day.
4 days per week.
26 weeks per year.
21,340 maximum pole capacity.

In the case of both plants, about 33 to 50 percent of the maximum capacity should be anticipated as realistic.

In Medan, Sumatra, three species are available:

a. damar laut - shorea ellipitica - av. breaking strength 15,000 psi.

b. keruing - diptocarpus warburgi - av. breaking strength 13,000 psi.

c. tusam - pinus meskusii - av. breaking strength 8,000 psi.

Damar laut and keruing are natural species while tusam is plantation grown. Damar laut and keruing are harvested and produced into poles by a company with a treating plant at Medan, Sumatra.

This company is regularly producing poles at the rate of about 40 poles per charge in their 1.5 m. x 15 m. cylinder. Using the factor applied to the West Java plants, the maximum anticipated production would be 12,500 poles with a realistic production of 1/3 or 1/2 this quantity.

Tusam is not reg'larly produced into poles but is available from the area around Lake Toba. Harvesting of tusam poles will be selective as the shape os not always good, the trees are often on slopes, and heavy cutting is not allowed as erosion must be avoided.

In Kalimantan, three species are available for consideration:

a. anthocephalus cabamba - fiber stress - 7,000 psi.

b. eucalyptus deglupta - fiber stress - 10,000 psi.

c. ulim eusideozyton zwagesi - av. breaking strength 10,000 psi.

Anthocephalus grows naturally and in plantations. Eucalyptus is grown in plantations. Both species will grow from seed to pole size in 3-5 years. The outer 2.5 to 4 cm. of eucalyptus is treatable and will make a good pole if properly handled. Anthocephalus is fully treatable and has a pith center which will dry and fall out. This will facilitate drying and treatment. The wood is not as strong as other woods suggested but can be compensated for by slightly larger circumferences. The wood is light, which is a positive factor in road transportation and construction.

Ulin is a restricted species and can be cut only as a native industry. The wood is heavy and naturally durable. It cannot be treated successfully but the natural durability appears adequate. The supply is limited and the quantities and availability may be difficult to predict and schedule.

Eucalyptus and anthocephalus are grown by a large timber corporation. The production facilities appear to be excellent and could be considered as a most dependable source of supply. Logging facilities operate year around and are modern and heavily mechanized. Shipment of poles can be arranged by water to ports in the areas where construction is being done. A treating plant would be required. This could be fabricated, shipped, and installed in 6-8 months. The installation of an automated cca treating plant capable of treating 5 charges of poles per day could more than supply the estimated needs of projects under consideration. A plant capable of supplying 40 to 50,000 poles per year should be encouraged.

The forestry service and treating plants both report that prices for green poles on the stump have decreased markedly in the last few months. Recent orders filled by existing treating plants confirm these reports. We have used such pricing in our material estimates. Competitive bidding with more suppliers offering, will no doubt further lower prices. We therefore recommend that wood pole production should be encouraged. Further, to supply quantities required for the rural and other programs we recommend expansion of treating facilities. It is our belief that sufficient interest has been generated among companies with timber concessions to install treating plants and enter the treated pole business.

We concluded that when procurement of treated poles is initiated, price will be reasonable and timely deliveries of required quantities can be accomplished. Poles should be procured locally according to AWPA amd ANSI specifications, using local woods discussed above.

3. Cross Arms and Anchor Logs.

Treated cross arms and anchor logs should be procured locally according to REA standards, using local woods.

4. Line Conductors and Service Cables.

As described elsewhere, bare all-aluminum cable and aluminum alloy (6201) should be used for line conductors. Likewise, twisted, self-supporting service cable, all-aluminum, with bare ACSR neutrals should be used.

A large local well designed wire and cable fabricating plant with two separate units, one for cooper and one for aluminum, is presently operating in Jakarta. The aluminum section has a capability of producing concentrically stranded conductors through medium circular mil sizes from imported standard rod sizes and core wire. Size capability is well above any requirement for this rural program. Both ACSR and all-aluminum types of cable have been produced in limited quantities for local customers. Presently 40 tons of all-aluminum cable is being fabricated for PLN. Oxlip (AWG 4/0) all-aluminum cable was being stranded during our visit.

One final cabling machine, working one 8-hour shift, can produce some 2,000 tons of cable per year. Dependent upon orders, this fabricator is willing to work additional shifts and even install additional cabling machines in existing factory space, providing business warrants such installations. It appears with present equipment and proper supply of raw material the plant could fabricate some 5,000 - 6,000 tons of aluminum conductors and cable per year.

Aluminum alloy conductor (6201-T81) is being produced on a trial basis, to ascertain if a quality product can be fabricated. Final determination on ability to produce this type of conductor has not been made.

Multiplex service cable up to AWG 4/0 size using bare ACSR netural and conventional black polyethylene insulated solid or stranded aluminum power conductors has been successfully fabricated in this plant. No XLP insulated multiplex service cable has been manufactured.

The managing director was of the opinion that he could be competitive with the world market on ACSR and all-aluminum cable, provided needed raw materials could be imported "duty free". He further stated he felt for this rural program, since foreign currency is available, that raw materials (rod and core wire) might be furnished in bond to his plant for fabricating into cable of various sizes and types. He was of the opinion that converting rupiah to procure raw materials could result in higher finished product costs.

This plant is the only one in Indonesia presently producing aluminum conductors.

It is suggested that procurement of conductors and service cable should be attempted using two methods, viz:

a. Advertise and receive bids for complete conductor and service cable requirements, CIF Indonesian ports, from foreign sources (Code 941 countries).

b. Simultaneously advertise and receive bids (CIF Indonesian ports) for necessary raw materials (rod, core wire, and insulation) to produce the amount of conductor and cable required in a. above. At same time receive bid(s) from local fabricators for handling raw materials, fabricating, and packing the amount of conductor and cable required in a. above.

This will obtain the cheapest price for the material and could well help establish a local industry.

5. Revenue Meters.

Watthour meters manufactured according to American National Standards Institute (ANSI) publications have ratings and characteristics far in excess of most Indonesian rural consumers' needs. Meter requirements for some 97% of the services in this program would be single-phase, two-wire 220 volt, 10 ampere, 50 hertz. The meters specified should be those using less stringent overload, thermal, and power factor characteristics than required by ANSI. It is believed adequate meters manufactured to other than ANSI standards, which will have characteristics compatable with the intended service , can be procured for some 50% of the cost of an ANSI meter. Meters for large loads and all power meters should be purchased according to ANSI publication for 50 hertz. To conform with principles stated elsewhere in this report, no load limiters should be purchased or installed.

6. Other Materials.

All other materials and equipment should be purchased using standard GOI and foreign source procurement procedures. No local industries were found producing acceptable materials, with the possible exception of transformers. A transformer plant producing three-phase distribution units was visited and found to be producing quality products using modern and adequate production equipment. This plant has no engineering staff per se, and is producing equipment according to "borrowed" designs. At present this plant cannot produce suitable single-phase transformers due to lack of competent designs. However, this plant has the capability of becoming a source for distribution transformers in future years.

PART F

PRICING

ESTIMATING COST OF MATERIALS

F. PRICING - ESTIMATING COST OF DISTRIBUTION SYSTEM MATERIALS.

Material costs have been developed, delivered to warehouses in Indonesia, by determining the costs in currencies expended, U. S. dollars and Indonesian Rupiah. Procedures and methods used are briefly described.

While it is known that Code 941 countries may furnish materials, only United States manufacturers' prices have been used. The use of these prices for estimates is considered logical as no published prices are available from Code 941 country suppliers. Further, recent bid openings in Indonesia indicate that while Code 941 suppliers have expressed interest, no bids were received. It can be shown in other areas that prices quoted from Code 941 suppliers vary with the "time" of bidding and are often 30 - 40% below other bidders. It is not known whether such offers, if accepted, were delivered and if the material quality delivered is as specified. While quality materials at lower prices are highly desirable, it is not felt that experience in Indonesia on electrical materials procurement, using USAID regulations and procedures, warrants use of these lower prices for cost estimates.

Material prices used are published list prices of suppliers adjusted by their current (Spring 1977) discount sheets. It is to be expected at time of bidding that there will be some additional reduction in base price (FOB factory) depending on quantity required, manufacturing plant, load, shipping schedules, etc. These "reductions", if they are made, cannot be reduced to concrete terms and therefore are not considered in estimating material costs. Prices used are from these manufacturers:

Product	Suppliers
Line hardware, insulators	A. B. Chance Co.
Conductor fittings, etc.	Joslyn Mfg. & Supply Co. McGraw-Edison Co.
Transformers, meters, meter sockets, instrument transformers, regulators, street lighting fixtures	General Electric Co. Westinghouse Electric Corp.
Non-NEMA standard watthour meters	Ta-Tung Engr. Co., Taipei, Taiwan
Bypass switches	Kearney-National
Airbreak switches	Kearney-National Westinghouse Electric Corp.

Reclosers, sectionalizers	McGraw-Edison Co.
Arresters	General Electric Westinghouse Electric Corp.
Connectors and splices	Burndy Corp.
Conductors and service drop cables	Alcoa Conductor Products Co. Southwire Co.
Cross arms	local producers
Poles and anchor logs	local producers

Costs for export packing and delivery to port were added where appropriate to obtain an FOB port price. Most materials are quoted with an Eastern and Western Zone price with freight allowed to destination within those zones. Since Eastern Zone prices are the lower priced and conference ocean freight rates to Indonesia from Atlantic-Gulf ports are roughly the same as from West Coast ports, Eastern Zone pricing is used. Export packing is quoted at approximately 5% of factory cost on many items and this adder is used where appropriate.

Cost to export (a U.S. dollar cost) consists of these expenses - Spring 1977 average rates shown are used:

a. Port brokers's fee - ¼ of 1% of commodity cost FOB port.

b. Port handling costs, stevedoring - US $7 per cubic foot measurement of shipment. This does not include heavy lifts which are not anticipated for these materials.

c. Ocean freight - US $125 per shipping unit, 2,000 pounds or 40 cubic feet, whichever produces most revenue for carrier.

d. Marine insurance - 1½% of C&F price for insulators, transformers, meters, regulators, etc.
3/4 of 1% of C&F price for hardware, conductors, etc.

e. Demurrage charges are not anticipated or used since 15 days at port are "no charge".

Cost to import (an Indonesian rupiah cost) consists of these expenses, gathered from local Indonesian sources and believed valid for this estimate:

a. Port broker's fee - Estimated at Rp 15,000/MT which includes all documentation and clearance as duty free merchandise.

b. Port handling costs, stevedoring - From shipside to warehouse and inspection area, Rp 4,000/MT.

c. Heavy lifts - Charges are made for use of port cranes, etc. at varying rates, according to character or size of lifting equipment. No costs are anticipated for heavy lifts on material to be imported.

d. Warehouse charges -

Outdoor	Rp 70/M^3/day.
Indoor (roof covered)	Rp 100/M^3/day.
Bonded	Rp 175/M^3/day.

Above rates apply for 12 days. After 12 days rates are increased 100% as a penalty, which we understand does not apply on USAID materials. Most materials (except corrugated packed material) will use outdoor rate for 12 days only or Rp 840/M^3. For corrugated packed material indoor rate will be used for 12 days only or Rp 1,200/M^3.

e. Loading for inland transport from port - After clearance from port (customs or warehouse area) stevedores load merchandise to owner's trucks, with rent of fork lifts, etc. To load a 5 to 6 ton truck, use Rp 3,000/MT as an average cost.

These import costs assume no customs duties, per se, but various stamp charges will no doubt accrue with each shipment. No definitive value can be assessed to these charges and they are not included in the estimated material costs used in this report.

Materials will be imported through several different ports on different islands of Indonesia. For material pricing at any warehouse, average import costs have been applied for any Indonesian port.

To transport materials from port to a central warehouse a price of Rp 6,000 per metric ton has been used. This cost is based on utilizing large open-bodied 5 to 6 ton trucks. An average of 50 km is used as the distance between port and central warehouse.

Cost of distributing materials to individual projects from central warehouses will be estimated as a job cost for the individual project.

To illustrate costing methods used and described above:

INSULATOR, PIN TYPE, ANSI 56-1, RADIO FREED, BROWN PORCELAIN

Material cost:

Unit	100 pieces
Shipping weight, export packed	875 pounds (0.4375 tons)
Volume, export packed	32 cu. ft. (0.8 shipping cube)
List price, Eastern zone delivery	US$587
Discount	none
Export packing 5% of net price	US$29.35
Cost FOB U.S. port	US$616.35

Export Cost:

Port broker's fees, ¼ of 1% of FOB cost	US $ 1.54
Stevedoring US $7 per 40 cu. ft. (shipping cube)	5.60
Ocean freight, US $125 per 40 cu.ft. (shipping cube)	100.00
Marine insurance, 1¼% of C & F cost (6.16.35 + 107.14)	9.04
Total export cost	US $116.18

Import Cost:

Port broker's fees, Rp 15,000/MT	Rp 5,955
Stevedoring Rp 4,000/MT	1,588
Warehousing at port, Rp 1,200 M^3	1,088
Loading on truck at port, Rp 3,000/MT	1,191
Total import cost	Rp 9,822

Inland freight:

Port to warehouse, Rp 6,000/MT	Rp 2,382

Total cost for insulators, pin type, FOB Indonesian warehouse:

	Rupiah	US$	US$ Equivalent
Material cost	-	616.35	616.35
Export cost	-	116.18	116.18
Import cost	9,822	-	23.67
Inland transport	2,382	-	5.74
Total cost per 100 pieces	12,204	732.53	761.94

Due to the mass of the calculation sheets used they are retained in the files at USAID/Jakarta. Costs shown are brought forward to the "Unit Cost" sheets for various construction assemblies.

PART G

LABOR COSTS

G. LABOR COSTS.

1. General.

Labor rates in Indonesia for various work classifications have no "going" price. In fact, depending upon source of information, wages vary from "nothing" to unbelievable highs. Apparently base wages for similar work vary between government enterprises and private concerns. It is reported that wage levels as well as benefits depend largely upon whether the employer is foreign or domestic and the type of financing of the project or business -- overseas or local.

There are very few formal labor laws and regulations in Indonesia. Those which exist have not been codified, making exact conditions and benefits difficult to assess and apply. Generally "Labor Law" is considered to be a collection of written regulations and unwritten customs and practices dealing with working for pay, either in cash or kind. It has been said that Indonesian Labor Law is most interested in these aspects of employment:

a. Making a work agreement.
b. Work obligations of employment.
c. Employers' obligations to employees both during and after the period of their work.
d. Termination of employment.
e. Settlement of labor disputes.

There are several publications in English which have gathered much of the pertinent information currently in use concerning labor. The 1974 publication of the Padjadjaran University Law School, Bandung, title "Labor Law", part of a series titled "Survey of Indonesian Economic Law", has been freely used to ascertain labor practices to estimate labor costs for this study.

Minimum or fixed wage rates are not proscribed by law, but wage rates contained in collective labor agreements have in several instances been extended to workers who are not part of the collective agreements. Generally unions do not exist, except in foreign or very large enterprises.

The above statements are recited for background only and are not to be construed as criticisms or that changes are suggested. However information gathered along with the above statements is being used to estimated total wages and salaries for both construction and operating personnel on the project.

2. Rate of Pay for Construction Employees.

In this rural electrification program, construction will be accomplished on four different islands of Indonesia. In three locations very little, if any, construction of this type has been done. We therefore assume all skilled and semi-skilled personnel for these locations will come from other areas. Compensation for these workers must be adjusted accordingly. These base rates are used in the table below, and include wages paid in cash, housing, and ration allowance, but not "benefits" or expenses away from place of employment.

Classification	Monthly Base Pay (Rupiah) Central Java	Outer Islands
General Foreman	78,000	80,000
Foreman	68,000	70,000
Skilled Worker, 1st Class	48,000	49,000
Skilled Worker, 2nd Class	38,000	39,000
Skilled Worker, Apprentice	31,000	30,000
Heavy Equipment Operator	35,000	33,000
Truck Driver	34,000	32,000
Pick-up or Car Driver	31,000	29,000
Laborer	28,000	26,000

Article 4 of Regulation No. 9-1964 of the Minister of Labor defines wages as:

a. Wages paid in cash.
b. Cost of rations supplied free of charge.
c. Cost of housing furnished free of charge.
d. Cost of medical treatment etc. provided free of charge
e. Other allowances-vix vacation, bonus, severance pay, etc.

These items have become standard compensation for workers and may be paid in cash or kind (limited to housing, food, etc.). Employers use various methods of application but most construction firms prefer, when possible, to pay items a, b, and c in cash. When the job site is too far from villages, camps are established and employees' monthly cash payments are reduced. The base rates in the above table will, however, cover costs to the employer using either method to compensate for rations and quarters.

Various regulations require payments for vacation, bonus, etc. based on length of service. For construction workers it is believed the following schedule of payment will satisfy requirements of items d and e. These payments are proscribed by Law 1/1951 and Law 12/1964.

a.	Paid holidays	- 11 days/year
b.	Bonus (Lebaran)	- 1 month's salary/year
c.	Paid vacation	- 12 work days/year
d.	Social Security Fund	- 5% of monthly wage
e.	Termination pay	- 1 month's salary/year of service

The above payments would be extra compensation for the average employee. These added costs must be reduced to working time rates for each employee. Labor regulations define a month as 173 hours of work with a normal work week of no more than 40 hours and no more than 7 hours each day (Law 1/1951). The law provides exceptions, but since for most exceptions overtime rates apply, only the normal work week is considered here.

Reducing these allowances to hourly working time rates:

a.	Paid holidays	11 X 7 =	77 hours
b.	Bonus		173 hours
c.	Vacation	12 X 7 =	84 hours
d.	Terminal pay		173 hours
	Total Hours Pay not worked	=	507 hours/year

Total work hours in a year 12X173 = 2,076 hours.
Total productive hours in a year 2,076-77-84 = 1,915 hrs.

The percent of non-productive hours to productive hours, using $\frac{507}{1915} \times 100$ works out at 26.48%.

Adding the Social Security Fund contribution of 5% to the above ratio gives a 31.48% additional cost which must be added to the hourly rates, calculated using monthly rates in the table to arrive at true hourly labor costs.

When employees are required to work away from their home area, a per diem allowance is paid in cash or kind to each employee. On large-scale operations camps are usually established, with the employer providing at no cost to the employee satisfactory camp type lodgings and prepared food. Under camp conditions no per diem is paid in cash. It is to be understood that base rates of pay including housing and ration allowance continue at the same level when the employee is working away from his home area. Customs and practices for cash payment of per diem allow Rp 1,800 to Rp 2,500 per employee depending upon his work classification. These amounts are to be used in this study for those employees who will be working away from their home areas.

3. Rate of Pay for Operating Personnel.

In calculating pay for operating personnel the above rates are used for the entire study, over the 15 year period. Office workers and clerical help are not shown in the above schedules, but they for the most part will be local people and wage rates will be paid accordingly. Since administrative and general expenses are calculated in this study on a fixed percentage of investment, small variations in office salaries will not appreciably affect this study.

MANPOWER NEEDS FOR SYSTEM OPERATION

Construction Period:

At least one year before energization:

Title	Number
General manager	1
Department heads:	
Office services	1
Consumer services	1
Engineering	1
Line department	1
Sub-department heads:	
Office services	5
Consumer services	3
Engineering	3
Line department	2
Total	18

During the year prior to energization:

Office services	20
Consumer services	3
Engineering	9
Line department	36
Total	68

Add in following years, as needed:

	Department			
Year	Office Services	Consumer Services	Engineering	Line
1 (after energization)	4	1	2	10
2 (after energization)	2	1	2	4
3 (after energization)	2	1	2	4

Total personnel at end of third full operating year - 121.

COMPOSITE MANHOUR RATES-CONSTRUCTION

TYPE OF CREW RIGHT-OF-WAY CLEARING

LOCATION: CENTRAL JAVA

CLASSIFICATION	NUMBER IN CREW	AVERAGE MONTHLY RATE	AVERAGE HOURLY RATE COL. (3) ÷ 173	BENEFITS / HOUR COL. (4) X 31.48 %	DAILY EXPENSE ALLOWANCE	EXPENSE ALLOWANCE PER WORK HOUR *	TOTAL COST/WORK HOUR COLS. (4)+(5)+(7)	TOTAL COST / CREW WORK HOUR COL (2) X (8)
UNIT	EACH	Rp	Rp	Rp	Rp	Rp	Rp	Rp
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
General Foreman	1/5	78,000	451	142	-	-	693	139
Foreman	1	68,000	393	124	-	-	517	517
Lineman, 2nd Class	1	38,000	220	69	-	-	289	289
Truck Driver	1	34,000	196	62	-	-	258	258
Pickup Driver	1/5	31,000	179	56	-	-	235	47
Laborers	40	28,000	162	51	-	-	213	8520
LABOR TOTAL	43 2/5							9770
Trucks	1	225,000	1301				1301	1301
Pickup Truck	1/5	135,000	780				780	156
GRAND TOTAL								11227

*	EXPENSE ALLOWANCE / WORK HOUR = COLUMN (6) X 7 ÷ 40	
(10)	MANHOUR COST / WORK HOUR = GRAND TOTAL COL. (9) ÷ LABOR TOTAL COL. (2)	Rp 259
(11)	AVERAGE NON-PRODUCTIVE TIME (TRAVEL TIME - WEATHER - ETC.)	23 %
(12)	PRODUCTIVITY FACTOR	1.40
13	MANHOUR RATE / PRODUCTIVE HOUR = LINE (10) X LINE (12) X $\left[\frac{\text{LINE (11)}}{100} + 1\right]$	Rp 446

COMPOSITE MANHOUR RATES-CONSTRUCTION

TYPE OF CREW POLE SETTING

LOCATION CENTRAL JAVA

CLASSIFICATION	NUMBER IN CREW	AVERAGE MONTHLY RATE	AVERAGE HOURLY RATE COL (3) ÷ 173	BENEFITS / HOUR COL (4) X 31.48 %	DAILY EXPENSE ALLOWANCE	EXPENSE ALLOWANCE PER WORK HOUR *	TOTAL COST/WORKHOUR COLS. (4)+(5)+(7)	TOTAL COST / CREW WORK HOUR COL (2) X (8)
UNIT	EACH	Rp	Rp	Rp	Rp	Rp	Rp	Rp
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
General Foreman	1/5	78,000	451	142	-	-	693	139
Foreman	2	68,000	393	124	-	-	517	1034
Lineman, 2nd Class	1	38,000	220	69	-	-	289	289
Lineman, Apprentice	2	31,000	179	56	-	-	235	470
Truck Driver	2	34,000	196	62	-	-	258	516
Pickup Driver	2 1/5	31,000	179	56	-	-	235	517
Laborer	20	28,000	162	51	-	-	213	4260
LABOR TOTAL	29 1/5							7225
Trucks with pole dolly	1	325,000	1879				1879	1879
Trucks with Winch	1	295,000	1705				1705	1705
Pickup Trucks	2 1/5	135,000	780				780	1716
GRAND TOTAL								12525

*	EXPENSE ALLOWANCE / WORK HOUR = COLUMN (6) X 7 ÷ 40	
(10)	MANHOUR COST / WORK HOUR = GRAND TOTAL COL (9) ÷ LABOR TOTAL COL (2)	Rp 429
(11)	AVERAGE NON-PRODUCTIVE TIME (TRAVEL TIME - WEATHER - ETC.)	23 %
(12)	PRODUCTIVITY FACTOR	1.40
13	MANHOUR RATE / PRODUCTIVE HOUR = LINE (10) X LINE (12) X $\left[\frac{\text{LINE (11)}}{100} + 1\right]$	Rp 739

COMPOSITE MANHOUR RATES-CONSTRUCTION

TYPE OF CREW - GUY & FRAMING

LOCATION: CENTRAL JAVA

CLASSIFICATION	NUMBER IN CREW	AVERAGE MONTHLY RATE	AVERAGE HOURLY RATE COL. (3) ÷ 173	BENEFITS / HOUR COL. (4) X 31.48 %	DAILY EXPENSE ALLOWANCE	EXPENSE ALLOWANCE PER WORK HOUR *	TOTAL COST/WORK HOUR COLS. (4)+(5)+(7)	TOTAL COST / CREW WORK HOUR COL. (2) X (8)
UNIT	EACH	Rp	Rp	Rp	Rp	Rp	Rp	Rp
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
General Foreman	1/5	78,000	451	142	-	-	693	139
Foreman	1	68,000	393	124	-	-	517	517
Lineman, 1st Class	2	48,000	277	87	-	-	364	728
Lineman, 2nd Class	1	38,000	220	69	-	-	289	289
Lineman, Apprentice	3	31,000	179	56	-	-	235	705
Truck Driver	1	34,000	196	62	-	-	258	258
Pickup Driver	1/5	31,000	179	56	-	-	235	47
LABOR TOTAL	2 8/5							2683
Trucks	1	225,000	1301				1301	1301
Pickup Trucks	1/5	135,000	780				780	156
GRAND TOTAL								4140

*	EXPENSE ALLOWANCE / WORK HOUR = COLUMN (6) X 7 ÷ 40	
(10)	MANHOUR COST / WORK HOUR = GRAND TOTAL COL. (9) ÷ LABOR TOTAL COL. (2)	Rp 493
(11)	AVERAGE NON-PRODUCTIVE TIME (TRAVEL TIME - WEATHER - ETC.)	23 %
(12)	PRODUCTIVITY FACTOR	1.40
13	MANHOUR RATE / PRODUCTIVE HOUR = LINE (10) X LINE (12) X $\left[\frac{\text{LINE (11)}}{100} + 1\right]$	Rp 849

COMPOSITE MANHOUR RATES-CONSTRUCTION

TYPE OF CREW CONDUCTOR STRINGING, SAGGING & CLIPPING

LOCATION: CENTRAL JAVA

CLASSIFICATION	NUMBER IN CREW	AVERAGE MONTHLY RATE	AVERAGE HOURLY RATE COL (3) ÷ 173	BENEFITS / HOUR COL (4) X 31.48 %	DAILY EXPENSE ALLOWANCE	EXPENSE ALLOWANCE PER WORK HOUR *	TOTAL COST/WORKHOUR COLS. (4)+(5)+(7)	TOTAL COST / CREW WORK HOUR COL (2) X (8)
UNIT	EACH	Rp	Rp	Rp	Rp	Rp	Rp	Rp
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
General Foreman	1/5	78,000	451	142	-	-	693	139
Foreman	2	68,000	393	124	-	-	517	1034
Lineman, 1st Class	5	48,000	277	87	-	-	364	1820
Lineman, 2nd Class	6	38,000	220	69	-	-	289	1734
Lineman, Apprentice	11	31,000	179	56	-	-	235	2585
Truck Driver	4	34,000	196	62	-	-	258	1032
Pickup Driver	3 1/5	31,000	179	56	-	-	235	752
Laborer	10	28,000	162	51	-	-	213	2130
LABOR TOTAL	41 2/5							11326
Trucks with Winch	1	295,000	1705				1705	1705
Trucks	3	225,000	1301				1301	3903
Pickup Trucks	3 1/5	135,000	780				780	2496
GRAND TOTAL								19330

*	EXPENSE ALLOWANCE / WORK HOUR = COLUMN (6) X 7 ÷ 40	
(10)	MANHOUR COST / WORK HOUR = GRAND TOTAL COL (9) ÷ LABOR TOTAL COL (2)	Rp 467
(11)	AVERAGE NON-PRODUCTIVE TIME (TRAVEL TIME - WEATHER - ETC.)	23 %
(12)	PRODUCTIVITY FACTOR	1.40
13	MANHOUR RATE / PRODUCTIVE HOUR = LINE (10) X LINE (12) X $\left[\frac{\text{LINE (11)}}{100} + 1\right]$	Rp 804

COMPOSITE MANHOUR RATES-CONSTRUCTION

TYPE OF CREW TRANSFORMER, REGULATORS, & SECTIONALIZING INSTALLATIONS

LOCATION CENTRAL JAVA

CLASSIFICATION	NUMBER IN CREW	AVERAGE MONTHLY RATE	AVERAGE HOURLY RATE COL (3) ÷ 173	BENEFITS / HOUR COL (4) X 31.48 %	DAILY EXPENSE ALLOWANCE	EXPENSE ALLOWANCE PER WORK HOUR *	TOTAL COST/WORKHOUR COLS. (4)+(5)+(7)	TOTAL COST / CREW WORK HOUR COL (2) X (8)
UNIT	EACH	Rp	Rp	Rp	Rp	Rp	Rp	Rp
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
General Foreman	1/5	78,000	451	142	-	-	693	139
Foreman	1	68,000	393	124	-	-	517	517
Lineman, 1st Class	4	48,000	277	87	-	-	364	1456
Lineman, Apprentice	6	31,000	179	56	-	-	235	1410
Truck Driver	2	34,000	196	62	-	-	258	516
Pickup Driver	1/5	31,000	179	56	-	-	235	47
LABOR TOTAL	13 2/5							4085
Trucks	1	225,000	1301				1301	1301
Truck with Winchs	1	295,000	1705				1705	1705
Pickup Trucks	1/5	135,000	780				780	156
GRAND TOTAL								7247

*	EXPENSE ALLOWANCE / WORK HOUR = COLUMN (6) X 7 ÷ 40	
(10)	MANHOUR COST / WORK HOUR = GRAND TOTAL COL (9) ÷ LABOR TOTAL COL (2)	Rp 541
(11)	AVERAGE NON-PRODUCTIVE TIME (TRAVEL TIME - WEATHER - ETC.)	23 %
(12)	PRODUCTIVITY FACTOR	1.40
13	MANHOUR RATE / PRODUCTIVE HOUR = LINE (10) X LINE (12) X $\left[\frac{\text{LINE (11)}}{100} + 1\right]$	Rp 932

COMPOSITE MANHOUR RATES-CONSTRUCTION

TYPE OF CREW METER & : SERVICE INSTALLATION

LOCATION CENTRAL JAVA

CLASSIFICATION	NUMBER IN CREW	AVERAGE MONTHLY RATE	AVERAGE HOURLY RATE COL (3) ÷ 173	BENEFITS / HOUR COL (4) X 31.48 %	DAILY EXPENSE ALLOWANCE	EXPENSE ALLOWANCE PER WORK HOUR *	TOTAL COST/WORKHOUR COLS. (4)+(5)+(7)	TOTAL COST / CREW WORK HOUR COL (2) X (8)
UNIT	EACH	Rp	Rp	Rp	Rp	Rp	Rp	Rp
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Lineman, 1st Class	2	48,000	277	87	-	-	364	728
Lineman, Apprentice	2	31,000	179	56	-	-	235	470
Pickup Driver	1	31,000	179	56	-	-	235	235
LABOR TOTAL	5							1433
Pickup Trucks	1	135,000	780				780	780
GRAND TOTAL								2213

*	EXPENSE ALLOWANCE / WORK HOUR = COLUMN (6) X 7 ÷ 40	
(10)	MANHOUR COST / WORK HOUR = GRAND TOTAL COL (9) ÷ LABOR TOTAL COL (2)	Rp 443
(11)	AVERAGE NON-PRODUCTIVE TIME (TRAVEL TIME - WEATHER - ETC)	35 %
(12)	PRODUCTIVITY FACTOR	1.40
13	MANHOUR RATE / PRODUCTIVE HOUR = LINE (10) X LINE (12) X $\left[\frac{\text{LINE (11)}}{100} + 1\right]$	Rp 837

H. ESTIMATED CONSTRUCTION COSTS FOR DISTRIBUTION SYSTEMS.

A "standard unit" or "standard kilometer" approach was taken to arrive at estimated system construction costs.

Average quantities for a "standard" kilometer were based on design criteria (described elsewhere), number of consumers, and terrain.

In estimating total prices for these standard units, several steps were taken to accurately cost these units. The method used to build-up this pricing was as follows:

1. Material prices F.O.B. Indonesian warehouse (see Part F) were applied to each distribution construction assembly, i.e. poles, pole top assemblies, service assemblies, transformer assemblies. This resulted in material costs per assembly as shown in columns (3), (4), and (5) of sheets titled "Unit Costs-Mid 1977", **found in this section.**

2. Labor man-hours for installation, column (6) of "Unit Costs-Mid 1977" are derived from standard hours commonly used in the construction industry in the U.S.A. Labor rates columns (7) and (8) of "Unit Costs-Mid 1977", are calculated using composite man-hour rates for various type of crews needed to install the different assemblies. Composite rates are based on labor rates in **Part G.** Included in the composite man-hour rates are costs, including operating and maintenance for equipment required by each crew. Since actual productive man-hours are used, allowances have been made in man-hour rates for non-productive time (travel time, weather, etc.), and a productivity factor is added.

   This productivity factor adjusts the man-hours required in Indonesia to the standard man-hours used. "Composite Man-hour Rates-Construction" are calculated for different types of crews and are included in **Part G.**

3. Job expense, column (9) of "Unit Costs-Mid 1977" includes provision for these and other incidential expenses not covered by material and labor costs. These expenses include office expenses, general overhead, small tools, insurance, etc.

4. Total installed cost of assemblies, columns (10), (11), and (12) of "Unit Costs-Mid 1977" are used to determine "Standard Kilometer" and "Standard Unit" prices. Assembly costs are extended on price sheets entitled "Distribution System Cost" **found in this section.**

5. From the "Distribution System Cost" sheets standard kilometer or standard unit prices are used in calculating distribution system costs for various operating years. Each year shows value of system <u>added</u> and is not cumulative.

Quantities used for deriving system yearly costs are taken from "Distribution Plant Increments" sheets prepared from distribution system designs and load data. Distribution system cost sheets subtotals are "adjusted to location" in certain construction areas. This item cares for additional expense for handling material, mostly local furnished, to job warehouse. Suitable adjustments are made in labor rates for the additional compensation required at remote locations. Engineering costs for local engineering services, only, are included in "Distribution System Costs". Foreign engineering services and training are, according to USAID/J, a grant and should not be included in costs.

Costs shown will adequately construct the systems delineated for the ensuing 2-year period, without escalation, provided all materials are contracted prior to March 1978.

The following tables are the estimated construction unit cost (as specified in REA form 803 - SPECIFICATIONS AND DRAWINGS FOR 14.4/24.9 KV LINE CONSTRUCTION) itemized in the following tables. These construction unit costs are used to calculate the "STANDARD KILOMETER" and "STANDARD UNIT".

UNIT COSTS - MID 1977

SHEET 1 OF 6

LOCATION: CENTRAL JAVA

UNIT DESIGNATION	DESCRIPTION	MATERIAL - INDONESIAN WHSE RUPIAH	MATERIAL US $	MATERIAL EQUIVALENT US $	LABOR MAN HOURS	LABOR RATE RUPIAH	LABOR EXTENSION RUPIAH	JOB EXPENSE RUPIAH	TOTAL INSTALLED COST RUPIAH	TOTAL INSTALLED COST US $	TOTAL INSTALLED COST EQUIVALENT US $
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
4A1	Prim Supt, 1Ø-0°-5° Ang	249	14.60	15.20	1.5	849	1274	758	2281	14.60	20.10
4A1A	Prim Supt, 1Ø-Offset New 0°-5° Ang	339	20.54	21.35	1.5	849	1274	1014	2626	20.54	26.87
4A1-1	Prim Dble Supt, 1Ø-0°-5° Ang	541	31.67	32.97	2.0	849	1698	1538	3777	31.67	40.77
4A1-1A	Prim Dble Supt, 1Ø-Offset New 0°-5° Ang	630	37.61	39.13	2.0	849	1698	1794	4122	37.61	47.54
4A1-2	Prim & New Dble Supt, 1Ø-0°-5° Ang	649	37.11	[illegible]	2.1	849	1783	1783	4214	37.11	47.26
4A2	Prim Dble Supt, 1Ø-5°-30° Ang	584	33.56	34.97	2.0	849	1698	1621	3903	33.56	42.96
4A2-3	Prim & New Dble Supt 1Ø-5°-30°	680	38.21	39.85	2.1	849	1783	1832	4295	38.21	49.56
4A3	Prim Supt, 1Ø-30°-60° Ang	484	27.79	28.96	1.5	849	1274	1329	3087	27.79	35.23
4A4	Prim Supt, 1Ø-60°-90° Ang	1025	61.62	64.09	3.0	849	2547	2914	6486	61.62	77.25
4A5	Prim Dead End, 1Ø	510	29.94	31.07	1.5	849	1274	1417	3201	29.94	37.55
4A5-1	Prim Tap, 1Ø	519	37.35	33.63	2.0	849	1698	1565	3781	32.35	41.49
4A5-2	Prim Tap, 1Ø	557	35.79	37.12	2.0	849	1698	1711	3966	35.79	45.35
4A5-2A	Prim Tap, 1Ø	526	34.18	33.45	2.0	849	1698	1641	3665	34.18	43.49
4A5-3	Prim Tap, 1Ø	488	31.55	32.73	2.0	849	1698	1528	3714	31.55	40.50
4A5-4	Prim Tap, 1Ø	706	44.88	46.58	2.2	849	1868	2120	4694	44.88	56.19
4A6	Prim Dble Dead End, 1Ø	1000	60.29	62.70	3.0	849	2547	2883	6430	60.29	75.75
4B1	Prim Supt, "V"Ø-0°-5° Ang	4328	33.42	43.55	3.0	849	2547	2074	8949	33.42	54.95
4B1A	Prim Supt, "V"Ø-Offset New 0°-5° Ang	4419	39.43	50.07	3.0	849	2547	2333	9298	39.43	61.63
4B1-1	Prim Dble Supt, "V"Ø-0°-5° Ang	8716	64.14	89.14	4.1	849	3481	4048	16245	65.14	107.25
4B1-1A	Prim Dble Supt, "V"Ø Offset New 0°-5°	8806	74.07	95.29	4.1	849	3481	4303	16590	74.07	114.05
4B2	Prim Dble Supt, "V"Ø 5°-30°	8774	69.90	91.04	4.1	849	3481	4126	16381	69.90	109.37
4B3	Prim Supt, "V" Ø 30°-60° Ang	889	51.04	53.19	3.2	849	2717	2479	6085	51.04	65.70
4B4-1	Prim Supt, "V" Ø 60°-90° Ang	1944	121.51	126.19	7.0	849	5943	5831	13718	121.51	156.57
4B5-1	Prim Dead End "V" Ø	970	57.59	59.93	3.8	849	3226	2810	7006	57.59	74.47
4C1	Prim Supt, 3Ø 0°-5° Ang	4099	45.83	55.71	4.0	849	3396	2652	10147	45.83	70.25
4C1-B	Prim Supt, 3Ø Offset New 0°-5° Ang	4189	51.76	61.35	4.0	849	3396	2907	10492	51.76	77.04
4C1-1	Prim Dble Supt, 3Ø 0°-5° Ang	8340	97.58	117.69	5.1	849	4330	5316	17956	97.58	140.92
4C1-1A	Prim Dble Supt, 3Ø Offset New 0°-5°	8430	103.51	123.92	5.1	849	4330	5572	18332	103.51	147.69
4C1-2	Prim Supt, 3Ø Large Cond 0°-2° Ang	4702	57.15	68.48	4.3	849	3651	3208	11561	57.15	85.01
4C1-3	Prim Dble Supt, 3Ø Large Cond 0°-5° Ang	9512	118.25	141.17	5.4	849	4585	6317	20414	118.25	167.44
4C1-4	Prim Supt, 3Ø Large Cond 0°-5° Angle	5072	75.84	88.06	4.3	849	3651	4020	12743	75.84	106.55
4C2	Prim Dble Supt, 3Ø 5°-30° Ang	8419	100.87	121.16	5.1	849	4330	5461	18210	100.87	[illegible]
4C2-1	Prim Dble Supt, 3Ø 5°-30° Ang	9552	99.67	121.96	5.3	849	4500	5542	19594	99.67	146.88
4C2-2	Prim Dble Supt, 3Ø 5°-30° Ang	9489	122.84	145.71	5.3	849	4500	6497	20486	122.84	172.20

UNIT COSTS - MID 1977

LOCATION - CENTRAL JAVA

UNIT DESIGNATION	DESCRIPTION	MATERIAL - INDONESIAN WHSE RUPIAH	MATERIAL - INDONESIAN WHSE US $	MATERIAL - INDONESIAN WHSE EQUIVALENT US $	LABOR MAN HOURS	LABOR RATE RUPIAH	LABOR EXTENSION RUPIAH	JOB EXPENSE RUPIAH	TOTAL INSTALLED COST RUPIAH	TOTAL INSTALLED COST US $	TOTAL INSTALLED COST EQUIVALENT US $
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
VC3	Primary Support,3Ø 30°-60° Angle	1301	76.89	80.02	4.2	849	3566	3678	8545	76.89	97.48
VC3-L	Prim Supt,3Ø 30°-60° Angle Large Cond	1490	109.12	112.71	4.8	849	4075	5095	10650	109.12	134.78
VC3-1	Prim Supt,3Ø Vertical 10°-20° Ang	1665	118.33	122.34	6.4	849	5434	5621	12720	118.33	145.95
VC4-1	Prim Supt,3Ø Vertical Const 60°-90°Ang	2862	174.58	181.49	8.0	849	6792	8211	17865	174.58	217.63
VC4-1L	Prim Supt,3Ø Vert Const 60°-90°Angle	3015	225.87	233.14	8.5	849	7217	10397	20629	225.87	275.58
VC5-1	Prim Supt,3Ø Vert Const D.E.	1394	82.74	85.81	4.8	849	4075	3960	9439	82.74	105.49
VC5-1L	Prim Supt,3Ø Vert Const D.E.	1503	111.39	115.01	5.0	849	4245	5198	10946	111.39	137.77
VC7	Prim Supt,3Ø Single D.E. 1-Arm	8343	98.15	118.25	7.0	849	5943	5502	19788	98.15	145.83
VC7-1	Prim Supt,3Ø Single D.E.1-Arm	11707	98.15	126.35	7.3	849	6198	5863	23763	98.15	155.41
VC8	Prim Supt,3Ø Double D.E.3-Arm	9775	183.10	206.67	8.4	849	7132	9289	26196	183.10	246.22
VC9-2	Prim Supt,3Ø Double D.E.3-Arm	10519	196.38	222.45	8.4	849	7132	9945	27896	196.38	263.60
VE1-1	Down guy-thru Bolt Type - ¼"	215	13.16	13.69	3.1	849	2632	831	3691	13.16	22.03
VE1-2	Down guy-thru Bolt Type - 3/8"	366	17.72	18.60	3.4	849	2887	1061	4314	17.72	28.12
VE1-3	Down guy-thru Bolt Type - 7/16"	546	22.45	23.77	3.7	849	3141	1300	4987	22.45	34.47
E2-1	Overhead Guy - ¼"	264	17.00	17.64	4.4	849	3736	1106	5106	17.00	29.30
E2-2	Overhead Guy - 3/8"	454	22.95	24.04	4.7	849	3990	1397	5841	22.95	37.02
E2-3	Overhead Guy - 7/16"	669	28.31	29.92	5.0	849	4245	1666	6579	28.31	44.16
E3-2	Down Guy-Wrapped Type-3/8"	399	19.29	20.25	3.8	849	3226	1163	4788	19.29	30.83
E3-3	Down Guy-Wrapped Type-7/16"	570	23.62	24.99	4.1	849	3481	1385	5436	23.62	36.72
E3-10	Guy Guard	42	5.06	5.16	0.5	849	425	257	724	5.06	6.80
E4-2	Overhead Guy-Wrapped Type-3/8"	470	23.07	24.20	4.9	849	4160	1420	6050	23.07	37.65
E4-3	Overhead Guy-Wrapped Type-7/16"	684	28.43	30.08	5.2	849	4415	1690	6789	28.43	44.79
VE5-1	D.E.Guys 3-Arm Const ¼"	941	47.80	49.83	12.0	849	10188	3087	14216	47.80	81.51
VE5-2	D.E.Guys 3-Arm Const 3/8"	1395	64.96	68.32	14.0	849	11886	4024	17305	64.96	106.66
VE7-2L	D.E.Guys-Vert Const 3/8"	1120	52.67	55.37	11.4	849	9679	3266	14065	52.67	86.56
VE7-3L	D.E.Guys-Vert Const 7/16"	1630	64.98	68.91	12.3	849	10443	3901	15974	64.98	103.47
F1-1	Anchor-Expanding-6000 pound	223	11.58	12.12	4.0	739	2956	799	3978	11.58	21.17
F1-2	Anchor-Expanding-8000 pound	223	11.58	12.12	4.0	739	2956	799	3978	11.58	21.17
F1-3	Anchor-Expanding-10000 pound	307	15.09	15.83	4.2	739	3104	957	4368	15.09	25.62
F1-4	Anchor-Expanding-12000 pound	307	15.09	15.83	4.2	739	3104	957	4368	15.09	25.62
F2-4	Anchor-Log Type- 16000 pound	6457	16.13	31.69	10.0	739	7390	2054	15901	16.13	54.45
F5-1	Anchor-Rock Type	99	4.32	4.56	8.0	739	5912	780	6791	4.32	20.69
F6-1	Anchor-Swamp Type-6000 pound	3312	26.14	34.12	6.0	739	4434	1859	9605	26.14	49.28
F6-2	Anchor-Swamp Type-8000 pound	4406	43.46	54.09	6.5	739	4804	2725	11935	43.46	72.22

UNIT COSTS - MID 1977

SHEET 2 OF 6

LOCATION CENTRAL JAVA

UNIT DESIGNATION	DESCRIPTION	MATERIAL - INDONESIAN WHSE			LABOR			JOB EXPENSE	TOTAL INSTALLED COST		
		RUPIAH	US $	EQUIVALENT US $	MAN HOURS	RATE RUPIAH	EXTENSION RUPIAH	RUPIAH	RUPIAH	US $	EQUIVALENT US $
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
VC-109,	VC106,or VC 136 1Ø Transformer										
-10	CSP Type	4677	487.58	496.85	8.0	932	7456	6434	18567	487.58	532.32
-15	CSP Type	4904	505.59	517.17	9.0	932	8388	6690	19982	505.59	533.50
-25	CSP Type	6622	603.41	619.35	12.0	932	11184	8047	25853	603.41	665.71
-37.5	CSP Type	8703	802.22	824.19	15.0	932	13980	10668	33351	802.22	882.56
-50	CSP Type	10441	888.85	914.11	20.0	932	18640	11980	41061	888.85	987.79
VC-312	Three 1Ø Transformer Cluster Mtg										
-15	CSP Type	22672	1700.16	1754.90	30.0	932	27960	22686	73318	1700.16	1876.51
-25	CSP Type	29176	1993.62	2061.40	40.0	932	37280	26783	92189	1993.62	2215.76
-37.5	CSP Type	34369	2590.05	2672.86	50.0	932	46600	34675	115644	2590.05	2865.71
-50	CSP Type	39703	2849.94	2945.61	60.0	932	55920	38680	134303	2849.94	3173.56
25	Secondary Assembly, 0°-5° Angle	41	2.46	2.56	0.7	849	594	166	801	2.46	4.39
26	Secondary D.E. Assembly	90	5.81	6.03	1.3	849	1104	361	1555	5.81	9.56
27	Secondary Assembly, 30°-60° Angle	58	3.14	3.28	0.7	849	594	196	848	3.14	5.18
28	Neutral Assembly, 0°-5° Angle	40	2.23	2.33	0.7	849	594	156	790	2.23	4.13
30B	Secondary Assembly, Fixed, 5°-60° Angle	67	3.22	3.38	0.7	849	594	200	816	3.22	5.30
21P	Secondary Assembly, Transf Bracket	21	1.76	1.81	0.1	849	85	84	190	1.76	2.22
	SERVICE ASSEMBLIES										
*33C	Multiplex Cable-House End	33	2.96	3.04	1.0	837	837	210	1080	2.96	5.56
*33L	Single Conductor-House End	28	4.12	4.19	0.3	837	251	199	478	4.12	5.27
*31C	Multiplex Cable-Pole End	82	6.81	7.01	1.2	837	1004	391	1477	6.81	10.37
*34C	Multiplex Cable-Pole End	94	6.81	7.04	1.2	837	1004	392	1490	6.81	10.40
*34L	Single Cond-Pole End	57	5.60	5.74	1.0	837	836	322	1215	5.60	8.53
*35C	Multiplex Cable-Pole End	29	4.43	4.50	0.3	837	251	212	492	4.43	5.62
*36C	Multiplex Cable-House End-Cond Stem	80	6.25	6.44	1.2	837	1004	368	1452	6.25	9.75
*37L	Single Cond-House End Conduit Stem	38	5.82	5.91	0.5	837	419	287	744	5.82	7.61
VM2-11	Grounding Assembly-Grd Rod Type	216	15.32	15.84	3.0	849	2547	912	3675	15.32	24.18
VM2-12A	Butt Wrapped Ground	133	12.71	13.03	1.5	849	1274	668	2075	12.71	17.71
VM2-12A2	Butt Ground, Plate Type	131	11.82	12.14	1.7	849	1443	649	2222	11.82	17.17
VM2-15	Grounding Hw Platform Type for ABS	24636	23.52	82.93	10.0	932	9320	4372	38328	23.52	115.88

UNIT COSTS - MID 1977

SHEET 4 OF 6

LOCATION CENTRAL JAVA

UNIT DESIGNATION	DESCRIPTION	MATERIAL - INDONESIAN WHSE RUPIAH	MATERIAL US $	MATERIAL EQUIVALENT US $	LABOR MAN HOURS	LABOR RATE RUPIAH	LABOR EXTENSION RUPIAH	JOB EXPENSE RUPIAH	TOTAL INSTALLED COST RUPIAH	TOTAL US $	TOTAL EQUIVALENT US $
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
WM3-4	Sectionalizing Fuse Cut-out-1Ø	505	61.56	63.09	7.0	932	6524	3270	10299	61.56	86.65
WM3-10Ø	Sectionalizing OCR-1Ø	7114	851.65	859.18	12.0	932	11184	11032	25330	851.68	912.72
WM3-16	Air Break Switch -3Ø	20011	1304	1352	60.0	932	55920	18513	94444	1304	1532
WM3-20	Sectionalizing OCR-3Ø-Cross Arm Mtg	26485	2492	2556	40.0	932	37280	32938	96703	2492	2725
WM3-20A	Sectionalizing OCR-3Ø-Cluster Mtg	9678	2593	2616	35.0	932	32620	33552	75850	2593	2776
WM3-23	Sectionalizing OCR-1Ø-W/By Pass Sw	10819	944	1010	15.0	932	13980	12995	37794	954	1075
WM3-25	Sectionalizing OCR-3Ø-W/By Pass Sws	35801	2974	3060	50.0	932	46600	39498	121899	2974	3265
WMT	VOLTAGE REGULATOR-STEP TYPE 1Ø										
-1	1 X 50 Amp	65412	6340	6498	100	932	93200	83691	242303	6340	6924
-3	3 X 50 Amp	176522	18976	19406	250	932	233000	249597	660119	18976	20567
-3	3 X 100 Amp .	199528	22903	23384	300	932	[illegible]	299516	778644	22903	24779
-3	3 X 200 Amp	247324	30506	31102	350	932	326200	397005	970529	30506	32845
-	Security or Street Light-175W Merc.	856	78.38	80.44	[illegible]	932	4846	3823	9525	78.38	101.33
-	REVENUE METERS -50 HERTZ										
-	1Ø-2W-10 Amp-240 Volt-Bottom Conn	77	6.93	7.12	1.5	837	1256	421	1754	6.93	11.16
-	1Ø-2W-15 Amp-240 Volt- Socket Type	104	34.45	34.70	1.5	837	1256	1566	2926	34.45	41.50
-	1Ø-3W-30 Amp-240/480Volt-SocketType	104	28.86	29.11	1.8	837	1507	1359	2970	28.86	36.02
-	3Ø-4W-30 Amp-240/415Volt-SocketType	251	132.26	132.86	4.0	837	3348	5845	9408	132.26	154.93
-	3Ø-4W-2.5Amp-240/415V.W/3 CTS.	3207	218.55	226.31	22.0	837	18414	11233	32558	218.55	297.75
-	1Ø-3W-2.5Amp-240/480V.W/2 CTS.	2136	94.29	94.44	20.0	837	16740	5801	24677	94.29	153.75
-	ACSR CONDUCTOR,BARE - KILOMETERS										
PENGUIN	# 4/0-6/1 Stranding	14389	717.55	757.25	50.0	804	40200	33810	88399	717.55	930.59
PIGEON	# 3/0-6/1 "	11411	574.78	602.28	45.0	804	35592	28854	76857	574.78	764.50
QUAIL	# 2/0-6/1 "	9903	466.44	490.30	45.0	804	36180	23966	70049	466.44	635.23
RAVEN	# 1/ -6/1 "	7215	369.96	387.35	40.0	804	32160	19291	58666	369.96	511.32
SPARROW	# 2-6/1 "	6534	235.72	252.19	35.0	804	28140	12380	48257	235.72	352.00
SWAN	# 4-6/1 "	3002	157.14	164.37	30.0	804	24120	9234	36356	157.14	244.75
TURKEY	# 6-6/1 "	1956	107.59	112.30	28.0	804	22512	6912	31380	107.59	193.20

UNIT COSTS - MID 1977

SHEET 5 OF 6

LOCATION CENTRAL JAVA

UNIT DESIGNATION	DESCRIPTION	MATERIAL-INDONESIAN WHSE RUPIAH	MATERIAL-INDONESIAN WHSE US $	MATERIAL-INDONESIAN WHSE EQUIVALENT US $	MAN HOURS	LABOR RATE RUPIAH	LABOR EXTENSION RUPIAH	JOB EXPENSE RUPIAH	TOTAL INSTALLED COST RUPIAH	TOTAL INSTALLED COST US $	TOTAL INSTALLED COST EQUIVALENT US $
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	ALL ALUMINUM COND BARE - KILOMETERS										
COSMOS	477 MCM-Strand	22096	1288	1341	70.0	804	56280	51280	139656	1288	1624.52
TULIP	#4/0 - 19 Strand	10226	571.20	595.84	45.0	804	36180	28345	74751	571.20	751.32
	6201 ALUM ALLOY COND BARE-KILOMETERS										
AZUSA	#1/0 Equiv - 7 Strand	6348	366.96	382.26	38.0	804	30552	18919	55819	366.96	501.46
AMES	#2 Equiv - 7 Strand	3960	230.95	240.4	33.0	804	26532	12634	43126	230.95	334.57
ALTON	#4 Equiv - 7 Strand	2521	151.66	157.73	28.0	804	22512	8797	33830	151.66	233.18
	MULTIPLEX SERVICE CABLE -KILOMETERS										
SHEPHERD	# 6 Duplex - XLP Insulated	4091	343.22	353.08	95.0	837	79515	22604	106210	343.22	599.15
TERRIER	# 4 Duplex "	6104	466.03	480.74	105.0	837	87885	23643	117632	466.03	749.09
PERIWINKLE	# 4 Triplex "	8952	636.26	657.83	115.0	837	96255	36926	142133	636.26	975.75
CONCH	# 2 Triplex "	13941	884.76	918.35	125.0	837	104625	48574	167140	884.76	1257.50
NERITINA	# 1/0 Triplex "	22074	1327	1379	150.0	837	125550	69840	217454	1327	1551
PALOMINO	# 2 Quadruplex "	18626	1247	1292	130.0	837	108810	64494	191930	1247	1709
COSTENA	#1/0 Quadruplex "	30089	1985	2057	160.0	837	133920	98778	262787	1985	2618
CRIOLLO	#2/0 Quadruplex "	37750	2274	2365	175.0	837	146475	112793	297018	2274	2990
	SINGLE CONDUCTOR SERVICE CABLE-KMS										
[illegible]	#4/0 Alum Stranded-XLP Insulated	12313	904	934	80.0	837	66960	45443	124716	904	1205
[illegible]	397.5 MCM Alum Stranded "	24592	1460	1519	150.0	837	125550	75605	225747	1460	2004
[illegible]	POLES (FOREIGN SUPPLY (U.S.A.))	1050	114.00	116.52	10.0	739	7390	5575	14015	114.00	147.77
[illegible]	Treated SYP	950	101.00	103.23	9.5	739	7021	4989	12960	101.00	132.23
[illegible]	" "	900	80.00	82.17	9.0	739	6651	4075	11626	80.00	109.02
[illegible]	" "	3730	123.00	132.04	13.0	739	9607	6440	19797	123.00	170.70
[illegible]	" "	3500	107.00	115.43	12.0	739	8868	5672	18040	107.00	150.47
[illegible]	" "	3000	87.00	94.23	11.5	739	8499	4760	16259	87.00	126.18

UNIT COSTS - MID 1977

SHEET 1 OF 1

LOCATION CENTRAL JAVA

UNIT DESIGNATION	DESCRIPTION	MATERIAL - INDONESIAN WOOD			LABOR			JOB EXPENSE	TOTAL INSTALLED COST		
		RUPIAH	US $	EQUIVALENT US $	MAN HOURS	RATE RUPIAH	EXTENSION RUPIAH	RUPIAH	RUPIAH	US $	EQUIVALENT US $
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	POLES-DOMESTIC SUPPLY										
9M-A	Treated Indonesian Woods	12710	8.59	39.22	7.2	739	5321	2160	20191	8.59	57.24
7.5M-A	" " "	16400	11.09	50.60	7.5	739	5543	2654	24597	11.09	70.35
7.5M-B	" " "	18286	12.36	56.42	8.0	739	5912	2933	27131	12.36	77.74
9.5M-C	" " "	23124	15.63	71.35	8.5	739	6282	3589	32995	15.63	95.14
11M-A	" " "	19926	13.47	61.49	10.5	739	7760	3327	31013	13.47	89.22
11M-B	" " "	23944	16.18	73.88	11.0	739	8129	3879	35952	16.18	102.81
11M-C	" " "	25502	17.24	78.69	11.5	739	8499	4116	38117	17.24	109.09
12.5M-A	" " "	24108	16.29	74.98	12.0	739	8868	3974	36950	16.29	105.33
12.5M-B	" " "	27224	18.40	84.00	12.5	739	9238	4410	40872	18.40	116.89
		33620	22.72	103.73	13.0	739	9607	5265	48492	22.72	139.57
12.5M-C	" " "	28948	19.56	89.31	14.5	739	10716	4776	44440	19.56	126.64
14M-B	" " "	35934	24.22	110.57	15.0	739	11085	5597	52616	24.22	151.00
14M-C	" " "	39688	26.82	122.45	16.0	739	11824	6264	57776	26.82	166.04
15.5M-B	" " "	41820	28.27	129.04	16.5	739	12194	6575	60589	28.27	174.27
15.5M-C	" " "										
91-20	R/W CLEARING-KILOMETERS	-	-	-	80	446	35680	3568	39248	-	94.59

II-8

DISTRIBUTION SYSTEM COST

11.55/20KV (NOMINAL) PRIMARY OVERHEAD

WOOD POLE LINE

THREE-PHASE CONSTRUCTION 477 KCMIL ALL ALUMINUM CONDUCTOR

STANDARD KILOMETER

LOCATION: CENTRAL JAVA

	DESIGNATION	DESCRIPTION	UNIT	UNIT COST - INSTALLED			QUANTITY	EXTENSION		
				RUPIAH	US $	EQUIVALENT US $		RUPIAH	US $	EQUIVALENT US $
1	8M-A	Poles	ea	20191	8.59	57.24	0.5	10096	4.30	28.62
2	9.5M-C	"	ea	32995	15.63	95.14	0.5	16498	7.82	47.57
3	11M-C	"	ea	38117	17.24	109.09	11	419287	189.64	1199.99
4	12.5M-C	"	ea	48492	22.72	139.57	4	193968	90.88	558.28
5	14M-C	"	ea	52616	24.22	151.00	0.5	26308	12.11	75.50
6	15.5M-C	"	ea	60589	28.27	174.27	0.5	30295	14.14	87.14
7										
8	VC1-2	Primary Supports	ea	11561	57.15	85.01	9.5	109830	542.93	807.60
9	VC2-1	" "	ea	19594	99.67	146.88	2	39188	199.34	293.76
10	VC3L	" "	ea	10650	109.12	134.78	2	21300	218.24	269.56
11	VC4-1L	" "	ea	20629	225.87	275.58	0.5	10315	112.94	137.79
12	VC7-1	" "	ea	23763	98.15	155.41	0.5	11882	49.08	77.71
13	VC5-2	" "	ea	27896	196.38	263.60	1	27896	196.38	263.60
14	VA5-2	" "	ea	3966	35.79	45.35	1	3966	35.79	45.35
15										
16	Cosmos	Conductors	KM	139656	1288	1624.52	3	418968	3864	2873.56
17	Oxlip	"	KM	73751	571.20	751.32	1	74751	571.20	751.32
18										
19	VE1-3	Guys	ea	4987	22.45	34.47	13	64831	291.[illegible]5	448.11
20	VE5-1	"	ea	14116	47.80	81.81	0.5	7058	23.90	40.91
21	F1-3	Anchors	ea	4368	15.09	25.62	8	34944	120.72	704.96
22	F1-4	"	ea	4368	15.09	25.62	2	8736	30.18	51.24
23	F6-2	"	ea	11935	43.46	72.22	1	11935	43.46	72.22
24										
25	VM2-12A2	Grounds	ea	2222	11.82	17.17	13	28886	153.66	223.21
26	VM2-11	"	ea	3675	15.32	24.18	4	14700	61.28	96.72
27		TOTAL COST - STANDARD KILOMETER						1585638	6833.84	10654.66

DISTRIBUTION SYSTEM COST

11.55/20KV (NOMINAL) PRIMARY OVERHEAD

WOOD POLE LINE

THREE-PHASE CONSTRUCTION #4/0 ALL ALUMINUM CONDUCTOR

STANDARD KILOMETER

LOCATION: CENTRAL JAVA

DESIGNATION	DESCRIPTION	UNIT	UNIT COST - INSTALLED RUPIAH	US $	EQUIVALENT US $	QUANTITY	EXTENSION RUPIAH	US $	EQUIVALENT US $
SH-A	Poles	ea	20191	8.59	57.24	0.2	4038	1.72	11.45
9.5H-B	"	ea	27131	13.36	77.74	0.1	2713	1.24	7.77
11H-B	"	ea	35952	16.18	102.81	11	395472	177.98	1130.91
12.5H-B	"	ea	40872	18.40	116.89	4	163488	73.60	467.56
14H-B	"	ea	44440	19.56	126.64	0.5	22220	9.76	63.32
15.5H-B	"	ea	57776	26.82	166.04	0.2	11555	5.36	33.21
VC1	Primary Supports	ea	10147	45.83	70.28	9	91323	412.47	632.52
VC2	" "	ea	18210	100.87	144.75	2	36420	201.74	289.50
VC3	" "	ea	8545	76.89	97.48	1	8545	76.89	97.48
VC4-1	" "	ea	17865	174.58	217.63	0.5	8933	87.29	108.82
VC7	"	ea	19788	98.15	145.83	0.5	9894	49.08	72.92
VC8	" "	ea	26196	183.10	246.22	1	26196	183.10	246.22
V[illegible]-2	" "	ea	3966	35.79	45.35	1	3966	35.79	45.35
Oxlip	Conductors	KM	74751	571.20	751.32	3	224253	1713.60	2253.96
Azuza	"	KM	55819	366.96	501.46	1	55819	366.96	501.46
VE1-2	Guys	ea	4314	17.72	28.12	13	56082	230.36	365.56
E2-2	"	ea	5841	22.95	37.02	0.2	1168	4.59	7.40
F1-2	Anchors	ea	3978	11.58	21.17	7	27846	81.06	148.19
F1-3	"	ea	4368	15.09	25.62	3	13104	45.27	76.86
VM2-12A2	Grounds	ea	2222	11.82	17.17	12	26664	141.84	206.04
VM2-11	"	ea	3675	15.32	24.18	4	14700	61.28	96.72
	Total Cost-Standard Kilometer						1204397	3960.98	6863.14

DISTRIBUTION SYSTEM COST

11.55/20KV (NOMINAL) PRIMARY OVERHEAD

WOOD POLE LINE

ONE 1-PHASE CONSTRUCTION #1/0 (EQUIVALENT) ALUMINUM ALLOY CONSTRUCTION

STANDARD KILOMETER

LOCATION: CENTRAL JAVA

DESIGNATION	DESCRIPTION	UNIT	UNIT COST - INSTALLED			QUANTITY	EXTENSION		
			RUPIAH	US $	EQUIVALENT US $		RUPIAH	US $	EQUIVALENT US $
SM-A	Poles	ea	20191	8.59	57.24	0.2	4038	1.72	11.45
9.5M-B	"	ea	27131	12.36	77.74	0.1	2713	1.24	7.77
11M-B	"	ea	35956	16.18	102.81	11	395472	177.98	1130.91
12.5M-B	"	ea	40872	18.40	116.89	3	122616	55.20	350.67
14M-B	"	ea	44440	19.56	126.64	0.5	22220	9.76	63.32
15.5M-B	"	ea	57776	26.82	166.04	0.2	11555	5.36	33.21
VC1	Primary Supports	ea	10147	45.83	70.28	8	81176	366.64	562.24
VC2	" "	ea	18210	100.87	144.75	2	36420	201.74	289.50
VC3	" "	ea	8545	76.89	97.48	1	8545	76.89	97.48
VC4-1	" "	ea	17865	174.58	217.63	0.5	8933	87.29	108.82
VC7	" "	ea	19788	98.15	145.83	0.5	9894	49.08	72.92
VC8	" "	ea	26196	183.10	246.22	1	26196	183.10	246.22
VAS-2	" "	ea	3966	35.79	45.35	1	3966	35.79	45.35
Azuza	Conductors	KM	55819	366.96	501.46	3	167457	1100.88	1504.38
Ames	"	KM	43126	230.95	334.87	1	43126	230.95	334.87
VE1-2	Guys	ea	4314	17.72	28.12	13	56082	230.36	365.56
VE2-2	"	ea	5841	22.95	37.02	0.2	1168	4.59	7.40
VF1-[illegible]	Anchors	ea	3978	11.58	21.17	6	27846	81.06	148.19
F1-[illegible]	"	ea	4368	15.09	25.62	3	13104	45.27	76.86
F6-[illegible]	"	ea	11935	43.46	72.22	1	11935	43.46	72.22
UM2-12A2	Grounds	ea	2222	11.82	17.17	11	24442	130.02	188.87
[illegible]-11	"	ea	3675	15.32	24.18	4	14700	61.28	96.72
	Total Cost-Standard Kilometer						1093604	3179.66	5814.85

DISTRIBUTION SYSTEM COST

11.55/20KV (NOMINAL) PRIMARY OVERHEAD

WOOD POLE LINE

THREE-PHASE CONSTRUCTION #2 (EQUIVALENT) ALUMINUM ALLOY CONDUCTOR

STANDARD KILOMETER

LOCATION: CENTRAL JAVA

	DESIGNATION	DESCRIPTION	UNIT	UNIT COST - INSTALLED			QUANTITY	EXTENSION		
				RUPIAH	US $	EQUIVALENT US $		RUPIAH	US $	EQUIVALENT US $
1	9M-A	Poles	ea	20191	8.59	57.24	0.2	4038	1.72	11.45
2	9.5M-B	"	ea	27131	12.36	77.74	0.1	2713	1.24	7.77
3	11M-B	"	ea	35952	16.18	102.84	11	395472	177.98	1130.91
4	12.5M-B	"	ea	40872	18.40	116.89	3	122616	55.20	350.67
5	14M-B	"	ea	44440	19.56	126.64	0.5	22220	9.76	63.32
6	15.5M-B	"	ea	57776	26.82	166.04	0.2	11555	5.36	33.21
7										
8	VC1	Primary Supports	ea	10147	45.83	70.28	8	81176	366.64	562.24
9	VC2	" "	ea	18210	100.87	144.75	2	36420	201.74	289.50
10	VC3	" "	ea	8545	76.89	97.48	1	8545	76.89	97.84
11	VC4-1	" "	ea	17865	174.58	217.63	0.5	8933	87.29	108.82
12	VC7	" "	ea	19788	98.15	145.83	0.5	9894	49.08	72.92
13	VC8	" "	ea	26196	183.10	246.22	1	26196	183.10	246.22
14	VA5-2	" "	ea	3966	35.79	45.35	1	3966	35.79	45.35
15										
16	Ants	Conductors	KM	43126	230.95	334.87	4	172504	923.80	1339.48
17										
18	VE1-2	Guys	ea	4314	17.72	28.12	13	56082	230.36	365.56
19	E2-2	"	ea	5841	22.95	37.02	0.2	1168	4.59	7.40
20	F1-2	Anchors	ea	3978	11.58	21.17	6	27846	81.06	148.19
21	F3-3	"	ea	4368	15.09	25.62	3	13104	45.27	75.86
22	F6-2	"	ea	11935	43.46	72.22	1	11935	43.46	72.22
23										
24	VM2-1252	Grounds	ea	2222	11.82	17.17	11	24442	130.02	188.87
25	VM2-11	"	ea	3675	15.32	24.18	4	14700	61.28	96.72
26										
27		Total Cost-Standard Kilometer						1055525	2771.63	5315.06

DISTRIBUTION SYSTEM COST

11.55/20KV(NOMINAL) PRIMARY OVERHEAD

WOOD POLE LINE

"V"-PHASE CONSTRUCTION #1/0 (EQUIVALENT) ALUMINUM ALLOY CONDUCTOR

STANDARD KILOMETER

LOCATION: CENTRAL JAVA

	DESIGNATION	DESCRIPTION	UNIT	UNIT COST-INSTALLED RUPIAH	UNIT COST-INSTALLED US $	UNIT COST-INSTALLED EQUIVALENT US $	QUANTITY	EXTENSION RUPIAH	EXTENSION US $	EXTENSION EQUIVALENT US $
1	9M-A	Poles	ea	20191	8.59	57.24	0.2	4038	1.72	11.45
2	9.5M-B	"	ea	27131	12.36	77.74	0.1	2713	1.24	7.77
3	11M-B	"	ea	35952	16.18	102.81	10	359520	161.80	1028.10
4	12.5M-B	"	ea	40872	18.40	116.89	3	122616	55.20	350.67
5	14M-B	"	ea	44440	19.56	126.64	0.5	22220	9.76	63.32
6	15.5M-B	"	ea	57776	26.82	166.04	0.2	111555	5.36	33.21
7										
8	VB1	Primary Supports	ea	8949	33.42	54.98	10	89490	334.20	549.80
9	VB2	" "	ea	16381	69.90	109.37	3	49143	209.70	328.11
10	VB3	" "	ea	6085	51.04	65.70	1	6085	51.04	65.70
11	VB4-1	" "	ea	13718	121.51	154.57	0.5	6859	60.76	77.29
12	VB5-1	" "	ea	[illegible]	57.59	74.47	0.5	3503	28.80	37.24
13	VA5-2	" "	ea	3966	35.79	45.35	1	3966	35.79	45.35
14										
15	Azusa	Conductors	KM	55819	366.96	501.46	2	111638	733.92	1002.92
16	Ames	"	KM	43126	230.95	334.87	1	43126	230.95	334.87
17										
18	VE1-2	Guys	ea	4314	17.72	28.12	13	56082	230.36	365.56
19	E2-2	"	ea	5841	22.95	37.02	0.2	1168	4.59	7.40
20	F1-2	Anchors	ea	3978	11.58	21.17	6	23868	69.48	127.02
21	F1-3	"	ea	4368	15.09	25.62	3	13104	45.27	76.86
22	F6-2	"	ea	11935	43.46	72.22	1	11935	43.46	72.22
23										
24	VM2-12A2	Grounds	ea	2222	11.82	17.17	11	24442	130.02	188.87
25	VM2-11	"	ea	3675	15.32	24.18	4	14700	61.28	96.72
26										
27		Total Cost-Standard Kilometer						981771	2504.70	4870.42

DISTRIBUTION SYSTEM COST

11.55/20KV (NOMINAL) PRIMARY OVERHEAD

WOOD POLE LINE

"V"-PHASE CONSTRUCTION #2 (EQUIVALENT) ALUMINUM ALLOY CONDUCTOR

STANDARD KILOMETER

LOCATION: CENTRAL JAVA

	DESIGNATION	DESCRIPTION	UNIT	UNIT COST-INSTALLED			QUANTITY	EXTENSION		
				RUPIAH	US $	EQUIVALENT US $		RUPIAH	US $	EQUIVALENT US $
1	8M-A	Poles	ea	20191	8.59	57.24	0.2	4038	1.72	11.45
2	9.5M-B	"	ea	27131	12.36	77.74	0.1	2713	1.24	7.77
3	11M-B	"	ea	35952	16.18	102.81	10	359520	161.80	1028.10
4	12.5M-B	"	ea	40872	18.40	116.89	3	122616	55.20	350.67
5	14M-B	"	ea	44440	19.56	126.64	0.5	22220	9.76	63.32
6	15.5M-B	"	ea	57776	26.82	166.04	0.2	11555	5.36	33.21
7										
8	VB1	Primary Supports	ea	8949	33.42	54.98	10	89490	334.20	549.80
9	VB2	" "	ea	16381	69.90	109.37	3	49143	209.70	328.11
10	VB3	" "	ea	6085	51.04	65.70	1	6085	51.04	65.70
11	VB4-1	" "	ea	13718	121.51	154.57	0.5	6859	60.76	77.29
12	VB5-1	" "	ea	7006	57.59	62.42	0.5	3503	28.80	37.24
13	VA5-2	" "	ea	3966	35.79	45.35	1	3966	35.79	45.35
14										
15	Ames	Conductors	KM	43126	230.95	334.87	3	129378	692.85	1004.61
16										
17	VE1-2	Guys	ea	4314	17.72	28.12	13	56082	230.36	365.56
18	E2-2	"	ea	5841	22.95	37.02	0.2	1168	4.59	7.40
19	F1-2	Anchors	ea	3978	11.58	21.17	6	23868	69.48	127.02
20	F1-3	"	ea	4368	15.09	25.62	3	13104	45.27	76.86
21	F6-2	"	ea	11935	43.46	72.22	1	11935	43.46	77.22
22										
23	VM2-12A2	Grounds	ea	2222	11.82	17.17	11	24442	130.02	188.87
24	VM2-11	"	ea	3675	15.32	24.18	4	14700	61.28	96.72
25										
26										
27		Total Cost-Standard Kilometer						956385	2232.68	4537.22

DISTRIBUTION SYSTEM COST

11.55 KV (NOMINAL) PRIMARY OVERHEAD

WOOD POLE LINE

SINGLE-PHASE CONSTRUCTION, #2 (EQUIVALENT) ALUMINUM ALLOY CONDUCTOR

STANDARD KILOMETER

II-15

LOCATION: CENTRAL JAVA

	DESIGNATION	DESCRIPTION	UNIT	UNIT COST - INSTALLED			QUANTITY	EXTENSION		
				RUPIAH	US $	EQUIVALENT US $		RUPIAH	US $	EQUIVALENT US $
1	8M-A	Poles	ea	20191	8.59	57.24	0.2	4038	1.72	111.45
2	9.5M-A	"	ea	24597	11.08	70.35	0.5	12299	5.54	35.18
3	11M-A	"	ea	31013	13.47	88.20	10	310130	134.70	882.00
4	12.5M-A	"	ea	36950	16.29	105.33	2	73900	32.58	210.66
5	14M-B	"	ea	44440	19.56	126.64	0.2	8888	3.91	25.33
6	15.5M-B	"	ea	57776	26.82	166.04	0.1	5778	2.68	16.60
7										
8	VA1	Primary Supports	ea	2281	14.60	20.10	9	20529	131.40	180.90
9	VA2	" "	ea	3903	33.56	42.96	2	7806	67.12	85.92
10	VA3	" "	ea	3087	27.79	35.23	1	3087	27.79	35.23
11	VA4	" "	ea	6486	61.62	77.25	0.5	3243	30.81	38.62
12	VA5	" "	ea	3201	29.84	37.55	0.3	960	8.95	11.26
13	VA5-1	" "	ea	3781	32.38	41.49	1	3781	32.38	41.49
14	VA6	" "	ea	6430	60.29	75.78	0.2	1286	12.06	15.16
15										
16	Ames	Conductor	KM	43126	230.95	334.87	2	86252	461.90	669.74
17										
18	VE1-2	Guys	ea	4314	17.72	28.12	8	34512	141.76	224.96
19	E2-2	"	ea	5841	22.95	37.02	0.2	1168	4.59	7.40
20	F1-2	Anchors	ea	3978	11.58	21.17	7	27846	81.06	148.19
21	F6-2	"	ea	11935	43.46	72.22	1	11935	43.46	72.22
22										
23	VM2-12A2	Grounds	ea	2222	11.82	17.17	9	19998	106.38	154.53
24	VM2-11	"	ea	3675	15.32	24.18	4	14700	61.28	96.72
25										
26										
27		Total Cost-Standard Kilometer						652136	1392.07	2963.48

II-16

DISTRIBUTION SYSTEM COST

11.55 KV (NOMINAL) PRIMARY OVERHEAD

WOOD POLE LINE

SINGLE-PHASE CONSTRUCTION, #4 (EQUIVALENT) ALUMINUM ALLOY CONDUCTOR

STANDARD KILOMETER

LOCATION: CENTRAL JAVA

	DESIGNATION	DESCRIPTION	UNIT	UNIT COST - INSTALLED			QUANTITY	EXTENSION		
				RUPIAH	US $	EQUIVALENT US $		RUPIAH	US $	EQUIVALENT US $
1	8M-A	Poles	ea	20191	8.59	57.24	0.2	4038	1.72	11.45
2	9.5M-A	"	ea	24597	11.08	70.35	0.5	12298	5.54	35.17
3	11M-A	"	ea	31013	13.47	88.20	9	279117	121.23	793.80
4	12.5M-A	"	ea	36950	16.29	105.33	2	73900	32.58	210.66
5	14M-B	"	ea	44440	19.56	126.64	0.2	8888	3.91	25.33
6	15.5M-B	"	ea	57776	26.82	166.04	0.1	5778	2.68	16.60
7										
8	VA1	Primary Support	ea	2281	14.60	20.10	8	18248	116.80	160.80
9	VA2	" "	ea	3903	33.56	42.96	2	7806	67.12	85.92
10	VA3	" "	ea	3087	27.79	35.23	1	3087	27.79	35.23
11	VA4	" "	ea	6486	61.62	77.25	0.5	3243	30.81	38.63
12	VA5	" "	ea	3201	29.84	37.55	0.3	960	8.95	11.26
13	VA5-1	" "	ea	3781	32.38	41.49	1	3781	32.38	41.49
14	VA6	" "	ea	6430	60.29	75.78	0.2	1286	12.06	15.16
15										
16	Alton	Conductors	KM	33830	151.66	233.18	2	67660	303.32	466.36
17										
18	VE1-2	Guys	ea	4314	17.72	28.12	8	34512	141.76	224.96
19	E2-2	"	ea	5841	22.95	37.02	0.2	1168	4.59	7.40
20	F1-2	Anchors	ea	3978	11.58	21.17	7	27846	81.06	148.19
21	F4-2	"	ea	11935	43.46	72.22	1	11935	43.46	72.22
22										
23	VM2-11A2	Grounds	ea	2222	11.82	17.17	[illegible]	26664	141.84	206.04
24	VM2-11	"	ea	3675	15.32	24.18	4	14700	61.28	96.72
25										
26										
27		Total Cost-Standard Kilometer						606915	1240.88	2703.33

DISTRIBUTION SYSTEM COST

240/480 VOLT (NOMINAL) SECONDARY OVERHEAD

WOOD POLE LINE

SINGLE-PHASE 3-WIRE CONSTRUCTION, #1/0 (EQUIVALENT) ALUMINUM ALLOY CONDUCTOR

STANDARD KILOMETER

LOCATION: CENTRAL JAVA

	DESIGNATION	DESCRIPTION	UNIT	UNIT COST - INSTALLED RUPIAH	UNIT COST - INSTALLED US $	UNIT COST - INSTALLED EQUIVALENT US $	QUANTITY	EXTENSION RUPIAH	EXTENSION US $	EXTENSION EQUIVALENT US $
1	[illegible]M-A	Poles	ea	20191	8.59	57.24	1	20191	8.59	57.24
2	9.5M-A	"	ea	24597	11.08	70.35	10	245970	110.80	703.50
3	11M-A	"	ea	31013	13.47	88.20	4	124052	53.88	352.80
4	12.5M-A	"	ea	36950	16.29	105.33	1	36950	16.29	105.33
5										
6	J5	Secondary Assemblies	ea	801	2.46	4.39	18	14418	44.28	79.02
7	J6	" "	ea	1555	5.81	9.56	24	37320	139.44	229.44
8	J7	" "	ea	848	3.14	5.18	6	5088	18.84	31.08
9	J8	Neutral Assemblies	ea	790	2.23	4.13	9	7110	20.07	37.17
10	J10	Secondary Assemblies	ea	861	3.22	5.30	3	2583	9.66	15.90
11										
12	Azusa	Conductors	KM	55819	366.96	501.46	2	111638	733.92	1002.92
13	Ames	"	KM	43126	230.95	334.87	1	43126	230.95	334.82
14										
15	VE1-2	Guys	ea	4314	17.72	28.12	9	38826	159.48	253.08
16	E2-2	"	ea	5841	22.95	37.02	1	5841	22.95	37.02
17	F1-2	Anchors	ea	3978	11.58	21.17	8	31824	92.64	169.36
18	F6-2	"	ea	11935	43.46	72.22	1	11935	43.46	72.22
19										
20	VM2-12	Grounds	ea	2222	11.82	17.17	12	26664	141.84	206.04
21	VM2-11	"	ea	3675	15.32	24.18	4	14700	61.28	96.72
22										
23										
24										
25										
26										
27		Total Cost-Standard Kilometer						778236	1908.37	3783.63

DISTRIBUTION SYSTEM COST

240/480 VOLT (NOMINAL) SECONDARY OVERHEAD

WOOD POLE LINE

SINGLE-PHASE 3-WIRE CONSTRUCTION, #2 (EQUIVALENT) ALUMINUM ALLOY CONDUCTOR

STANDARD KILOMETER

LOCATION: CENTRAL JAVA

DESIGNATION	DESCRIPTION	UNIT	UNIT COST-INSTALLED RUPIAH	UNIT COST-INSTALLED US $	UNIT COST-INSTALLED EQUIVALENT US $	QUANTITY	EXTENSION RUPIAH	EXTENSION US $	EXTENSION EQUIVALENT US $
8M-A	Poles	ea	20191	8.59	57.24	1	20191	8.59	57.24
9.5M-A	"	ea	24597	11.08	70.35	10	245970	110.80	703.50
11M-A	"	ea	31013	13.47	88.20	4	124052	53.88	352.80
12.5M-A	"	ea	36950	16.29	105.33	1	36950	16.79	105.33
J5	Secondary Assemblies	ea	801	2.46	4.39	18	14418	44.28	79.02
J6	" "	ea	1555	5.81	9.56	24	37320	139.44	229.44
J7	" "	ea	848	3.14	5.18	6	5088	[illegible].84	31.08
J8	Neutral Assemblies	ea	790	2.23	4.13	9	7110	20.07	37.17
J10	Secondary "	ea	861	3.22	5.30	3	2583	9.66	15.90
Ames	Conductors	KM	43126	230.95	334.87	3	129378	692.85	1004.61
VE1-2	Guys	ea	4314	17.72	28.12	9	38826	159.48	253.08
E2-2	"	ea	5841	22.95	37.02	1	5841	22.95	37.02
F1-2	Anchors	ea	3978	11.58	21.17	8	31824	92.64	169.36
F4-2	"	ea	11935	43.46	72.22	1	11935	43.46	72.22
VM2-12J2	Grounds	ea	2222	11.82	17.17	12	26664	141.84	206.04
VM2-11	"	ea	3675	15.32	24.18	4	14700	61.28	96.72
	Total Cost-Standard Kilometer						752850	1636.35	3450.45

DISTRIBUTION SYSTEM COST

240/480 VOLT (NOMINAL) SECONDARY UNDERBUILT ON
PRIMARY OVERHEAD WOOD POLE LINE
SINGLE-PHASE, 2-WIRE CONSTRUCTION, #1/0 (EQUIVALENT) ALUMINUM ALLOY CONDUCTOR
STANDARD KILOMETER

LOCATION: CENTRAL JAVA

DESIGNATION	DESCRIPTION	UNIT	UNIT COST - INSTALLED RUPIAH	UNIT COST - INSTALLED US $	UNIT COST - INSTALLED EQUIVALENT US $	QUANTITY	EXTENSION RUPIAH	EXTENSION US $	EXTENSION EQUIVALENT US $
[illegible]	Secondary Assemblies	ea	801	2.46	4.39	20	16020	49.20	87.80
[illegible]	" "	ea	1555	5.81	9.56	10	15550	58.10	95.60
[illegible]	" "	ea	848	3.14	5.18	4	3392	12.56	20.72
[illegible]	" "	ea	861	3.22	5.30	2	1722	6.44	10.60
[illegible]	Conductors	KM	55819	366.96	501.46	2	111638	733.92	1002.92
[illegible]	Guys	ea	3681	13.16	22.03	8	29448	105.28	176.24
[illegible]	"	ea	5106	17.00	29.30	1	5106	17.00	29.30
[illegible]	Anchors	ea	3978	11.58	21.17	7	27846	81.06	148.19
[illegible]	"	ea	9605	26.14	49.28	1	9605	26.14	49.28
	Total Cost-Standard Kilometer						220327	1089.70	1620.60

DISTRIBUTION SYSTEM COST

240/480 VOLT (NOMINAL) SECONDARY UNDERBUILT ON
PRIMARY OVERHEAD WOOD POLE LINE
SINGLE-PHASE, 2-WIRE CONSTRUCTION, #2 (EQUIVALENT) ALUMINUM ALLOY CONDUCTOR
STANDARD KILOMETER

LOCATION: CENTRAL JAVA

	DESIGNATION	DESCRIPTION	UNIT	UNIT COST-INSTALLED RUPIAH	UNIT COST-INSTALLED US $	UNIT COST-INSTALLED EQUIVALENT US $	QUANTITY	EXTENSION RUPIAH	EXTENSION US $	EXTENSION EQUIVALENT US $
1	J5	Secondary Assemblies	ea	801	2.46	4.39	20	16020	49.20	87.80
2	J6	" "	ea	1555	5.81	9.56	10	15550	58.10	95.60
3	J7	" "	ea	848	3.14	5.18	4	3392	12.56	20.72
4	J10	" "	ea	861	3.22	5.30	2	1722	6.44	10.60
5										
6										
7	[illegible]	Conductors	KM	43126	230.95	334.87	2	86252	461.90	669.74
8										
9	[illegible]1-1	Guys	ea	3681	13.16	22.03	8	29448	105.28	176.24
10	[illegible]2-1	"	ea	5106	17.00	29.30	1	5106	17.00	29.30
11	[illegible]3-1	Anchors	ea	3978	11.58	21.17	7	27846	81.06	148.19
12	[illegible]4-1	"	ea	9605	26.14	49.28	1	9605	26.14	49.28
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										
24										
25										
26										
27		Total Cost-Standard Kilometer						194941	817.68	1287.42

DISTRIBUTION SYSTEM COST

SERVICES AND METERS

SINGLE-PHASE, 3-WIRE, 240/450 VOLTS

STANDARD UNIT

LOCATION: CENTRAL JAVA

DESIGNATION	DESCRIPTION	UNIT	UNIT COST - INSTALLED RUPIAH	UNIT COST - INSTALLED US $	UNIT COST - INSTALLED EQUIVALENT US $	QUANTITY	EXTENSION RUPIAH	EXTENSION US $	EXTENSION EQUIVALENT US $
SM-A	Lift Pole	ea	20191	8.59	57.24	0.2	4038	1.72	11.45
K-10C	Service Assembly-House End	ea	1080	2.96	5.56	1	1080	2.96	5.56
K-15C	Service Assembly-Pole End	ea	492	4.43	5.62	1	492	4.43	5.62
35	Secondary Assembly	ea	790	2.23	4.13	0.2	158	0.45	0.83
-	Service Cond. #4 Triplex- "Periwinkle"	ft	142	0.636	0.979	30	4260	19.08	29.35
-	Meter, Socket Type, 1Ø, 3 wire 30 Amp 240/450 Volt	ea	2970	28.86	36.02	1	2970	28.86	36.02
	TOTAL COST - STANDARD UNIT						12998	57.50	88.83

DISTRIBUTION SYSTEM COST

SERVICES AND METERS

SINGLE-PHASE 2 - WIRE 240 VOLTS

STANDARD UNIT

LOCATION: CENTRAL JAVA

DESIGNATION	DESCRIPTION	UNIT	UNIT COST - INSTALLED			QUANTITY	EXTENSION		
			RUPIAH	US $	EQUIVALENT US $		RUPIAH	US $	EQUIVALENT US $
SM-3	Lift Pole	ea	20191	8.59	57.24	0.1	2019	0.86	5.73
F16C	Service Assembly-House End	ea	1452	6.25	9.75	1	1452	6.25	9.75
K15C	Service Assembly-Pole End	ea	492	4.43	5.62	1	492	4.43	5.62
3S	Secondary Assembly	ea	790	2.23	4.13	0.1	79	0.22	0.41
-	Service Cond. #6-"Shepherd"	M	106	0.34	0.60	35	3710	11.90	20.84
-	Meter, Conventional Type, 1Ø 2 wire 10 Amp. 240 Volt	ea	77	6.93	7.12	1	77	6.93	7.12
	TOTAL COST - STANDARD UNIT						7829	30.59	49.46

DISTRIBUTION SYSTEM COST

SERVICES AND METERS

THREE-PHASE, 4-WIRE, 240/415 VOLTS, 100 AMP MAXIMUM

SELF-CONTAINED METER

STANDARD UNIT

LOCATION: CENTRAL JAVA

DESIGNATION	DESCRIPTION	UNIT	UNIT COST - INSTALLED			QUANTITY	EXTENSION		
			RUPIAH	US $	EQUIVALENT US $		RUPIAH	US $	EQUIVALENT US $
SH-A	Lift Pole	ea	20191	8.59	57.24	0.4	8076	3.44	22.90
K10C	Service Assembly-House End	ea	1080	2.96	5.56	1	1080	2.96	5.56
K11C	Service Assembly-Pole End	ea	1477	6.81	10.37	1	1477	6.81	10.37
3S	Secondary Assembly	ea	790	2.23	4.13	0.4	316	0.89	1.65
-	Service Cable, Quadruplex "Palomino"	M	192	1.247	1.709	30	5760	37.41	51.28
-	Meter, Socket Type, 3Ø, 4wire, 30 Amp, 240/415 Volt	ea	9408	132.26	154.93	1	9408	132.26	154.93
	TOTAL COST - STANDARD UNIT						26117	183.77	246.70

DISTRIBUTION SYSTEM COST

SERVICES AND METERS

THREE-PHASE, 4-WIRE, 240/415 VOLTS, MORE THAN 100 AMPS

TRANSFORMER METERING

STANDARD UNIT

LOCATION: CENTRAL JAVA

DESIGNATION	DESCRIPTION	UNIT	UNIT COST - INSTALLED			QUANTITY	EXTENSION		
			RUPIAH	US $	EQUIVALENT US $		RUPIAH	US $	EQUIVALENT US $
SM-A	Lift Pole	ea	20191	8.59	57.24	0.5	10096	4.30	28.62
K10C	Service Assembly-House End	ea	1080	2.96	5.56	1	1080	2.96	5.56
K11C	Service Assembly-Pole End	ea	1477	6.81	10.37	1	1477	6.81	10.37
J5	Secondary Assembly	ea	790	2.23	4.13	0.5	395	1.12	2.07
-	Service Cable, #2/0 Quadruplex "Grullo"	M	297	2.274	2.99	25	7425	56.85	74.75
-	Meter, Socket Type, 3Ø, 4 wire 2.5 Amp 240/415 Volt, with 3-200/5 Amp C.T.S.	ea	22744	218.58	273.38	1	22744	218.58	273.39
	TOTAL COST - STANDARD UNIT						43217	290.62	394.76

DISTRIBUTION SYSTEM COST

TRANSFORMERS-OVERHEAD POLE TYPE

SINGLE H.V BUSHING COMPLETELY SELF-PROTECTED

SINGLE-PHASE, 50 Hz.11.55-220/440 VOLTS WITH TAPS

STANDARD KVA UNIT

LOCATION: CENTRAL JAVA

DESIGNATION	DESCRIPTION	UNIT	UNIT COST - INSTALLED RUPIAH	UNIT COST - INSTALLED US $	UNIT COST - INSTALLED EQUIVALENT US $	QUANTITY	EXTENSION RUPIAH	EXTENSION US $	EXTENSION EQUIVALENT US $
	The "MIX" of transformers by KVA capacity needed per 100 Installation is estimated or these quantities								
	TOTAL KVA								
VC-105	10 KVA 190	ea	18567	487.58	532.32	19	352773	9264	10114
	15 KVA 375	ea	19882	505.59	553.50	25	497050	12640	13838
	25 KVA 1250	ea	25853	603.41	665.71	50	1292650	30170	33285
	37.5 KVA 112.5	ea	33351	602.22	882.58	3	100053	2407	2648
	50 KVA 150	ea	41061	888.85	987.79	3	123183	2666	2963
	Total KVA/100 Installations 2077.5								
	Total Cost/100 Installations						2365709	57147	62848
	Cost/KVA Line 15 ÷ 2077.5						1139	27.51	30.25
	TOTAL COST - STANDARD KVA Unit						1139	27.51	30.25

DISTRIBUTION SYSTEM COST

MISCELLANEOUS CONSTRUCTION ITEMS

STANDARD UNITS

LOCATION: CENTRAL JAVA

DESIGNATION	DESCRIPTION	UNIT	UNIT COST - INSTALLED			QUANTITY	EXTENSION		
			RUPIAH	US $	EQUIVALENT US $		RUPIAH	US $	EQUIVALENT US $
-	Security Light-175 Watt Merc	ea					9525	78.38	101.33
VM7-1	Regulators-1Ø-1X50 Amp	ea					242203	6340	6924
VM7-3	" 3Ø-3X50 Amp	ea					660119	18976	20567
VM7-3	" 3Ø-3X100Amp	ea					778644	22903	24779
VM7-3	" 3Ø-3X200Amp	ea					970529	30506	32645
VM3-4	Sectionalizing Fused C.O.-1Ø	ea					10299	61.86	86.68
VM3-10A	Oil CKT Recloser-1Ø	ea					25330	851.68	912.72
VM3-1[illegible]	Air Break SW.G.O.-3Ø	ea					94444	1304	1532
VM3-20	Oil CKT Recloser-[illegible]X-Arm Mtg	ea					96703	2492	2725
VM3-20A	" " " 3Ø Cluster Mtg	ea					75850	2593	2776
VM3-23	" " " 1Ø W/By Pass Sw	ea					37794	984	1075
VM3-25	" " " 3Ø W/By Pass Sw	ea					121899	2974	3268
R1-20	R/W Clearing	KM					39248	-	94.59

PART I

GENERAL PLANT

I. GENERAL PLANT.

This item of capital cost includes buildings, vehicles, tools, machines, and equipment required for construction and operation of the electric plant as well as the handling of office work.

Cost estimates were obtained from DGC and other local sources, and quantities were based on the experience of competent electrification advisors in Indonesia and elsewhere.

1. Headquarters Facilities.

The general office and headquarters support facilities should be located near the power site selected by the board of directors and their A&E advisors. No less than 3 hectares of land should be obtained. It should be situated where future expansion is possible and where good, available rights-of-way may be obtained to carry the feeder lines from the power plant into the distribution system.

Consideration must be given to access by road, to adequate supply of water for use by the staff and for power plant operation, and to selection of a site not subject to flooding or drainage problem.

The administration building should contain approximately 900 square meters of floor space in order to provide the staff with both adequate and efficient work space. A meeting room capable of seating 100 persons is desirable. Board and staff meetings may be held in this room. Community service and member relations require a facility of this type. The office building must be located some distance from the power plant to minimize noise problems.

Funds have been provided in the capital budget estimates for improvements to the headquarters and power plant site. It is anticipated that the architectural and supervisory work will be done by the A&E firm provided by USAID.

In addition to the office building, funds have been budgeted for a warehouse with 500 square meters of enclosed floor space. Provision is made for a pole yard and outdoor storage space for bulk items such as wire reels and transformers, and for a small vehicle maintenance facility with gasoline storage. The entire compound should be surrounded by a security fence.

2. Office Equipment and Furniture.

This includes both office furniture and office machines for billing, typing, mimeographing, etc. A large staff will be required to handle the work involved in accepting the anticipated number of member applications and membership fees, processing a large number of wiring loans and billing the members for electric usage and loan repayments, and preparing reports to the board of directors and to PLO. Funds have been budgeted for all required office machines, including mechanical billing machines, to match the size of the enterprise.

3. Tools and Work Equipment.

In order to perform construction, operations, and maintenance work on the power lines and in the power plant in a safe and efficient manner, good tools are a necessity. Funds have been budgeted in sufficient quantities to purchase tools as required. It is assumed that they will be properly stored and cared for.

4. Test and Laboratory Equipment.

If good electric service is to be delivered to the members, voltage must be checked and regulated. Loads on various lines must be measured and balanced. Power delivered must be measured by accurate meters. All of these functions, and more, must be checked by use of sophisticated and precisely accurate test devices. This work begins before the first meter is removed from the meter shop to be installed. Funds are provided for purchase of these devices.

5. Transportation Equipment.

Transportation of men and materials is a major cost item during the construction and operational phases of an electric service cooperative. Funds have been budgeted for the following initial fleet:

1 heavy truck for hauling equipment and supplies.

1 line truck, equipped with "A-frame" and winch for pole line work.

4 service trucks, 3/4 ton, for use during the housewiring program and later on for operation and maintenance work on the system.

2 light vans for personnel.

10 motorcycles for patrolling lines, reading meters and collecting bills.

6. Communications Equipment.

Good communications between the headquarters office and personnel in the field are essential to efficiency in delivering quality service to all consumer members. It is especially desirable where telephone service is lacking, as it is at this proposed project site. One base radio station near the office and power plant and eight mobile units have been budgeted.

7. Staff Housing.

A headquarters facility will be located near the operational center of the service area where rental housing may not be available. It is anticipated that management and technical employees will be recruited generally from outside the service area. Therefore funds have been budgeted for 10 staff houses at or near the office.

8. The PLN will order all construction materials required for connecting 100,000 services during the first three years of operation under the USAID loan. Funds have not been budgeted for a normal inventory. This will be a matter to consider if a stock of materials are not on hand when contract construction comes to an end.

9. Contingencies: Experience indicates that in developing such an extensive enterprise unforseen needs will arise. Therefore, US$ 344,496 or Rp. 142,965,840 for contingencies is budgeted.

PART J

HOUSEWIRING PROGRAM AND ESTIMATING COSTS

J. HOUSEWIRING PROGRAM.

It is anticipated that many households in the poorer economic areas will fail to sign up for service in the new distribution system if they do not have cash savings on hand to pay for the cost of wiring their premises. Most prospective consumers are farm workers with very low income. They will require financial assistance if they are to prepare their houses with the safety switch, wiring, and outlets for using electricity.

It should be noted that the PLN distribution system is expected to pay for and own the service drop from the pole to the kilowatt-hour meter, and including the meter and the ground. Wires to the safety switch and all wiring, outlets, connections, and switches beyond the meter are provided and owned by the consumer. All wiring and electrical appliances and equipment installed must meet standards set by PLN and be approved by PLN before the service is connected.

Because success of rural electrification is measured in part by the percentage of households which sign up to get electrical service, it is important to make sure houses are wired on schedule, and ready for connection.

It is recommended that PLN take two steps which will assist in obtaining a large sign-up when the electric system is getting under way.

1. The cost of wiring a house should be kept as low as possible. To assist in this, PLN should examine the possibility of :

   a. Bulk purchasing of standard housewiring materials.

   b. Arranging to train housewiring electricians recruited locally in the service area, to individually contract for installing housewiring for consumers at a fixed price.

   c. Adopting standard housewiring specifications.

To insure that all wiring installations are safe, there will have to be an inspection and certification made before the system will connect the service. This is an absolute requirement to prevent fires and loss of life. Competent inspection must not be disregarded. Any consumer who so desires may arrange to have his wiring done by private contractors other than those trained under PLN auspices, but it must be subject to the same inspection before the system will connect the service.

A sketch of a typical minimum housewiring installation, together with a list of materials is provided below.

2. A program should be offered to provide low-interest loans for housewiring which the system can extend to the prospective consumers. Loans would be made for repayment within 5 years, with an arrangement for regular monthly payments at the same time collections are made for electricity used.

   The loans would be made only to those potential consumers who demonstrate a need for such assistance. Members would generally be encouraged to pay for housewiring from their own money in cash. Loans would cover only a basic installation with three ceiling lights and one convenience outlet. Consumers requiring larger installation should arrange their own financing for additional facilities.

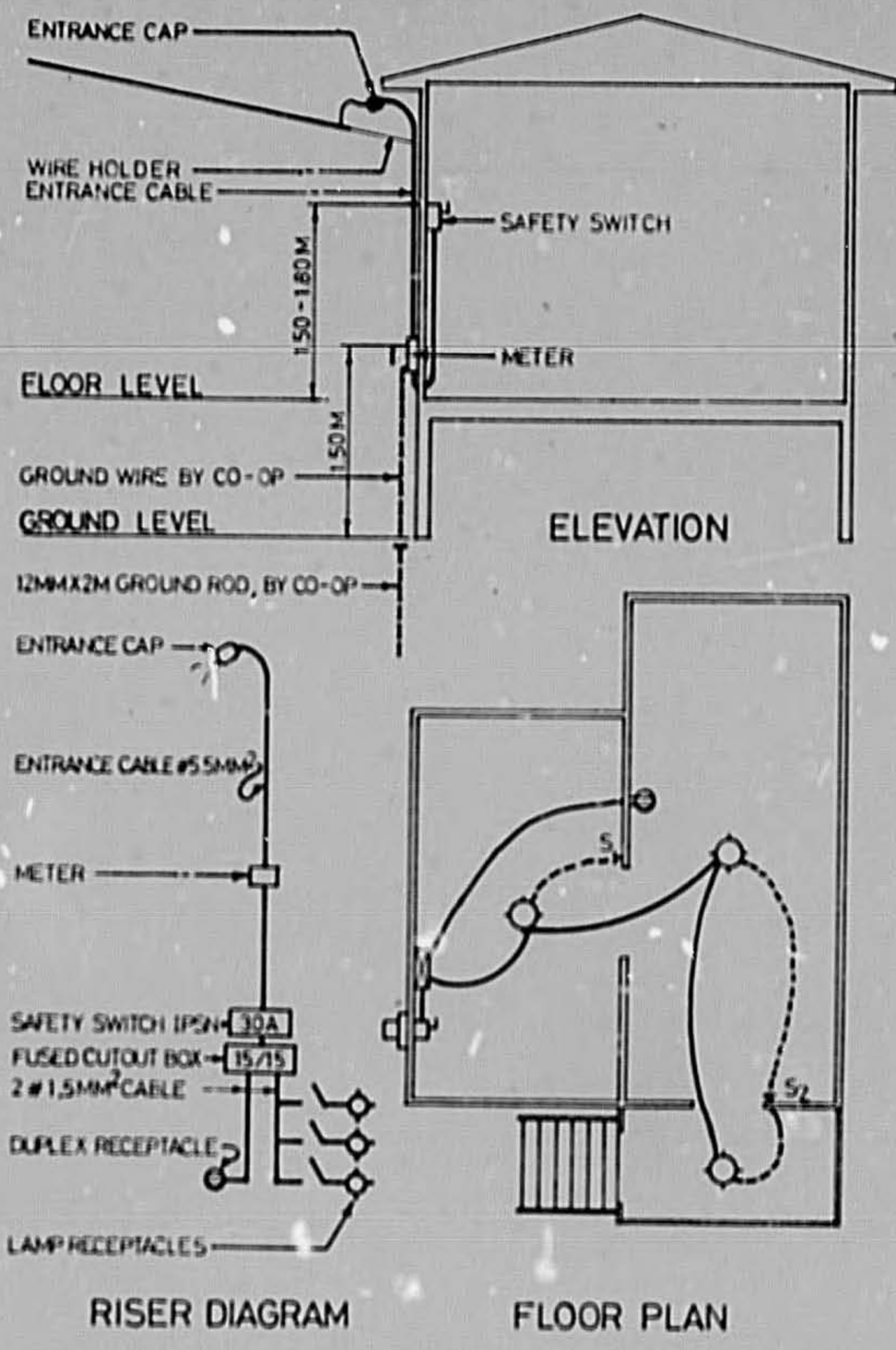
   A sum sufficient to provide house-wiring loans through a 4-year period should be provided. By the fifth year members' repayments of principal and interest will make possible a revolving fund for credit in subsequent years to take care of the needs of additional new members.

TABLE 15 MATERIALS FOR BASIC HOUSEWIRING INSTALLATION

	Item	Market Price (Rupiah)	Estimated Wholesale Price (Rupiah)	Quantity Required	Extended Cost (Rupiah)
1.	Entrance wire, kwh meter to disconnect switch, 2 #5.5/mm² (30 amp)	190/m.	125/m.	5.5 m.	688
2.	Fused disconnect switch, 30 amp rating	2,250	1,650	1	1,650
3.	Fuse holder	200	150	1	150
4.	15 amp fuse	50	35	2	70
5.	Wire, from disconnect switch to fixtures and switches, 2 #1.5/mm (19 amp)	140/m.	90/m.	55 m.	4,950
6.	Ceiling mount, surface, incandescent lamp socket	100	75	3	225
7.	Convenience outlet, surface mount	550	400	1	400
8.	Snap switch, surface mount	350	250	3	750
9.	Junction box, 2½", PVC, with cover	25	20	2	40
10.	Staples 3/8", metal with nails	3	2	350	700
11.	Wood Screws, #6 3/4"	1.5	1	12	12
12.	Electrician tape	9/m.	6/m.	2 m.	12

Total Price	(F.O.B. Jakarta 1977)	Rp 9,647
Total Estimated Price	(F.O.B. Coop 1978)	Rp 11,500

TYPICAL HOUSE WIRING PLAN



SUKONO '77.