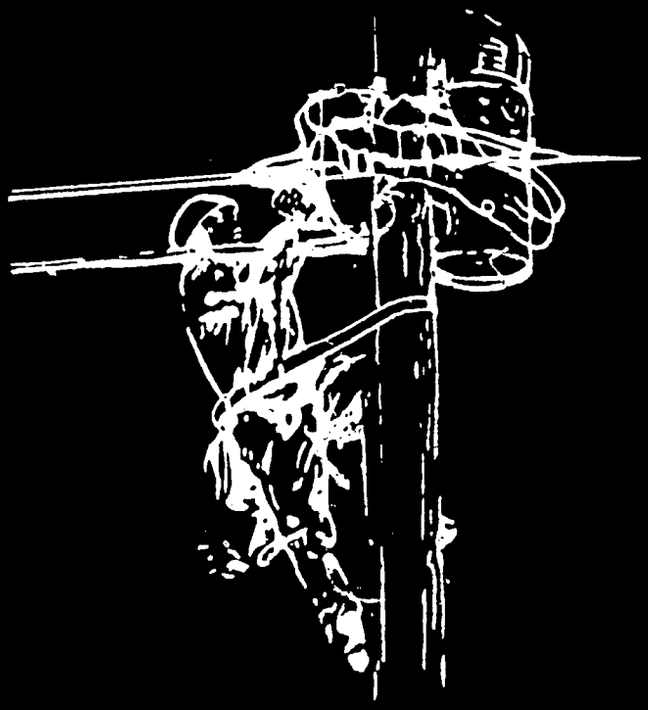
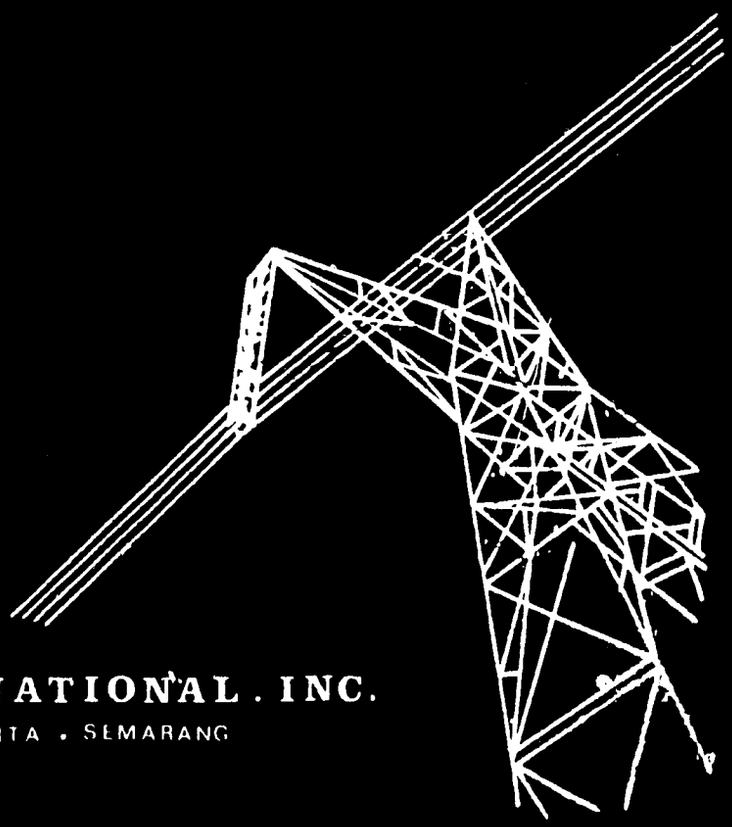


PERUSAHAAN UMUM LISTRIK NEGARA

JAKARTA INDONESIA



MAIN
Engineers

CHAS. T. MAIN INTERNATIONAL . INC.

BOSTON . BANDUNG . JAKARTA . SEMARANG

PDAAN 584

ISN 32672

FINAL REPORT

WEST JAVA I AND II TRANSMISSION

AND SUBSTATION PROJECTS

CONTRACTS

PJ. 013/PST/74 AND PJ. 023/PST/75

USAID LOANS 497-H-028 & 497-W-032

MAIN
Engineers

PERUSAHAAN UMUM LISTRIK NEGARA CONSULTANT
CHAS. T. MAIN INTERNATIONAL. INC.
BANDUNG — TROMOLPOS 69. TEL. 56869 JL. PROGO 32
JAKARTA — P.O. BOX 100. KBT KEBAYORAN TIMUR. TEL. 776925 JL. WIJAYA 1/61
SEMARANG — P.O. BOX 26, TEL. 31 1 702 JL. SLAMET 1

3 March 1983

Letter No. J-5856.

Ir. R. Semiawan
Proyek Induk Jaringan Jawa Barat & Jakarta Raya
Perusahaan Umum Listrik Negara
Jalan Cililitan Besar No. 1
Cawang, Jakarta

Subject: West Java I and II Projects
Final Report

Dear Ir. Semiawan:

In accordance with Article 7.3 of the West Java I Contract No. Pj. 013/PST/74 and Appendix V of the West Java II Contract No. Pj. 023/PST/75, enclosed are twenty (20) copies of MAIN's Final Report for the West Java Transmission and Substation Projects.

MAIN is most pleased to have been associated with PLN on these Projects and we look forward to further projects with PLN.

Please accept our deep appreciation of the vital contribution made by you and your staff and be assured of our best wishes for the future.

Very truly yours,
CHAS. T. MAIN INTERNATIONAL, INC.

Donald A. Dowling

D.A. Dowling
Projects Director

CHAS. T. MAIN, INT'L, INC. DONALD A. DOWLING PROJECT DIRECTOR

cc. : DIRBANG - PLN Pusat (2)
USAID - JKT (10)
MAIN - BSN (2)
MAIN - CHA (1)

CJW/swt

HOME OFFICE — SOUTHEAST, TOWER, PRUDENTIAL CENTER, BOSTON, MASSACHUSETTS, 02199 U.S.A.

WEST JAVA I AND II TRANSMISSION AND SUBSTATION PROJECTS

FINAL REPORT

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SECTION I

INTRODUCTION

SECTION I

INTRODUCTION

Comprehensive economic and social development plans for Java have been formulated by the Government of Indonesia. Historically, economic progress and hence the standard of living in a country are very dependent on the availability and utilization of electrical energy.

In order assist in the implementation of government plans and objectives, PERUSAHAAN UMUM LISTRIK NEGARA (PLN) has developed a long range program for the improvement of the national electric system. Transmission and substation construction in West Java is an essential part of this program.

Based on documented and forecasted statistics, the United States Agency for International Development (AID) agreed to fund the transmission and substation additions covered by this report.

Chas. T. Main International, Inc. (MAIN) was engaged to provide the engineering, design and construction management required to successfully accomplish this vital phase of PLN's program.

This Final Report details the many services provided by MAIN under PLN/MAIN Contracts Pj. 013/PST/74 and Pj. 023/PST/75 and summarizes the history of associated transmission and substation construction.

MAIN is most pleased to have been involved in the development of PLN's ambitious program and gratefully acknowledges the vital contribution of PLN officers and personnel.

SECTION II

EXECUTIVE SUMMARY

The West Java Transmission and Substation Projects were designed to complete a 150 KV transmission interconnection grid between West and Central Java, Indonesia, together with related substations. This interconnected system permits transfer of power between generating stations at Central Java and West Java load centers. Generating unit operating restrictions resulting from electrical isolation of the two areas are now eliminated. Generating unit operation and maintenance flexibility are improved and more economic and reliable service can be provided to electric consumers.

The United States Agency for International Development (AID) provided financing of $ 17,200,000 for the design, supply and supervision of construction for the section between Tegal, Central Java, and Bandung in West Java. For the section between Bandung and Jakarta, AID provided financing of $ 19,700,000 for design, supply and supervision of construction and also the actual construction of the transmission line. The Government of Indonesia and Perusahaan Umum Listrik Negara (PLN) provided equivalent local currency in the amount of $ 22,700,000 as well as a cadre of capable and effective personnel.

Engineering and design commenced in 1974 on an original plan for distribution rehabilitation in a number of cities. Cost estimates, however, indicated that there were not sufficient funds for transmission, substations and distribution system addition. Distribution rehabilitation was therefore eliminated and efforts were concentrated on the transmission lines and substations.

Bid documents for imported materials, equipment and construction services were issued in mid 1977 and signing of contracts was completed by April 1978. Contracts with local contractors were completed to provide for transmission tower foundation installation, tower erection and conductor stringing. All substations and termininal facilities were constructed and erected by PLN and local contractor forces. Transmission work was completed in January 1981 and the substations and related training were concluded in October 1982.

Approximately 120 trainees attended training courses in foundation installation and inspection, tower erection and conductor stringing. Some 25 PLN employees were trained in substation equipment installation and erection. On the job training was conducted at all times.

It was estimated in early evaluation that service to 500,000 additional customers is made possible by the projects and that 2500 Indonesian employees were required for project construction. Additionally, local suppliers and contractors benefited in supplying materials and services. Present and future customers will benefit from the additional power available and from improved system reliability. Further the economy of the entire area will be enchanced by increased commercial and industrial capabilities.

HIGHLIGHTS

FINANCING	USAID	$ 36,900,000	
	GOI/PLN	$ 22,700,000	equivalent

DISPOSITION OF USAID FUNDS	Material/Equipment	$ 28,596,481.21
	Construction/Services	8,133,753.38
	Bank Charges	167,388.67
	Uncommitted	2,376.74
	Total	$ 36,900,000.00

MATERIAL/EQUIPMENT	Shipments	184
	Weight	13,503.78 Long Tons
	CIF Value	$ 28,596,481.21

CONTRACTS	Foreign	11
	Local	56
	Total	67

TIMING	1 June 1974 to 15 October 1982

PERSONNEL MANMONTHS	US	1,156.2
	Indonesian	14,426.7
	Third Country	51.9

TRAINING	Transmission	120	PLN
	Substation	25	PLN
	Distribution	62	PLN
	General	2,380	Contractor
TRANSMISSION	Line ROW	357.5	Km
	Towers	886	
	Foundations	3,544	
	Conductor/Shieldwire	3,071.8	Km
SUBSTATIONS	Complete Stations	3	
	Terminal Facilities	1	
DISTRIBUTION	Survey Area	17,235	Km^2
	Towns/Villages	41	
	Drawings	1,475	
	Copies	10,325	

SECTION III

GENERAL INFORMATION

Objectives of the Projects

The West Java Electric Transmission and Distribution Rehabilitation Projects were originally established to provide ;

1) a reliable and economical electric power system from Tegal to Bandung with related substations and rehabilitation and expansion of distribution facilities at Cirebon (West Java I Project) and,

2) a transmission system from Bandung to Jakarta with present and future substations and rehabilitation and expansion of distribution facilities around the Bogor area (West Java II Project).

Initial efforts were devoted to distribution rehabilitation and expansion but cost estimates revealed that all planned work-transmission, substations and distribution - would require more funds than available. Consequently, distribution rehabilitation and expansion were eliminated from the Projects and overall efforts were concentrated on transmission lines and substation construction. Construction of the transmission lines and related substations permit a transfer of power from generating facilities in Central Java and Cirebon to Jakarta and vice-versa as required. Completion of the line from Tegal to Jakarta was vitally important for PLN system reliability. The West Java Projects were closely associated with other electric power projects being implemented in West Java.

Description of the Projects

The Projects cover the engineering design, material and equipment procurement, construction and construction supervision, technical and managerial assistance and training required in connection with :

1. New 150 KV double circuit transmission lines.

   a. West Java I Project - 187 Km connecting Tegal, Cirebon and Bandung.
   b. West Java II Project - 170 Km connecting Bandung, Bogor and Jakarta.

2. New 150/70/20 KV Substations.

   a. West Java I Project - Ujungberung (Bandung) and switching facilities at Tegal.
   b. West Java II Project - Bandung North (Bandung) and Bogor.

3. Installation of adequate system protection for all transmission lines and substations.

4. Provision of vehicles, tools and service equipment for system operation and maintenance.

5. Furnish PLN with a library of technical books and periodicals related to the electric power industry.

Funding of the Projects

To finance the reasonable foreign exchange cost of imported capital equipment, related engineering, construction and training services, the United States Agency for International Development (USAID) entered into the following Loan Agreements with the Government of Indonesia for relending to PLN.

1. West Java I Project - USAID Loan No. 497-H-028 US $ 17,200,000.
2. West Java II Project - USAID Loan No. 497-W-032 US $ 19,700,000.

To meet local currency expenditures, the Government of Indonesia agreed to provide Rupiah in the estimated equivalent of US $ 5,800,000 for the West Java I Project and US $ 3,900,000 for the West Java II Project. This total of US $ 9,700,000 has since been increased to some US $ 22,700,000 equivalent.

Consulting Services

In accordance with the above Loan Agreements and with USAID concurrence, PLN and Chas. T. Main International, Inc. (MAIN), Boston, Massachusetts, USA, entered into the following Contracts :

1. West Java I Project - Contract No. Pj. 013/PST/74, dated 16 February 1974. Duration of Contract, as amended, 19 June 1974 to 30 June 1982.

2. West Java II Project - Contract No. Pj. 023/PST/75, dated 27 January 1975. Duration of Contract, as amended, 29 August 1975 to 30 June 1982.

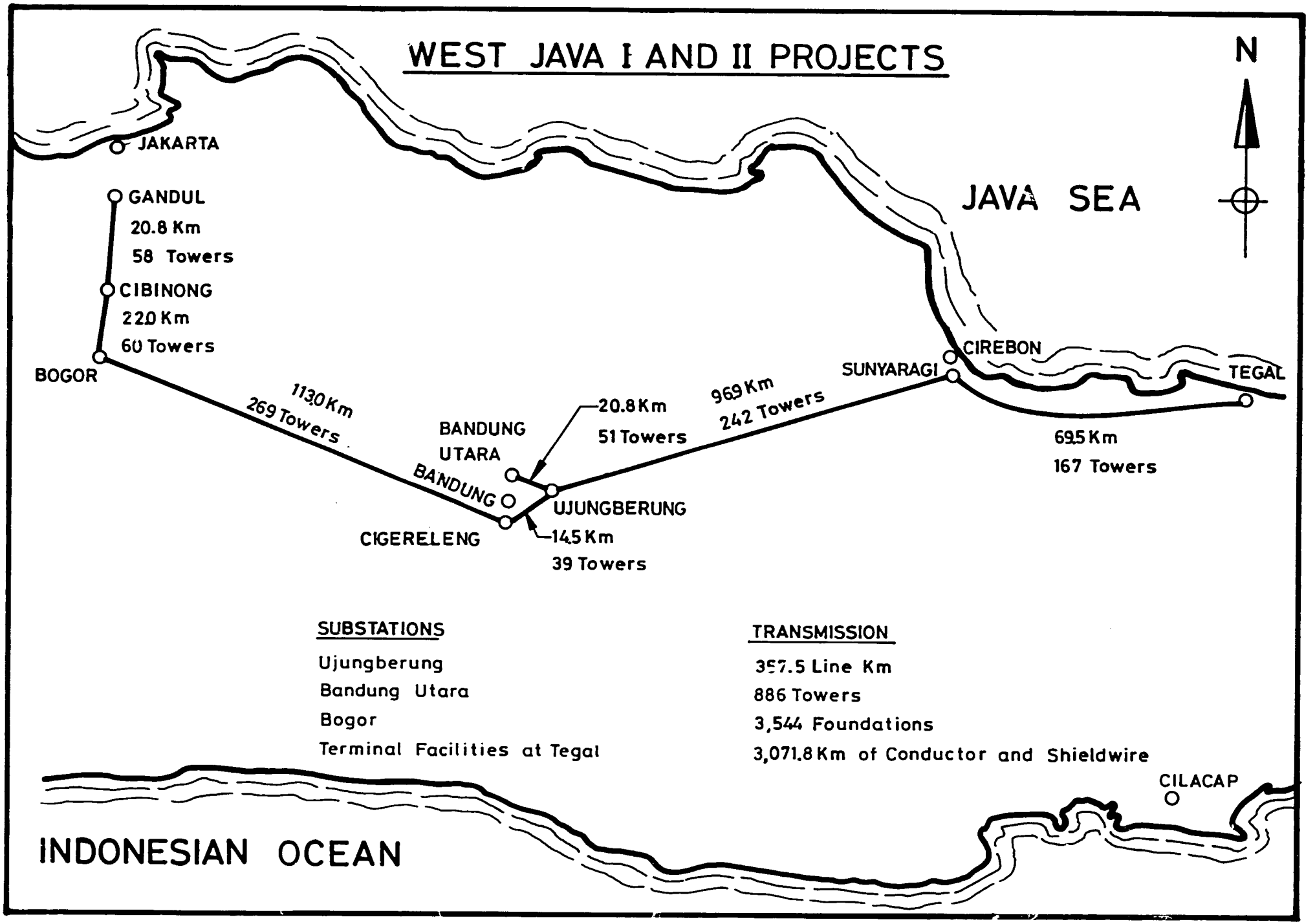
Scope of Services

The Scope of Services to be provided by MAIN under the Contracts include but are not limited to the following items :

1. General Services
2. Engineering and Design Services
3. Procurement Services
4. Construction Planning and Pre-contracting Services
5. Engineering Supervision and Inspection Services
6. Construction Project Management and Supervision Services
7. Initial Operation and Testing
8. Training.

Project Block Diagram

The following page is the Block Diagram for the West Java I and II Projects. The Diagram shows the major parts of the system being installed and the pertinent parameters.


WEST JAVA I AND II PROJECTS
N
JAKARTA
GANDUL
20.8 Km
58 Towers
CIBINONG
22.0 Km
60 Towers
BOGOR
JAVA SEA
CIREBON
SUNYARAGI
TEGAL
113.0 Km
269 Towers
BANDUNG
UTARA
BANDUNG
CIGERELENG
20.8 Km
51 Towers
UJUNGBERUNG
14.5 Km
39 Towers
96.9 Km
242 Towers
69.5 Km
167 Towers
SUBSTATIONS
Ujungberung
Bandung Utara
Bogor
Terminal Facilities at Tegal
TRANSMISSION
357.5 Line Km
886 Towers
3,544 Foundations
3,071.8 Km of Conductor and Shieldwire
CILACAP
INDONESIAN OCEAN

SECTION IV

IMPLEMENTATION OF THE AID LOANS

The Loan Agreements between the Government of Indonesia (GOI), borrower of the Loans, and the United States Agency for International Development (AID), lender of the Loans, required GOI to fulfill certain conditions before AID Letters of Commitment could be issued or before disbursements of funds could be made under Bank Indonesia Letters of Credit. Perusahaan Umum Listrik Negara (PLN) was named the beneficiary under the Loans.

Implementation Letters issued by AID are briefly summarized as follows :

West Java I Project - Loan 497-H-028

Implementation Letter Number 1 - 31 July 1973 - set forth procedures for using proceeds of the Loan and information to assist GOI in implementing the West Java I Project in accordance with the Loan Agreement. Responsibilities of the several parties to the Loan were defined, the Engineering Consultant (MAIN) was approved and terminal dates for Conditions Precedent and Arrangements for Disbursements were cited. Shipping requirements, necessary reports and eligible Source Countries were detailed.

Implementation Letter Number 2 - 6 August 1973 - extended the terminal date for Conditions Precedent to 9 October 1973.

Implementation Letter Number 3 - 31 August 1973 - advised GOI that several Conditions Precedent to initial financing had been fulfilled.

Implementation Letter Number 4 - 29 March 1974 - advised GOI that all Conditions Precedent to initial financing had been fulfilled.

Implementation Letter Number 5 - 24 April 1974 - extended the Terminal Disbursement Date of the Loan Agreement from 9 April 1978 to 31 December 1978 to enable processing of final payments to the various Contractors.

Implementation Letter Number 6 - 11 July 1975 - advised GOI that the terminal date for fulfillment of certain other Conditions Precedent had been extended until 9 November 1975.

Implementation Letter Number 7 - 16 June 1976 - advised GOI of revised AID Geographic Codes 941 and 935 with respect to procurement of Project goods and services.

Implementation Letter Number 8 - 27 August 1976 - advised GOI that the terminal date for fulfillment of certain other Conditions Precedent had been extended until 9 November 1976.

Implementation Letter Number 9 - 4 April 1977 - advised GOI that AID had reviewed and approved Amendment Number 2 to PLN Contract Number Pj. 013/PST/74 with Chas. T. Main International, Inc. The appropriate Letter of Commitment was approved for increase.

Implementation Letter Number 10 - 15 April 1977 - advised GOI that certain Conditions Precedent were fulfilled, and that others were no longer relevant or applicable. Thus, Letters of Commitment for further Project financing were authorized. The Terminal Date for financing had been extended from 9 November 1976 to 15 April 1977.

Implementation Letter Number 11 - 20 June 1977 - advised GOI that the Terminal Date for Requesting New Disbursing Authority had been extended from 7 October 1977 to 31 October 1978 to accomodate the remaining procurement required under the Loan.

Implementation Letter Number 12 - 24 June 1977 - advised GOI that the Loan Funds will be considered as GOI's investment in PLN.

Implementation Letter Number 13 - 26 January 1978 - extended the Terminal Disbursement Date for Loan Funds to 31 December 1980. Further, three (3) PLN Contracts with various equipment suppliers were approved.

Implementation Letter Number 14 - 5 January 1979 - extended the Terminal Date Disbursement Authorization to 31 March 1980.

Implementation Letter Number 15 - 19 May 1980 - extended the Terminal Date Disbursement Authorization to 30 June 1981 and the Terminal Disbursement Date to 31 March 1982. After these dates, respectively, AID Funds cannot be committed or disbursed.

Implementation Letter Number 16 - 4 May 1982 - extended the Terminal Disbursement Date to 30 September 1982.

West Java II Project - Loan 497-W-032

Implementation Letter Number 1 - 20 September 1974 - set forth procedures for using proceeds of the Loan and information to assist GOI in implementing the West Java II Project in accordance with the Loan Agreement. Responsibilities of the several parties to the Loan were defined, the Engineering Consultant (MAIN) was approved and terminal dates for Conditions Precedent and Arrangements for Disbursements were cited. Shipping requirements, necessary reports and eligible Source Countries were detailed.

Implementation Letter Number 2 - 5 March 1975 - advised GOI that Conditions Precedent to the issuance of Letters of Commitment had been fulfilled. Terminal dates for satisfying other Conditions Precedent had been extended from 29 September 1974 to 22 February 1975.

Implementation Letter Number 3 - 16 June 1976 - advised GOI of revised AID Geographic Codes 941 and 935 with respect to procurement of Project goods and services.

Implementation Letter Number 4 - 27 August 1976 - advised GOI that the terminal date for fulfillment of certain Conditions Precedent had been extended until 9 November 1976.

Implementation Letter Number 5 - 4 April 1977 - advised GOI that AID had reviewed and approved Amendment Number 2 to PLN Contract No. Pj. 023/PST/75 with Chas. T. Main International, Inc. The appropriate Letter of Commitment was approved for increase.

Implementation Letter Number 6 - 15 April 1977 - advised GOI that certain Conditions Precedent were fulfilled, and that others were no longer relevant or applicable. Thus, Letters of Commitment for further Project financing were authorized. The Terminal Date for financing had been extended from 9 November 1976 to 15 April 1977.

Implementation Letter Number 7 - 20 June 1977 - advised GOI that the Terminal Date for Requesting New Disbursing Authority had been extended from 7 October 1977 to 31 October 1978 to accomodate the remaining procurement required under the Loan.

Implementation Letter Number 8 - 5 January 1979 - extended the Terminal Disbursement Date for Loan Funds to 31 December 1980.

Implementation Letter Number 9 - 19 May 1980 - extended the Terminal Date Disbursement Authorization to 30 June 1981 and the Terminal Disbursement Date to 31 March 1982. After these dates, respectively, AID Funds cannot be committed or disbursed.

Copies of all Implementation Letters are available at the offices of GOI, PLN, AID and MAIN.

SECTION V

AID LETTERS OF COMMITMENT

To finance the foreign exchange cost of imported capital equipment and related engineering, construction and training services, USAID entered into the following Loan Agreements with the Government of Indonesia for relending to PLN.

West Java I Project	- USAID Loan 497-H-028	US $ 17,200,000.00
West Java II Project	- USAID Loan 497-W-032	US $ 19,700,000.00

y of Foreign Exchange	
oan 497-H-028	US $ 17,200,000.00
Total Letters of Commitment, as amended	17,197,632.86
Uncommitted	US $ 2,367.14

Loan 497-W-032	US $ 19,700,000.00
Total Letters of Commitment, as amended	19,699,990.40
Uncommitted	US $ 9.60

On the pages following are summary and details of the Letters of Commitment issued by USAID.

West Java I and II Projects

Letter of Commitment Data

Letter of Commitment Number	Contractor/ Supplier	Issuance Date	Expiration Date	Contract Amount	Bank Charges	Total Amount
H-02801	MAIN	15 May 74	31 Mar 82	$ 3,824,009.00	$ 22,423.00	$ 3,846,432.00
H-02802	Irby	3 Feb 78	30 Jun 81	2,902,946.03	17,522.97	2,920,469.00
H-02803	Southwire	17 Feb 78	30 Jun 81	1,991,843.83	12,132.26	2,003,976.09
H-02804	Copperweld	17 Feb 78	31 Aug 80	294,739.06	1,773.20	296,512.26
H-02805	Irby	8 Jun 78	30 Sep 82	4,688,295.79	14,442.95	4,702,738.74
H-02806	TSE	21 Jun 78	31 Mar 81	400,636.37	1,110.00	401,746.37
H-02807	Ohio Brass	21 Jun 78	28 Feb 81	87,852.00	264.00	88,116.00
H-02808	G/E	21 Jun 78	31 Dec 81	2,532,800.59	7,941.81	2,540,742.40
H-02809	Motorola	23 Aug 78	30 Jun 81	395,819.20	1,080.80	396,900.00
Total	Loan 497-H-028 West Java I			$ 17,118,941.87	$ 78,690.99	$ 17,197,632.86
W-03201	MAIN	27 Mar 75	31 Mar 82	$ 2,509,793.00	$ 13,586.00	$ 2,523,379.00
W-03202	Irby	2 Feb 78	30 Jun 81	8,199,107.37	48,552.35	8,247,659.72
W-03203	Irby	8 Jun 78	31 Dec 81	4,840,440.19	14,295.33	4,854,735.52
W-03204	Ohio Brass	21 Jun 78	28 Feb 81	87,852.00	264.00	88,116.00
W-03205	G/E	21 Jun 78	31 Dec 81	3,974,100.16	12,000.00	3,986,100.16
Total	Loan 497-W-032 West Java II			$ 19,611,292.72	$ 88,697.68	$ 19,699,990.40

LETTER OF COMMITMENT 497 - H - 02801

Engineering Design, Procurement, Construction Management, Initial Testing, Operation and Training

Engineer : Chas. T. Main International, Inc.
Contract Number : Pj. 013/PST/74, 16 February 1974

Issued	: 15 May 1974	$ 1,374,043.00
Amendment Number 1	: 20 June 1974 Correct payment schedule of Special Provisions, Paragraph C.	- 0 -
Amendment Number 2	: 4 May 1977 Finance cost of additional services to be provided under Amendment Number 2 to Contract	1,598,828.00
Amendment Number 3	: 18 December 1978 Extend expiration date to 31 December 1980	- 0 -
Amendment Number 4	: 7 March 1979 Finance cost of additional services to be provided under Amendment Number 3 to Contract	871,899.00
Amendment Number 5	: 4 May 1979 Correct Amendment Number 4 to Letter of Commitment	1,662.00
Amendment Number 6	: 20 October 1980 Extend expiration date to 31 March 1982	- 0 -
Total		$ 3,846,432.00

LETTER OF COMMITMENT 497 - H - 02802

Material Supply of Insulators, Hardware and
Transmission Tower Steel

Contractor : Irby Construction Company
Contract Number : Pj. 153/PST/77, 5 September 1977

Issued	: 3 February 1978	$ 2,547,000.00
Amendment Number 1	: 10 July 1978	- 0 -
Correct description of materials in Special Provision subparagraph A.1		
Amendment Number 2	: 1 November 1979	203,696.00
Additional supply of transmission line materials to be provided under Amendment Number 2 to Contract		
Amendment Number 3	: 9 June 1980	- 0 -
Extend expiration date to 31 December 1980		
Amendment Number 4	: 20 October 1980	- 0 -
Extend expiration date to 30 June 1981		
Amendment Number 5	: 5 January 1981	169,773.00
Additional supply of transmission line materials to be provided under Amendment Number 3 to Contract		
Total		$ 2,920,469.00

LETTER OF COMMITMENT 497 - H - 02803

Material Supply of Conductor

Contractor : Southwire Company
Contract Number : Pj. 203/PST/77, 28 November 1977

Issued	: 17 February 1978	$ 1,918,000.00
Amendment Number 1	: 11 April 1979	31,105.81
Additional supply of conductor provided for under Amendment Number 2 to Contract		
Amendment Number 2	: 10 May 1979	54,948.15
Additional supply of conductor provided for under Amendment Number 1 to Contract		
Amendment Number 3	: 20 December 1979	- 0 -
Extend expiration date to 31 December 1980		
Amendment Number 4	: 20 October 1980	- 0 -
Extend expiration date to 30 June 1981		
Amendment Number 5	: 10 March 1981	(77.87)
Reflect actual CIF cost of conductor		
Amendment Number 6	: 23 April 1981	- 0 -
Correct error in transposition		
Total		$ 2,003,976.09

LETTER OF COMMITMENT 497 - H - 02804

Material Supply of Shield Wire

Contractor : Copperweld Industries International, Inc.
Contract Number : Pj. 202/PST/77, 20 November 1977

Issued (As 497-H-02802)	:	17 February 1978	$ 286,000.00
Amendment Number 1	:	22 February 1978	- 0 -
Change number to 497-H-02804			
Amendment Number 2	:	16 March 1979	10,512.26
Additional supply of Shield Wire provided for under Amendment Number 1 to Contract			
Amendment Number 3	:	10 June 1980	- 0 -
Extend expiration date to 31 August 1980			
Total			$ 296,512.26

LETTER OF COMMITMENT 497 - H - 02805

Material Supply of Substation Equipment,
Tools and Vehicles

Contractor : Irby Construction Company
Contract Number : Pj. 052/PST/78, 11 March 1978

Issued	: 8 June 1978	$ 4,513,300.74
Amendment Number 1	: 13 June 1978	- 0 -
Documentation required for payment		
Amendment Number 2	: 14 September 1978	- 0 -
Utilization of funds		
Amendment Number 3	: 13 June 1979	- 0 -
Extend expiration date to 30 September 1980		
Amendment Number 4	: 1 November 1979	47,852.00
Additional substation materials and vehicle spare parts to be provided under Amendment Number 1 to Contract		
Amendment Number 5	: 27 February 1980	- 0 -
Include financing for installation and testing supervision services		
Amendment Number 6	: 2 June 1980	141,586.00
Transfer funding from West Java II Loan 497-W-032		
Amendment Number 7	: 15 September 1980	- 0 -
Extend expiration date to 30 June 1981		
Amendment Number 8	: 20 October 1980	- 0 -
Extend expiration date to 31 December 1981		

Amendment Number 9 : 4 December 1981 Extend expiration date to 31 March 1982	$	- 0 -
Amendment Number 10 : 4 June 1982 Extend expiration date to 30 September 1982		- 0 -
Total	$	4,702,738.74

LETTER OF COMMITMENT 497 - H - 02806

Material Supply of Wire Stringing Equipment

Contractor : Tension Stringing Equipment, Inc.
Contract Number : Pj. 050/PST/78, 10 March 1978

Issued	: 21 June 1978	$ 370,583.98
Amendment Number 1	: 13 September 1978	- 0 -
	Amend Transportation and Insurance items in Special Provisions Paragraph A.	
Amendment Number 2	: 27 February 1979	35,669.44
	Additional supply of equipment provided for under Amendment Number 1 to Contract	
Amendment Number 3	: 13 June 1979	- 0 -
	Extend expiration date to 31 December 1979	
Amendment Number 4	: 16 January 1980	- 0 -
	Extend expiration date to 30 June 1980	
Amendment Number 5	: 24 January 1980	(2,222.56)
	Decrease supply of equipment	
Amendment Number 6	: 10 July 1980	- 0 -
	Extend expiration date to 31 December 1980	
Amendment Number 7	: 20 October 1980	- 0 -
	Extend expiration date to 31 March 1981	
Amendment Number 8	: 10 March 1981	(2,284.49)
	Decrease supply of equipment	
Amendment Number 9	: 1 June 1981	- 0 -
	Extend expiration date to 30 September 1981	
Total		$ 401,746.37

LETTER OF COMMITMENT 497 - H - 02807

Material Supply of Lightning Arresters

Contractor : Ohio Brass Company
Contract Number : Pj. 051/PST/78, 10 March 1978

Issued	: 21 June 1978	$	88,116.00
Amendment Number 1	: 13 September 1978		- 0 -
Amend Transportation and Insurance items in Special Provisions Paragraph A.			
Amendment Number 2	: 13 June 1979		- 0 -
Extend expiration date to 31 December 1979			
Amendment Number 3	: 6 May 1980		- 0 -
Extend expiration date to 31 August 1980			
Amendment Number 4	: 17 December 1980		- 0 -
Extend expiration date to 28 February 1981			
Total		$	88,116.00

LETTER OF COMMITMENT 497 - H - 02908

Material Supply of Substation Equipment

Contractor : General Electric Company
Contract Number : Pj. 053/PST/78, 11 March 1978

Issued	: 21 June 1978	$ 2,459,931.40
Amendment Number 1	: 7 September 1978 Amend Transportation and Insurance items in Special Provisions Paragraph A.	- 0 -
Amendment Number 2	: 13 June 1979 Extend expiration date to 30 September 1980	- 0 -
Amendment Number 3	: 27 February 1980 Include financing for installation and testing supervision services	- 0 -
Amendment Number 4	: 2 June 1980 Additional substation material to be provided under Amendment Number 1 to Contract.	80,811.00
Amendment Number 5	: 20 October 1980 Extend expiration date to 31 December 1981	- 0 -
Total		$ 2,540,742.40

LETTER OF COMMITMENT 497 - H - 02809

Supply of Radio Equipment and Training

Contractor : Motorola, Inc.
Contract Number : Pj. 087/PST/78, 11 May 1978

Issued	: 23 August 1978	$ 396,900.00
Amendment Number 1	: 7 September 1979	- 0 -
Extend expiration date to 31 December 1980.		
Amendment Number 2	: 20 October 1980	- 0 -
Extend expiration date to 30 June 1981		
Amendment Number 3	: 19 March 1981	- 0 -
Extend expiration date to 31 December 1981		
Total		$ 396,900.00

LETTER OF COMMITMENT 497 - W - 03201

Engineering Design, Procurement, Construction Management, Initial Testing, Operation and Training

Engineer : Chas. T. Main International, Inc.
Contract Number : Pj. 023/PST/75, 27 January 1975

Issued	: 27 March 1975	$ 1,549,500.00
Amendment Number 1	: 4 May 1977	860,379.00
Finance cost of additional services to be provided under Amendment Number 2 to Contract		
Amendment Number 2	: 7 March 1979	112,560.00
Finance cost of additional services to be provided under Amendment Number 3 to Contract		
Amendment Number 3	: 4 May 1979	940.00
Correct Amendment Number 2 to Letter of Commitment		
Amendment Number 4	: 13 June 1979	- 0 -
Extend expiration date to 31 December 1980		
Amendment Number 5	: 20 October 1980	- 0 -
Extend expiration date to 31 March 1982		
Total		$ 2,523,379.00

LETTER OF COMMITMENT 497 - W - 03202

Material Supply and Construction of Transmission Line

Contractor : Irby Construction Company
Contract Number : Pj. 152/PST/77, 8 September 1977

Issued	: 2 February 1978	$ 7,792,000.00
Amendment Number 1	: 22 June 1978	- 0 -
	Correct description of Contract Services in Special Provisions subparagraph A.i.	
Amendment Number 2	: 25 October 1978	343,057.60
	Finance cost of additional material and labor provided for under Amendment Number 2 to Contract	
Amendment Number 3	: 22 March 1979	(31,656.88)
	Correct Amendment Number 2 to Letter of Commitment	
Amendment Number 4	: 29 April 1980	141,586.00
	Finance cost of additional material and labor provided for under Amendment Number 3 to Contract.	
Amendment Number 5	: 20 October 1980	- 0 -
	Extend expiration date to 30 June 1981	
Amendment Number 6	: 5 January 1981	2,673.00
	Finance cost of additional material and labor provided for under Amendment Number 4 to Contract	
Total		$ 8,247,659.72

LETTER OF COMMITMENT 497 - W - 03203

Material Supply of Substation Equipment

Contractor : Irby Construction Company
Contract Number : Pj. 052/PST/78, 11 March 1978

Issued	: 8 June 1978	$ 4,996,321.52
Amendment Number 1	: 13 June 1978	- 0 -
Documentation required for payment		
Amendment Number 2	: 14 September 1978	- 0 -
Utilization of funds		
Amendment Number 3	: 13 June 1979	- 0 -
Extend expiration date to 30 September 1980		
Amendment Number 4	: 27 February 1980	- 0 -
Include financing for installation and testing supervision services		
Amendment Number 5	: 16 April 1980	(141,586.00)
Transfer funding to West Java I Loan 497-H-028.		
Amendment Number 6	: 15 September 1980	- 0 -
Extend expiration date to 30 June 1981		
Amendment Number 7	: 20 October 1980	- 0 -
Extend expiration date to 31 December 1981		
Amendment Number 8	: 4 December 1981	- 0 -
Extend expiration date to 31 March 1982		
Total		$ 4,854,735.52

LETTER OF COMMITMENT 497 - W - 03204

Material Supply of Lightning Arresters

Contractor : Ohio Brass Company
Contract Number : Pj. 051/PST/78, 10 March 1978

Issued	: 21 June 1978	$	88,116.00
Amendment Number 1	: 13 September 1978		- 0 -
Amend Transportation and Insurance items in Special Provisions Paragraph A.			
Amendment Number 2	: 13 June 1979		- 0 -
Extend expiration date to 31 December 1979			
Amendment Number 3	: 7 May 1980		- 0 -
Extend expiration date to 31 August 1980			
Amendment Number 4	: 17 December 1980		- 0 -
Extend expiration date to 28 February 1981			
Total		$	88,116.00

LETTER OF COMMITMENT 497 - W - 03205

Material Supply of Substation Equipment

Contractor : General Electric Company
Contract Number : Pj. 053/PST/78, 11 March 1978

Issued	: 21 June 1978	$ 3,986,100.16
Amendment Number 1	: 7 September 1978 Amend Transportation and Insurance items in Special Provision Paragraph A.	- 0 -
Amendment Number 2	: 13 June 1979 Extend expiration date to 30 September 1980	- 0 -
Amendment Number 3	: 27 February 1980 Include financing for installation and testing supervision services	- 0 -
Amendment Number 4	: 20 October 1980 Extend expiration date to 31 December 1981	- 0 -
Total		$ 3,986,100.16

SECTION VI

CONTRACTUAL DATA

To provide the Engineering Services, Construction Labor and Materials and Equipment necessary to design, construct and equip the Projects, PLN entered into more than sixty Contracts (as amended) totalling more than US $ 36,700,00 and almost Rupiah 12.000.000.000,-.

Following are Contract details :

US $ CONTRACTS

West Java I

1.	No. Pj. 013/PST/74 Chas. T. Main International, Inc. Engineering Services	16 Feb. '74	$	3,824,009.00
2.	No. Pj. 153/PST/77 Irby Construction Company Tower Steel, Insulators and Accessories	5 Sep. '77		2,902,946.03
3.	No. Pj. 202/PST/77 Copperweld Industries Shieldwire	28 Nov. '77		294,739.06
4.	No. Pj. 203/PST/77 Southwire Company Conductor	28 Nov. '77		1,991,843.83

5.	No. Pj. 050/PST/78 Tension Stringing Equipment Co. Wire-Stringing Equipment	10 Mar. '78	$ 400,636.37
6.	No. Pj. 051/PST/78 Ohio Brass Company Lightning Arresters	10 Mar. '78	87,852.00
7.	No. Pj. 052/PST/78 Irby Construction Company Substation Equipment Tools and Equipment	11 Mar. '78	4,688,295.79
8.	No. Pj. 053/PST/78 General Electric Company Substation Equipment	11 Mar. '78	2,532,800.59
9.	No. Pj. 087/PST/78 Motorola, Inc. Radio Equipment	11 May '78	395,819.20
	Total West Java I		$ 17,118,941.87

West Java II

1.	No. Pj. 023/PST/75 Chas. T. Main International, Inc. Engineering Services	25 Jan. '75	$ 2,509,793.00

2.	No. Pj. 152/PST/77 Irby Construction Company Transmission Line Supply and Construction	5 Sep. '77	$ 8,199,107.37
3.	No. Pj. 051/PST/78 Ohio Brass Company Lightning Arresters	10 Mar. '78	$ 87,852.00
4.	No. Pj. 052/PST/78 Irby Construction Company Substation Equipment	11 Mar. '78	4,840,440.19
5.	No. Pj. 053/PST/78 General Electric Company Substation Equipment	11 Mar. '78	3,974,100.16
	Total West Java II		$ 19,611,292.72
	Total Both Projects		$ 36,730,234.59

RUPIAH CONTRACTS

West Java I

1.	No. Pj. 013/PST/74 Chas. T. Main International, Inc. Engineering Services	16 Feb. '74	Rp. 555.096.119,-

2.	No. Spj. 022/PLN/PI RING/77 P.T. Tikon Abadi Foundations - Section I	22 Oct. '77	Rp.	199.278.000,-
3.	No. Spj. 023/PLN/PI RING/77 P.T. Gunung Kencana Foundations - Section IIA	27 Oct. '77		153.445.000,-
4.	No. Spj. 024/PLN/PI RING/77 P.T. Dharma Niaga Foundations - Section IIB	27 Oct. '77		164.789.000,-
5.	No. Spj. 010/PLN/PI RING/78-79 P.T. Perfect Circle Tower Erection	8 Dec. '78		132.894.300,-
6.	No. Spj. 065A/SPP/PI RING JATENG/78-79 P.T. Santraco Raya Tegal Substation Civil Work	21 Apr. '79		50.278.000,-
7.	No. Spj. 072/SPP/PI RING JATENG/78-79 P.T. Sigma Tirta Tegal Substation Structure Erection	17 Oct. '79		25.966.000,-
8.	No. Spj. 017/PLN/PI RING/79-80 P.T. Silkar National Conductor Stringing - Section I	22 Jan. '80		127.790.850,-
9.	No. Spj. 019/PLN/PI RING/79-80 P.T. Citac Ltd. Conductor Stringing - Section III	2 Feb. '80		164.364.000,-

10. No. Spj. 001/PLN/PI RING/80-81 Rp. 464.500.000,-
P.T. Erses 3 Apr. '80
Ujungberung Substation Civil Work

11. No. Spj. 002/PLN/PI RING/80-81 199.989.000,-
P.T. Erses 3 Apr. '80
Ujungberung Substation Control House

12. No. Spj. 013/PLN/PI RING/80-81 18.860.000,-
P.T. Dharma Niaga 6 Jul. '80
Ujungberung Substation Temporary 150 KV
Transmission Line By-Pass

13. No. Spj. 007/PLN/PI RING/80-81 33.234.000,-
P.T. Citacontrac 3 Jun. '80
Caisson for Tower No. 278

14. No. Spk. 003/PLN/PI RING/81 19.823.000,-
P.T. Citacontrac 26 Mar. '81
Relocate Towers 317 and 319

15. No. Spk. 004A/PLN/PI RING/81 19.962.000,-
P.T. Erses 20 Apr. '81
Ujungberung Substation Additional Control House Work

16. No. Spk. 007A/PLN/PI RING/81 45.236.000,-
P.T. Erses 18 May '81
Ujungberung Substation Additional Civil Work

17. No. Spk. 010/PLN/PI RING/81 19.896.000,-
P.T. Citacontrac 25 Jun. '81
Ujungberung Substation Control Room Wiring

18.	No. Spk. 011/PLN/PI RING/81 P.T. Citacontrac 25 Jun. '81 Ujungberung Substation Control Cabinet Wiring	Rp.	19.798.000,-
19.	No. Spk. 030/PLN/PI RING/81 P.T. Viterico 24 Nov. '81 Ujungberung Substation Yard Lighting		19.903.000,-
20.	No. Spj. 03/PLN/PI RING/77 C.V. Usaha Jaya 14 Nov. '77 Sunyaragi Substation Warehouse and Open Storage		65.552.000,-
	Total West Java I	Rp.	2.500.654.269,-

West Java II

1.	No. Pj. 023/PST/75 25 Jan. '75 Chas. T. Main International, Inc. Engineering Services	Rp.	718.743.035,-
2.	No. Pj. 152/PST/77 5 Sep. '77 Irby Construction Company Transmission Line Supply and Construction		774.481.343,-
3.	No. Pj. 052/PST/78 11 Mar. '78 Irby Construction Company Tools and Equipment		135.227.727,-
4.	No. Spj. 001/PLN/PI RING/77-78 P.T. Citac Ltd. 5 Jun. '78 Foundations - Sections II and III		329.553.000,-

5.	No. Spj. 002/PLN/PI RING/78-79 P.T. Citac Ltd. 9 Aug. '79 Foundations - Ujungberung - Cigereleng	Rp.	175.128.000,-
6.	No. Spj. 022/PLN/PI RING/79-80 P.T. Sahabat Agung 4 Dec. '79 Cibinong - Gandul Stub Angles		10.618.000,-
7.	No. Spj. 009/PLN/PI RING/79-80 P.T. Citac Ltd. 30 Nov. '79 Foundations - Section IV A		62.441.000,-
8.	No. Spj. 010/PLN/PI RING/79-80 P.T. Citac Ltd. 30 Nov. '79 Foundations - Section IV C		36.029.000,-
9.	No. Spj. 018/PLN/PI RING/79-80 P.T. Amarta Karya 24 Jan. '80 Foundations - Section IV B		64.630.000,-
10.	No. Spj. 008/PLN/PI RING/80-81 P.T. Pembangunan Perumahan 5 Jul. '80 Bandung Utara Substation Civil Work		334.619.000,-
11.	No. Spj. 006/PLN/PI RING/80-81 P.T. Perfect Circle 31 May '80 Bandung Utara Substation Control House		230.501.000,-
12.	No. Spj. 009/PLN/PI RING/80-81 P.T. Perfect Circle 31 May '80 Bogor Substation Civil Work		475.428.000,-

13.	No. Spj. 007/PLN/PI RING/80-81 P.T. Perfect Circle 31 May '80 Bogor Substation Control House	Rp.	212.915.000,-
14.	No. Spj. 020/PLN/PI RING/79-80 P.T. Hutama Karya 16 Feb. '80 Bandung Utara Substation Access Road		31.967.000,-
15.	No. Spj. 009B/PLN/PI RING/81-82 P.T. Buana Power 29 May '81 Bogor Substation Access Road		64.700.000,-
16.	No. Spj. 013/PLN/PI RING/80-81 P.T. Dharma Niaga 6 Jul. '80 Bogor Substation Temporary 150 KV Transmission Line By-Pass		10.608.000,-
17.	No. Spj. 001j/PLN/PI RING/80-81 P.T. Samapta Nusantara 6 May '81 Transport Power Transformers to Bogor		89.843.000,-
18.	No. Spk. 028/PLN/PI RING/80 P.T. Perfect Circle 20 Dec. '80 Bogor Substation Additional Civil Work		47.061.850,-
19.	No. Spk. 002A/PLN/PI RING/81 P.T. Perfect Circle 13 Mar. '81 Bogor Substation Additional Control House Work		20.850.000,-
20.	No. Spk. 013A/PLN/PI RING/81 P.T. Buana Power 17 Jul. '81 Bogor Substation Additional Access Road Work		6.389.400,-

21. No. Spk. 014/PLN/PI RING/81 Rp. 18.220.000,-
P.T. Dharma Niaga 10 Aug. '81
Bogor Substation Tower and Switchyard Foundations

22. No. Spk. 017/PLN/PI RING/81 19.215.000,-
P.T. Perfect Circle 18 Aug. '81
Bogor Substation Additional Civil Work

23. No. Spk. 018/PLN/PI RING/81 19.900.000,-
P.T. Perfect Circle 1 Sep. '81
Bandung Utara Substation Additional Control House Work

24. No. Spk. 018A/PLN/PI RING/81 19.892.500,-
P.T. Buana Power 21 Sep. '81
Bogor Substation Additional Access Road Work

25. No. Spk. 021/PLN/PI RING/81 19.833.000,-
C.V. Perfecta 2 Sep. '81
Bandung Utara Substation Switchyard Work

26. No. Spk. 022/PLN/PI RING/81 16.108.000,-
P.T. Perfect Circle 3 Sep. '81
Bogor Substation Additional Control Building Work

27. No. Spk. 023A/PLN/PI RING/81 26.200.000,-
P.T. Pembangunan Perumahan 28 Sep. '81
Bandung Utara Substation Additional Switchyard Work

28. No. Spk. 024/PLN/PI RING/81 19.274.000,-
P.T. Metalika 14 Oct. '81
Bogor Substation Yard Lighting

29.	No. Spk. 001A/PLN/PI RING/82 C.V. Kaylani 10 Jan. '82 Bandung Utara Substation Yard Lighting	Rp.	19.690.000,-
	Total West Java II	Rp.	4.010.065.855,-

West Java I and II Projects

1.	No. Spj. 016/PLN/PI RING/77 P.T. Sumber Jaya 4 Jul. '77 Grounding Material	Rp.	54.245.000,-
2.	No. Spj. 017/PLN/PI RING/77 P.T. Arcon 13 Aug. '77 Stub Angles		40.100.000,-
3.	No. Spj. 001j/OP LOG/79 P.T. Keluarga Pradeni Veem 7 Feb. '79 Transport Power Transformers to Bandung		128.999.492,-
4.	No. Spj. 038/PLN/PI RING/78 P.T. Sahabat Agung 5 Jan. '78 Cigereleng Substation Maintenance Shop and Open Storage		166.316.000,-
5.	No. Spj. 014/PLN/PI RING/81-82 C.V. Perfecta 13 Jul. '81 Reinforcement of Bridges - Jakarta to Bandung		180.400.000,-

6.	No. Spj. 045/PLN/PI RING/81-82 P.T. Wijaya Karya 17 Nov. '81 Transport Transformers To Bandung	Rp.	496.000.000,-
7.	Survey and Soil Investigation		400.000.000,-
	Substation Land Purchases		1.037.000.000,-
	Transmission Land Purchases and ROW		2.970.570.000,-
	Total	Rp.	5.473.630.492,-
	Total Both Projects	Rp.	11.984.350.616,-

SECTION VII

DISTRIBUTION

General

In July 1972, PLN awarded a Contract to MAIN to perform a "Distribution System Rehabilitation Study". The study included thirteen (13) distribution load areas. This Study resulted in MAIN's providing the Engineering and Design Services for the Cirebon area. Additional like services for the Bogor area were eliminated due to budget constraints. MAIN's distribution efforts began in June 1974 and, in January 1975, the Distribution Design Report was submitted for PLN review and approval.

Survey work, mapping and training continued until December 1975 when it was determined that the distribution portion of the Project would be terminated because of lack of available funds. Such funds were then allocated to the transmission and substation phases of the Projects. Some work continued on the distribution field surveys, map preparation, design and field staking until June 1976. At this time, the design was complete.

In December 1977, PLN III Distribution officials met with MAIN to arrange the turnover of maps, design criteria, design maps and construction standards. The transfer was completed in April 1978 and all distribution system work was terminated. MAIN agreed to furnish PLN any technical assistance required to interpret the design or other portions of the work. During the operational period of the Distribution efforts, four (4) MAIN personnel and a maximum of 62 PLN and Local Hire personnel were utilized. As the distribution work neared completion, survey parties and field staking crews were transferred to the transmission and substation phases.

Design and Survey Information

The Cirebon Distribution Area covered 17,235 square kilometers and included forty one cities and villages. The area was bounded on the north by the city of Indramayu; on the south by the village of Luragung; on the east by the Java Sea; and on the west by the city of Jatiwangi. For the purpose of surveying and mapping, the area was divided into twenty five separate units. Most of the boundaries used were city limits or other geographical delineations such as a river or a road intersection. Statistical data by area included survey findings, load checks, mapping, design and number of poles.

It should be noted that the total kilometers of line required was considerably more than the estimated totals in the Distribution Report prepared for PLN in 1972. This was due to an increase in the original scope of work when, at PLN's request, new villages were added to the distribution area and the distribution system was designed as a closed loop system.

Survey Method

An investigation of existing information on the Cirebon Distribution Area revealed a lack of up-to-date and accurate maps. In order to prepare the Distribution Design it was necessary to survey the entire area, produce new maps as needed and update the existing maps. The stadia survey method was chosen, using a standard transit and metric stadia rod.

The survey crews noted all roads, streets, railroads, existing power and telephone lines and other planimetric data necessary to prepare maps for the Distribution Design.

Map Preparation

The field notes were used to prepare mylar distribution maps. The maps were to a scale of 1:1000 covering an area of one kilometer by 0.5 kilometer with no overlap. Copies of the distribution maps were returned to the field and were completed by entering the staking information.

The construction design information, as prepared by MAIN was entered on reproducible copies prepared from the completed mylars. The information on the reproducible was to be used to prepare unit tabulations for the IFB's and as the construction map for the Contractor.

When construction was completed and electric service in operation , it was intended that the mylar would be used to enter the necessary information to provide a distribution map for maintenance purposes and to show future additions to the system. For this purpose the unit information used for construction purposes would not be shown.

Voltage Levels

To conform with the Ministry of Public Works and Power requirements, the following voltage levels were chosen : 11.55/20 KV, three (3) phase primary service; 220 volt, three (3) phase secondary service. The latter was a change from the existing services of 127/220 volts. The frequency remained at 50 Hz.

The initial primary distribution system design was based on a four (4) wire system. As the design progressed, there were many discussions on the advantages of using a three (3) wire system. The final design was for a three (3) wire effectively grounded system in order to match the design of the existing substations which would serve as the feeder source. Since no final decision was reached regarding the type of system to be used, Construction Standards were prepared for both systems.

Construction Standards

The Construction Standards for the four (4) wire system and three (3) wire system each include sufficient information for construction. This included both three (3) phase and single (1) phase wood pole and steel pole units, guys, anchors, grounding, sectionalizing, system protection and service connections. Additional guides for erection, tree trimming and taps were also included.

The Construction Standards were patterned after the United States Rural Electric Administration (REA) standards modified to meet requirements in Java.

Wood Poles

The wood poles were to be cut and treated in Indonesia. They were to be used in all rural areas and smaller cities and in the outlying areas of the larger cities.

The types and sizes chosen are the same as those used in the United States. They would have the same ratio of butt to top diameter and be available in Classes A, B and C, varying in length from ten (10) meters to fourteen (14) meters.

Steel Poles

PLN required that steel poles be used in the core area of the larger cities for asthetic reasons.

Designs were prepared for the various types of steel poles required. Class A poles were limited to a height of thirteen(13) meters while Class B and C were limited to a height of twenty (20) meters. All poles were to be manufactured from black pipe. Specifications for the manufacture of the steel poles were prepared for contractors.

Pole Numbering System

All maps used the coordinate system of numbering. The 000 North - South and East - West point for the Cirebon Distribution Area was the monument at the intersection of Jl. Siliwangi and Jl. Veteran in Cirebon. By using the coordinate system, each pole had different number which served to identify it both geographically and for a record system. The relocation of an existing pole or the addition of a new pole to the constructed system would require the use of a new number based on its coordinates and would not require the use of sub-letters. The coordinate system of numbering was approved by PLN as the best pole numbering system for the Cirebon Distribution Area.

Conductor

To comply with the Ministry of Public Works and Power Decree No. 04/I/1970, concerning guidelines for construction of electric distribution networks, the use of alumunium conductor was considered throughout the design with the exception of grounding wire.

Economic Conductor Selection Graphs were prepared for three phase and single phase systems. From the results of these graphs the conductors selected were 477 MCM - SAC (EC - H 19) for three (3) phase feeders with a 4/0 AWG - SAC (EC-H 19) neutral and 1/0 - AAAC (6201-T81) for secondary circuits.

The use of other size conductor was encouraged when load or voltage requirements indicate the economical use of smaller conductor. In order to minimize the number of types of conductor to be stocked, the service cable selected fell within the range of all known requirements for line and service conductor for the Cirebon Distribution Area.

Hardware

All pole hardware was to be of standard manufacture similar to that used on REA projects in the United States. In addition, the hardware would be hot dipped galvanized on all exposed surfaces.

Transformers

All transformers for single (1) phase use were to be 50 KVA pole mounted, outdoor type, completely self-protected.

Transformers for three (3) phase use were to be a platform mounted, outdoor conventional type with a five-legged core suitable for wye-wye connections. These transformers would have a size ranging from 225 KVA to 500 KVA. Small three (3) phase transformer installations would consist of three single (1) phase transformers cluster-mounted on the pole.

There were some specific requirements for larger KVA units and each would be individually selected. Some of these transformers would be used to convert existing 6 KV industrial loads.

After completion of construction, PLN would require an accounting method for transformers by type and location. A Transformer Record Card was designed for this purpose with the recommendation that the transformer number relate to the pole number and transformer size. At a later date this information could be used as part of a computer program for load study and for a print-out which would indicate transformer or feeder overlap. This information would also serve for future planning of new lines and substations.

Construction Estimating

All information referring to construction units was included in sepia Design Maps thus eliminating the need for a Structure Data Sheet.

In order to account for the quantities of construction units and material, a series of construction estimating forms were designed.

Distribution Conversion Plan

In order to make an orderly conversion from the 127/220 volt system to a 220/380 volt system, a Distribution Conversion Plan for the Cirebon Area was designed. Some areas would receive new 20 KV distribution lines and other areas would use existing 30 KV lines converted to 20 KV. During the conversion, provision was made to use temporary conversion transformers on the 30 KV line to keep the existing service operating and provide a 20 KV supply source for the new system.

A written plan was submitted to PLN during the design period to show the sequence of work and the responsibility of both PLN and the contractor during conversion.

Conclusions

The Cirebon Distribution System was designed to provide a safe electric distribution system to serve the maximum number of consumers possible, using economical construction methods to meet financial limits.

Although most of the material was to be of a standard manufacture, it was intended to make use of local poles treated in Indonesia. It was also the intent to make maximum use of the Indonesian labor force.

The system was designed to operate with a minimum of voltage drop and with a minimum of power outages. The latter would be accomplished by the use of a loop feeder system whenever possible. The loop feeder system can be easily adapted to any type distribution system PLN may wish to construct in the future.

A cursory inspection of current field conditions indicates that few of the stakes remain. There have been a large number of changes in right-of-way : the addition of sidewalks, new buildings as well as new load centers in developing cities and villages. All maps concerned with these changes will have to be revised before any construction begins. With these changes, the design as prepared and submitted by MAIN could be used to provide a well designed, reliable, economical electric distribution system for the Cirebon Distribution Area in a minimum amount of time and at a reasonable cost.

SECTION VIII

TRANSMISSION

Description

The Transmission portion of the West Java Projects consisted of a 150 KV double circuit line extending from the existing Tegal Substation via Cirebon, Bandung and Bogor to the existing Gandul Substation south of Jakarta. Completion of this line provided 150 KV connection from Semarang in Central Java to the loop around Jakarta. Under a previous Contract, MAIN designed the 150 KV double circuit line from Semarang to Tegal, Central Java.

Summarized data are as follows :

	Section	Km.	Towers	Type of Conductor	Foundations
West Java I					
I.	Tegal to Cirebon	69.5	167	556.5 DOVE	668
II.	Cirebon to Ujungberung (Bandung)	96.9	242	556.5 DOVE	968
III.	Ujungberung to Bandung North	20.8	51	556.5 DOVE	204
West Java II					
I.	Ujungberung to Cigereleng (Bandung)	14.5	39	556.5 DOVE Bundled	156
II.	Cigereleng to Bogor	113.0	269	556.5 DOVE	1,076
III.	Bogor to Cibinong	22.0	60	556.5 DOVE	240
IV.	Cibinong to Gandul (Jakarta)	20.8	58	795 DRAKE Bundled	232
	Totals	357.5	886		3,544

PLN and various Contractor forces installed over 3,000 Kilometers of conductor and shieldwire to complete the 357.5 line Kilometer from Tegal to Jakarta.

General

System studies and conductor evaluation were completed by MAIN as the Engineering Consultant for PLN. These results were published in MAIN's "West Java Power System Feasibility Report on Transmission Lines" dated January 1973. Additional basic design and preparation of specifications and drawings were done by MAIN's Home Office and Field Staff. Design parameters such as clearances, loading conditions, etc. were stated in the detailed Design Reports published for both phases of the Projects. Design of the West Java II phase utilized the same basic criteria as West Java I, except that two (2) sections of the line have bundled conductor to allow transfer of more power in areas of high electrical load.

Towers

A study was conducted by MAIN to determine whether existing tower designs from the Ketenger project in Central Java could be used for support of the West Java I transmission line. Reuse of existing designs reduced cost by avoiding tower testing and extensive design and detailing costs. As indicated under "Conductors" in this report, the decision had been made to use a larger conductor than had been used for the Ketenger lines, previously designed by MAIN.

During examination of the tower loadings for the West Java I Project, it was found that the larger conductor - 556.5 kcmil "DOVE" ACSR could be supported on essentially the same line towers as were used in the Ketenger line to support 477 kcmil "HAWK" ACSR. One reason for this was the requirement that all tower members in the Ketenger project conform to a maximum slenderness ratio. Also, the shield wires are the same for both Projects. Some changes were required to be made in the heavier suspension and strain towers, and a new terminal tower design was provided. Initial requirements for the Project included an effort to provide interchangeability

of parts with the towers of the Ketenger project previously constructed in Central Java. This was achieved as far as possible. The towers are basically the same as for Ketenger. However, some changes in tower members resulted from the increased loads imposed by the larger "DOVE" conductors.

Also some changes in detailing resulted from the decision to use metric dimensions from a supplier not located in the USA. Selection of a supplier from another country was made primarily for economic reasons. It later developed that there were a number of problems resulting from this choice. Included in these were late delivery, unbalanced delivery, fabricating from random lengths of steel, substitutions because of unavailability of sizes, increased coordination requirement for stub angles furnished from Indonesia, and general problems in securing and review of designs and drawings. The difficulty in communication with the suppliers tended to magnify problems and increase the time required by the Engineer for coordination. As the work progressed, numerous requests for substitution of steel members were received.

Since the transmission line in West Java II was a continuation of similar construction to West Java I, the same tower designs were utilized except where the phase conductors were bundled. In the two (2) line sections where PLN required the use of heavier conductors, a new series of towers was designed. Through proper selection of spans, the same towers were used for bundled "DRAKE" conductors as for bundled "DOVE". Full scale tower tests were required for the new designs. It was decided to test the Light Suspension tower and the Light Strain tower. Since test facilities in Italy were used, the prototype towers were fabricated in Italy from Italian steel. It was necessary for the Engineer to ascertain the compatibility of steel in the test towers with that of production counterparts furnished from India. Also the difficulties in coordinating operations at several geographic locations became quickly apparent. As in the West Java I Project, there were increased problems with late deliveries, securing and review of designs and drawings, and overall Project coordination. Award of Contract to the low bidder resulted in additional costs which were difficult to evaluate. Reuse of shop drawings may not be desirable on future work because of added cost of construction.

Foundations

As a result of a complete soils investigation program by ITB, Institute of Technology, Bandung, the foundation conditions were found to be generally good expect for high ground water table in some areas. The drilled pier type of foundation is generally preferred for the type and magnitude of loads applied. However, in Indonesia the necessary equipment was not readily available, access for equipment was restricted, and along much of the route the high ground water table reduced the stability of excavations. The pad and pedestal type of foundation design was also provided along with a design for steel pile foundation. Criteria were furnished to be used by the field engineer in application of the foundation types and sizes to soil conditions found at the tower sites. During the progress of the work, the Engineer assigned to construction management evaluated the soil conditions at each site and selected the type of foundation to be used. Piles were not needed.

One tower in the West Java I area was in danger of being undermined when the river changed course. A large cylindrical caisson type foundation, which surrounded the entire tower and included all leg foundations, was designed to provide protection from the river flow.

Prior to the commencement of stringing operations but after installation of foundations and towers, it was discovered that two (2) tower sites were in unstable areas. A decision was made to complete the stringing and monitor any tower movement while the circuits were energized. Substantial movement was detected and it was decided to move the two (2) towers. The new tower locations appear stable but monitoring will continue.

During the construction period, MAIN was advised that cylindrical steel reusable forms were no longer available. Therefore, the contractors were allowed to substitute prismatic pedestals to support the legs of the towers. The pedestals were redesigned to allow use of wood forms on plane surfaces.

When it was found during the course of construction that some concrete test results indicated unacceptable concrete strength, PLN requested that MAIN send a foundations specialist to Indonesia. As a result of this investigation, some pedestals were redesigned on the basis of lower concrete strength, and foundations were reconstructed according to repair procedures developed.

Grounding

Ground rods were installed and connected to the towers to reduce footing resistance. With shield wires disconnected, ground resistance measurements were then taken. If the resistance exceeded 10 ohms, counterpoise was added. Ideally, the counterpoise would have progressed radially from each tower leg to form a reflective plane. This would have been more effective in reducing the magnitude of tower potential. However, right-of-way restrictions confined the counterpoise location to simple connections between tower legs and a single wire placed along the centerline of the right-of-way to a location where grounding by ground rod would be effective.

Conductors

Although the West Java I line was similar to the adjoining Ketenger line, it provided a connection between the systems of two (2) districts of PLN. The heavier "DOVE" 556.6 kcmil ACSR conductor was selected. The special Alumoweld core wire was used to provide longer service life in the humid climate and possible salt corrosion exposure near the coast. Strength of conductor was not as critical as in some other localities. Generally, the National Electric Safety Code loading for Light District was the governing load condition. MAIN supplemented the NESC loading with other loads deemed to be applicable, particularly with regard to unbalanced longitudinal loading from one or more conductors or shield wires.

As a continuation of the West Java I line with the same general criteria, the "DOVE" 556.5 kcmil ACSR conductor was selected for the West Java II line. However, PLN elected to provide more power transfer capacity in two line sections where future demand is expected to be unusually high. For the Ujungberung to Cigereleng section, each phase consists of two "DOVE" 556.5 kcmil ACSR conductors in a vertical bundle. For the Cibinong to Gandul section, each phase consists of two "DRAKE" 795 kcmil ACSR conductors in a vertical bundle.

The vertical configuration was preferred because spacers and spacer-dampers are not needed. Not only is the cost of such equipment avoided, but the vortex shedding from the windward conductor in a horizontal configuration, which contributes to subconductor oscillation, is not a factor where the vertical bundle is used.

Special alumoweld core wire was specified to provide long service life in the humid climate and possible salt corrosion exposure near the coast. Some conductor reels were inadvertently lost as a result of a marine accident. An intensive investigation was undertaken by the Contractor to determine the extent of damage to the conductor. MAIN recommended acceptance with credit for damage. PLN decided to refuse permission to use the conductor. In order to expedite the completion of the work PLN authorized substitution of a conductor with grease filled core wire. This conductor is generally located in the Puncak Pass to Bogor section on the line, an area which should have less critical exposure to corrosion than some other portions of the line.

Insulation

In view of the very high isokeraunic level, the desirability of using unbalanced insulation, whereby the circuit on one side of the towers would have a higher level of insulation than the other side, was investigated. Continuation of the basic tower designs from Central Java precluded achievement of the theoretically correct 2.8 unit difference between number of units in strings of different circuits.

However, practically, the addition of two (2) units does offer adequate imbalance. The insulator string with the least number of units is located on the south/southwest side of the suspension type towers. Since this side faces the approaching storms more frequently, the lightning outages should usually occur on that circuit, thereby assuring more reliable and continuous service from the northerly circuit. From Tegal to a predetermined location west of Cirebon, "fog" type insulators were used on suspension structures. Due to the proximity to the seashore, this portion of line was assumed to be more vulnerable to salt contamination. It is not assumed that selection of these insulators will prevent outages or remove the need of insulator washing. However, due to the longer leakage distance, it should be possible to use greater time intervals between washing operations.

PLN expressed a preference for glass insulators and the tender documents were prepared accordingly. Although glass was offered as the primary bid with porcelain as an alternate, the progress of the project lagged to such an extent that the selected glass insulator supplier was not able to meet the revised delivery dates. MAIN did not consider either superior to the other from a performance standpoint and a porcelain insulator supplier was selected who could meet the required delivery date.

Line Shielding

With no ice to consider, it was possible to construct each circuit in a vertical configuration and locate one circuit on each side of the tower. One shield wire, 7#8 Alumoweld, was provided on each side of the tower. By locating the shield wires directly above the circuits, an optimum shielding angle was obtained. Therefore, lightning flashovers should be limited to the backflash mode, thereby substantially reducing the probability of outages. Alumoweld shield wires were specified to resist corrosion in the humid climate and possible salt corrosion along the coast.

Vibration Control

Since no ice is expected, the probability of conductor galloping is minimal. Furthermore, since there are no horizontal conductor bundles, subconductor oscillation is not a problem. Therefore, aeolian vibration, resulting from relatively low steady wind, was the only conductor or shield wire vibration to be considered in design. Use of moderate conductor tensions and Stockbride type dampers were selected to control this type of vibration.

Route Changes, Project Delay

Several segments of the West Java I line were affected by changes in route after a substantial amount of the work had been done. The Bandung Utara substation area is an example of this. Much delay was experienced before the final location of the substation could be fixed. The transmission line was then routed almost around the substation site and connected to the west side. In many areas the tower locations were changed because of the late negotiations for right-of-way or inability to secure right-of-way.

After the West Java II line route was selected from Cigereleng to Bogor, it was found to be unacceptable because of its proximity to a resort area. A reroute was necessary. Also, in the Bogor to Gandul section, much difficulty was encountered in establishing the final layout at the future Cibinong substation. Also, from Cibinong to Gandul, a lengthy delay resulted from the conflict with a proposed gas line and resulting reroutes. A substantial amount of extra time was required on both West Java I and II for MAIN to rework areas where the line had already been spotted.

SECTION IX

SUBSTATIONS

Description

The substation additions consist of the following :

1. Tegal Substation

   Terminal facilities for two lines of the 150 KV Tegal - Sunyaragi double circuit transmission line.

2. Bandung Utara Substation

   Complete substation including control house and other equipment for four 150 KV transmission line terminals, two 30 MVA - 150/20 KV transformers and metal clad switchgear for eight 20 KV feeder circuits.

3. Bogor Substation

   Complete substation including control house and other equipment for four 150 KV transmission line terminals, four 70 KV transmission line terminals, two 60 MVA - 150/70 KV transformers, two 30 MVA - 150/20 KV transformers and metal clad switchgear for eight 20 KV feeder circuits.

4. Ujungberung Substation

   Complete substation including control house and other equipment for six 150 KV transmission line terminals, four 70 KV transmission line terminals, one 60 MVA - 150/70 KV transformer, two 30 MVA - 150/20 KV transformers and metal clad switchgear for eight 20 KV feeder circuits.

Line terminals for the 150 KV transmission line were installed at Sunyaragi, Cigereleng and Gandul Substations as part of another Project.

Design Objectives

The arrangement of equipment and buses is in accordance with modern concepts affording maximum safety and ease of maintenance and operation.

The basic arrangement is "low profile" to minimize visual impact and make the substations as aesthetically pleasing as possible.

Maximum use was made of interchangeable equipment and components to simplify maintenance and minimize spare parts inventory.

At the new substations, the design is in accordance with PLN plans for the area. In addition to facilities included in the initial project, the design provides for future addition of six 150 KV circuits, one 150/20 KV transformer bank and associated equipment at Bogor, four 150 KV circuits, one 150/20 KV transformer bank and associated equipment at Bandung Utara and four 150 KV circuits, two 70 KV circuits, one 150/70 KV transformer bank, one 150/20 KV transformer bank and associated equipment at Ujungberung.

Substations are designed utilizing two winding 150/70 KV transformers at points where the 70 KV subtransmission enters the proposed West Java system and three winding 150/20/6 KV transformers with the 6 KV winding for station service power, suppression of the third harmonic currents and to provide a ground fault current source.

All 150 KV transformer neutrals will be effectively grounded. This will provide sources of zero sequence current for efficient ground fault relaying of the 150 KV transmission lines and stabilize the system neutral.

A grounding transformer and appropriate resister are installed to provide impedance grounding of the 70 KV transmission system at Bogor and Ujungberung.

The 20 KV distribution system neutral is resistance grounded.

A main and auxiliary duplicate bus layout in the 150 KV and 70 KV switchyards provide easy circuit switching for all operating and maintenance requirements. A bus tie circuit breaker is provided to permit transfer of load from one bus to another without interrupting service.

Indoor 20 KV metal clad switchgear is designed to permit required switching operations without interrupting of service to the distribution system.

Local seismic conditions were considered in the design of major substation equipment, structures and foundations.

Operating Conditions

Substation equipment was selected to provide safe and reliable operation during abnormal transmission system voltage up to 165 KV or 10% above the nominal voltage of 150 KV.

The substations are shielded by overhead ground wires and lightning masts. This greatly reduces the probability of direct lightning strokes to the substation equipment. Voltage surges due to lightning will originate on the transmission lines. Lightning arresters on each line will reduce surges entering the substations.

Basic Voltage Rating

Three definitions of system power-frequency voltage were used in determining insulation values and the selection of equipment.

1. Nominal system voltage
2. Maximum continuous voltage 10% above nominal
3. Maximum phase-to-ground voltage during fault conditions

Lightning Arresters

All lightning arresters are Station Class to obtain maximum protection for substation equipment.

Determination of voltage ratings of the lightning arresters was based on the following criteria :

1. The arresters rating must equal or exceed the maximum phase-to-ground fault voltage.
2. The arresters rating must be at least 25% higher than the maximum continuous phase-to-ground voltage.

It was determined that the lightning arrester characteristics provide good surge protection for transformer insulation.

Insulation

All external porcelain insulation (bus supports, disconnect switches, bushings, etc.) have the full Basic Impulse Level (BIL) rating applicable for the nominal voltage class.

The power transformer insulation BIL is 150 KV for the 20 KV windings and 350 KV for the 70 KV windings.

Insulation of the 150 KV windings is 550 KV BIL. This is two steps below nominal full BIL of 750 KV. The selection of 550 KV BIL is in accordance with modern good engineering practice and is considerably less costly than full insulation.

Post insulators were used for both bus supports and disconnect switches. These insulators are interchangeable for each voltage class, thus reducing spare parts inventory.

Insulation Coordination

The proper relationship between lightning arrester characteristics and transformer insulation characteristics was established on the basis of the following :

(a) The protective ratio, defined as the ratio of the insulation withstand characteristics of the protected equipment to the arresters protective level, and

(b) The protective margin, defined by the following equation :

$$PM = (PR - 1) \times 100, \text{ expressed as a percent}$$

Clearances

The minimum phase-to-ground clearance was established at the height of the post type insulators for each voltage class.

The phase-to-phase centerline spacing for bus conductors has been established on the basis of accepted industry practice.

The minimum phase-to-phase clearances, and minimum clearances between conductors and grade, are based on Table I of 1954 A.I.E.E. Committee Report " A Guide for Minimum Electrical Clearances for Standard Basic Insulations Levels".

Transformers

The 150/70 KV transformers are triple-rated, Self Cooled/Forced Air/ Forced Oil-Air. The MVA ratings for the 150 KV and 70 KV windings are 36/48/60 MVA continuous load at 55° C temperature rise and 40.32/63.76/67.20 MVA continuous load at 65° C temperature rise.

The 150/20/6 KV transformers are rated 18/24/30 MVA for the 150 and 20 KV windings while the 6 KV winding is rated 6/8/10 MVA, all at 55° C temperature rise. These windings also have 65° C insulation which permits continuous loads of 12% above the 55° C rating. The 30 MVA maximum corresponds to PLN planning for this type substation.

Based on conditions of a 40° C ambient temperature and prior equivalent load of 70% of rating, these transformers would be able to carry an emergency overload for one hour of 1.20 times the normal maximum rating without loss of life expectancy.

The transformer low voltage windings (70 KV and 20 KV) are equipped with a load tap changing mechanism capable of a plus and minus 10% change of voltage. Thus the desired voltage may be maintained on the low voltage winding independent of uncontrolled transmission system voltage fluctuations.

The transformers are also equipped with 5% plus and minus no-load taps on the high voltage winding. This feature permits selection of an optimum transformer high voltage winding tap based on transmission system operating voltage level.

Circuit Breakers

The outdoor circuit breakers are conventional bulk oil type. This type of circuit breaker has proven to be extremely reliable in service at voltages through 230 KV.

The interrupting ratings of the circuit breakers are as follows :

SYSTEM KV Nominal	INTERRUPTING Rating-MVA
150	5000
70	2500

The circuit breakers are equipped with standard multi-ratio, bushing type current transformers.

Indoor Switchgear

The indoor 20 KV switchgear consists of two lineups of 12 metalclad cubicles. Each lineup consists of two bus sections each with four feeder breakers and source breaker which connects each bus to a power transformer in the substation switchyard. The buses in one lineup are identified as No. 1 and No. 2. Buses in the other lineup are identified as No. 1A and No. 2A. In addition to breakers described above, a bus tie breaker located in the bus 1A lineup can connect buses 1A and 2. A bus tie breaker located in the bus 2A lineup can connect bus 2A to bus 1.

This conventional double bus arrangement permits load transfer from one bus to another without interruption. Operation and maintenance of the switchgear is thus extremely convenient while also providing a high degree of service reliability.

Vacuum type interrupters are used in the circuit breakers. Experience has proven these interrupters to be very reliable with low maintenance requirements.

Ratings

Voltage	34.5 KV Rated	- 20 KV Operating
Current	1200 ampere	(source and bus tie breakers)
	600 ampere	(feeder breakers)

Interrupting 1000 MVA.

Protective Relaying

Distance directional comparison carrier (blocking) relaying is used for 150 KV transmission line phase and ground fault protection. The power line carrier trip blocking equipment used transmits an audio tone signal.

Directional overcurrent relays are installed to protect against mis-operation of the primary line relay system. This is a local backup system which will initiate line tripping independent of all equipment at an adjacent substation. The primary and backup relays are coordinated by a timing relay.

Current differential relays are used to provide highly sensitive protection for power transformer internal faults. In addition to current differential relaying the following devices either initiate tripping and alarm or alarm only.

a. Sudden pressure relay - senses sudden pressure changes within the transformer tank - Tripping & alarm.
b. Fan failure - Alarm only.
c. Oil flow failure - Alarm only.
d. High transformer winding or oil temperature - Alarm only.

Bus differential relays are used to provide very high speed clearing of 150 KV and 70 KV bus faults.

Induction disc overcurrent relays provide fault protection for the 20 KV distribution circuit feeders. Automatic circuit reclosing relays will restore service after a momentary interruption for transient faults.

Grounding

Substation grounding is designed to limit step potential and touch potential voltages to safe levels.

Fencing

A chain link fence 165 centimeters high encloses the substation area. The top section consists of arms at a 45° angle from the vertical carrying strands of barbed wire to effectively prevent unauthorized entry into the area.

Equipment Building

A two floor masonry and concrete building is provided to house the primary control and relaying equipment, station battery, 20 KV switchgear and communications equipment. Offices and other facilities make the building suitable for full time manned operation.

Driveways

A loop driveway system with two main roadways running through the 150 KV switchyard area is provided. These main roadways are located so that all major equipment, such as 150 KV and 70 KV circuit breakers and the 150 KV transformers will be directly adjacent for ease of maintenance, removal and installation.

SECTION X

SYSTEM COMMUNICATIONS

Description

System communications are provided by a reliable and secure power line carrier network. This network has channels for voice, relaying, teletype, telemetering and data acquisition.

Design Objectives

The design provides a modern, all solid-state single-sideband power line carrier system as the heart of the communications system. A carrier link over each 150 KV circuit ensures reliability.

To establish a communications system adequate for the initial phase of the power system, the following facilities are installed.

1. A voice circuit to interconnect with PLN's dial telephone system.
2. Channel equipment for protective relaying.
3. Channel equipment for a point to point teletype system.

To provide the capability for expansion as required, the following functions were considered :

1. Dispatcher's unswitched telephone system.
2. Data channels for supervisory control and telemetry.
3. Remote control of PLN radio transmitters.

Power Line Carrier Equipment (PLC)

Various communications channel requirements are provided by power line carrier systems. These systems operate on a phase-to-ground basis. One PLC system is provided for each circuit of the double circuit transmission system and operates on a duplex basis (different carrier frequency for each of two parallel transmission circuits).

PLC radio frequencies assigned to each transmission circuit are coordinated to adjacent line sections.

The power line carrier terminal equipment is modern, all solid-state plug-in module construction and will utilize the single side band method of transmission. Power output is 20 watts. An outdoor broad-band line tuning unit is provided for each PLC terminal.

The line traps and coupling capacitor devices have voltage and current rating suitable for the transmission system. The coupling capacitor devices are combined with potential devices as appropriate where measurement of line potential is required.

Voice Channel Equipment

Each power line carrier terminal is capable of multiplexing to provide four independent voice channels. Each terminal is wired for four voice channels, but voice channel equipment is installed only for the initial communications system requirements.

Each voice channel is capable of being multiplexed with audio tone channels suitable for such uses as the following :

Protective relaying control
Telemetry
Supervisory control
Teletype
Economic dispatch of generation
Remote alarming

The voice channels are capable of operating completely dedicated to multiplexed tones or a combination of one or more tones combined with a restricted quality voice circuit.

Relay Channel Equipment

One voice channel for each PLC system carries audio tones to control the transmission line protective relaying. All related equipment for this function was installed.

Teletype Channel Equipment

Tone equipment to provide channels for the operating of a selectable point-to-point teletype system was installed. The tone channel arrangement is coordinated with the teletype system on the adjacent Ketenger Transmission System.

Telephone System

A full duplex voice channel is provided for PLN's telephone system. This voice channel is used to interconnect telephone switching facilities (PAX or others) at the Cirebon PLTG complex and other locations.

SECTION XI

RADIO COMMUNICATIONS

A Mobile Radio System was installed to achieve complete coverage of the transmission lines and roads within a 50 Km distance from each base and repeater station and to provide effective coverage within a 25 Km radius surounding each fixed station. Base, fixed and repeater stations were so located to achieve 100% coverage of the Java I and II transmission systems.

The Mobile Radio System was designed to ensure uninterrupted reliable operation and arranged to provide communications for :

Base or Fixed-to-Mobile or Portable direct or through repeater.
Mobile or Portable-to- Base or Fixed direct or through repeater.
Mobile-Mobile direct or through repeater.
Mobile-to-Portable or Portable-to-Mobile direct.

The Mobile Radio System is designed to accomodate future additional base, repeater or fixed stations, locally controlled or remotely controlled from existing or future remote control consoles.

A survey indicated that a 40 meter tower located at each base and repeater station location would be adequate to fully cover the specified area. Later Contractor visits to each site verified these conclusions.

Each base, repeater and fixed station location has a 12-volt d-c power system for the Mobile Radio Equipment. Each station power system consists of a 12-volt battery and two (2) battery chargers.

Fach base station is completely controlled from a remote control console by means of audio tones. Each repeater station is completely controlled from a base or fixed station or from a mobile radio also by means of audio tones. Each fixed station has provisions for control from a remote location on the same property.

The Mobile Radio System consists of the following units :

Base Stations	4	each
Repeater Stations	2	each
Fixed Stations	8	each
Mobile radios	40	each
Portable radios	30	each

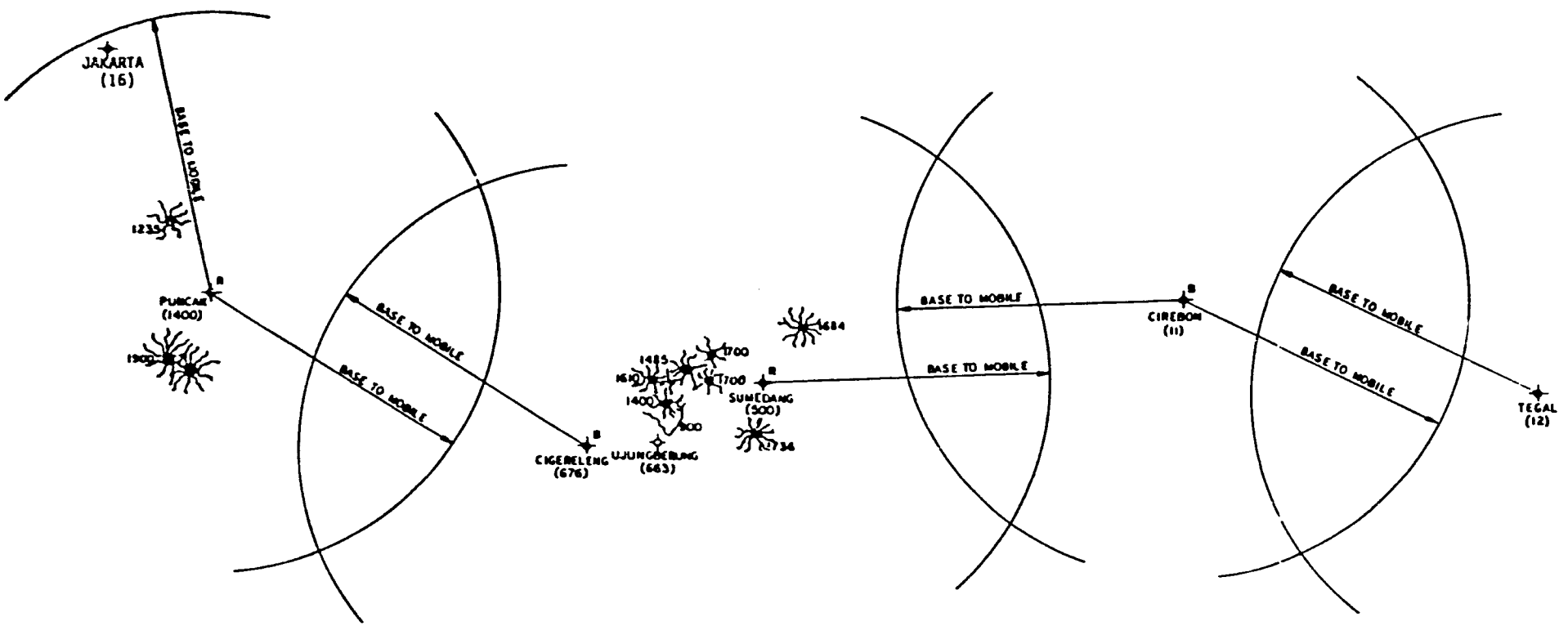
Drawing 2861-14-R1 in this Section shows the coverage afforded by the system.

The stations are located as follows :

Repeater Stations	:	Puncak
		Sumedang
Base Stations	:	Jakarta (PLN Cawang Offices)
		Cirebon (PLN Sunyaragi Substation)
		Bandung (PLN Ciliwung Offices)
		Bandung (C.T. Main Offices)
Fixed Stations	:	Jakarta (C.T. Main Offices)
		Bandung (C.T. Main Offices)
		Bogor Substation
		Ujungberung Substation
		Bandung Utara Substation
		Cigereleng Substation
		Bandung (PLN Ciliwung)
		Location X

NOTES

1. NUMERALS IN ( ) INDICATE ELEVATION IN METERS.
2. B INDICATES BASE STATION.
3. R INDICATES REPEATER STATION.



2-14-77	2P-2861-14-A
DATE	DRAWN FOR
DRAWN	CHECKED
APPROVED	
DATE MADE	2-10-77

MOBILE RADIO SYSTEM LAYOUT

SYSTEM NEGARA

PERUSAHAAN UMUM LISTRIK NEGARA
WEST JAVA I AND II PROJECTS

MAIN
CHAS T MAIN INTERNATIONAL, INC

SCALE
CLIENT JOB DWG NO.
2861 - 14 - R1

7/2

SECTION XII

MATERIAL SHIPMENTS

Successful implementation of the material and equipment requirements of the West Java Projects involved 184 shipments totalling almost US $ 28,600,000.00 in expenditures of USAID Loan Funds. In accordance with AID Guidelines, almost 58% of all shipments were made on American Flag Carriers, a significant accomplishment in that all of the Transmission Tower Steel was imported from and transported on vessels from countries other than the United States.

Shipments are summarized as follows :

Project	Number of Shipments	Total Long Tons	Long Tons Shipped on US Vessels	% Approx.	CIF Cargo Value
West Java I	82	6,225.45	3,460.31	56	$ 13,266,932.06
West Java II	102	7,278.33	4,355.86	60	15,329,549.15
Total	184	13,503.78	7,816.17	58	$ 28,596,481.21

Details by Project, Supplier Contracts and individual shipment data are shown on the following pages.

West Java I and II Projects

Material Shipments

Contract Number	Supplier	Number of Shipments	Total Long Tons	U.S. Vessels	Percent	Total Freight	Paid with Loan Funds	CIF Cargo Value
West Java I								
153	Irby	14	3163.42	403.42	12.75	$ 210,493.53	$ 210,493.53	$ 2,902,946.03
202	Copperweld	2	173.89	173.89	100.00	35,288.55	35,288.55	294,732.90
203	Southwire	5	1383.59	1383.59	100.00	206,252.57	206,252.57	1,991,843.83
050	T S E	4	67.17	67.17	100.00	19,795.50	19,795.50	400,636.37
051	Ohio Brass	1	12.96	12.96	100.00	7,331.30	7,331.30	87,852.00
052	Irby	37	1011.09	1011.03	99.99	436,973.41	436,973.41	4,688,295.79
053	G / E	15	407.75	407.75	100.00	202,779.78	202,779.78	2,531,438.59
087	Motorola	4	5.58	0.50	8.96	20,698.73	20,698.73	369,186.55
Total		82	6225.45	3460.31	55.58	$ 1,139,613.37	$1,139,613.37	$13,266,932.06
West Java II								
152	Irby	30	5178.37	2257.23	43.59	$ 531,366.89	$ 531,366.89	$ 6,464,577.34
051	Ohio Brass	1	12.96	12.96	100.00	7,331.30	7,331.30	87,852.00
052	Irby	30	1239.20	1237.91	99.90	394,400.64	394,400.64	4,838,962.80
053	G / E	41	847.80	847.76	100.00	446,073.96	446,073.96	3,938,157.01
Total		102	7278.33	4355.86	59.83	$1,379,172.79	$1,379,172.79	$15,329,549.15
Combined		184	13503.78	7816.17	57.88	$2,518,786.16	$2,518,786.16	$28,596,481.21

BORROWERS SHIPPING STATEMENT DETAILS

CONTRACT NUMBER Pj. 153/PST/77	SUPPLIER Irby Construction Company	USAID LOAN NUMBER 497-H-028

VESSELS	PORTS	BILL OF LADING	TOTAL	U.S. VESSELS		FREIGHT COSTS U.S. DOLLAR EQUIVALENT		SUPPLIER INVOICE REFERENCE		
NAME REGISTRY	EXIT ENTRY	NUMBER DATE CARGO DESCRIPTION	LONG TONS	LONG TONS	PERCENT OF TOTAL	TOTAL	PAID WITH LOAN FUNDS	NUMBER	DATE	CARGO VALUE
Green Valley USA	New Orleans Cirebon	# 2 28 Jun. 78 Pole Line Hardware	28.91	28.91	100	7,161.65	7,161.65	T-1	10 Jul.78	40,804.70
Mallory Lykes USA	New Orleans Cirebon	# 12 12 Jul. 78 Insulators	173.97	173.97	100	39,381.57	39,381.57	T-2	17 Jul.78	242,359.05
Green Valley USA	New Orleans Cirebon	# 6 21 Aug. 78 Pole Line Hardware	50.31	50.31	100	10,318.22	10,318.22	T-3	25 Aug.78	260,359.99
Cherry Chantek Singapore	Bombay Cirebon	# S-559 24 Aug. 78 Tower Steel	751.82	-	-	33,610.85	33,610.85	T-4	3 Sep.78	537,949.20
By PLN Truck	Semarang Cirebon	- - Tower Steel	104.79	104.79	100	18,673.45	18,673.45	T-5	10 Nov.78	89,966.51
Ruth Lykes USA	New Orleans Cirebon	# 51 30 Nov. 78 Pole Line Hardware	2.80	2.80	100	873.50	873.50	T-6	5 Dec.78	20,681.59
Balatang Singapore	Bombay Cirebon	# S-TP-15 17 Dec. 78 Tower Steel	433.35	-	-	19,373.38	19,373.38	T-7	18 Dec.78	306,102.48
Asean Leader Singapore	Bombay Cirebon	#C-1 & C-3 8 Jan. 79 Tower Steel	1,060.71	-	-	47,419.98	47,419.98	T-8	22 Jan.79	795,583.30
Letitia Lykes USA	New Orleans Cirebon	# 33 17 Jan. 79 Pole Line Hardware	31.07	31.07	100	7,482.11	7,482.11	T-9	22 Jan.79	45,143.57
Asean Challenger Singapore	Bombay Cirebon	# C-1 26 Feb. 79 Tower Steel	Included Above			No Charge		T-10	16 Mar.79	No Charge
Asean Endeavour Singapore	Bombay Cirebon	#C-1 & C-2 7 Mar. 79 Tower Steel	176.34	-	-	7,883.53	7,883.53	T-11	16 Mar.79	151,424.26
Ruth Lykes USA	New Orleans Cirebon	# 23 24 Apr. 79 Pole Line Hardware	4.47	4.47	100	805.25	805.25	T-12	26 Apr.79	8,925.15
Asean Challenger Singapore	Bombay Cirebon	# STP-8 25 May 79 Tower Steel	337.78	-	-	16,130.54	16,130.54	T-13	19 Jun.79	232,768.45
Letitia Lykes USA	New Orleans Cirebon	# 21 9 Sep. 79 Pole Line Hardware	7.10	7.10	100	1,379.50	1,379.50	T-14	17 Sep.79	1,950.00
		Contract Amendment No. 3-Increased prices and extra tower weight						T-17	24 Jan.81	168,927.78
		Totals	3,163.42	403.42	12.75	210,493.53	210,493.53			2,902,946.03

BORROWERS SHIPPING STATEMENT DETAILS

CONTRACT NUMBER PJ. 202/PST/77			SUPPLIER Copperweld					USAID LOAN NUMBER 497-H-028		
VESSELS	PORTS	BILL OF LADING	TOTAL	U.S. VESSELS		FREIGHT COSTS U.S. DOLLAR EQUIVALENT		SUPPLIER INVOICE REFERENCE		
NAME REGISTRY	EXIT ENTRY	NUMBER DATE CARGO DESCRIPTION	LONG TONS	LONG TONS	PERCENT OF TOTAL	TOTAL	PAID WITH LOAN FUNDS	NUMBER	DATE	CARGO VALUE
Liberty Voyage USA	Baltimore Cirebon	# 7201 2 Jun. 78 Shieldwire	166.39	166.39	100	33,760.33	33,760.33	0336	22 May 78	281,969.08
Letitia Lykes USA	New Orleans Cirebon	# 14 9 Sep. 79 Shieldwire	7.50	7.50	100	1,528.22	1,528.22	1707	27 Aug 79	12,763.82
			173.89	173.89	100	35,288.55	35,288.55			294,732.90

BORROWERS SHIPPING STATEMENT DETAILS

CONTRACT NUMBER			SUPPLIER Southwire				USAID LOAN NUMBER 497-H-028				
VESSELS	PORTS	BILL OF LADING	TOTAL	U.S. VESSELS		FREIGHT COSTS U.S. DOLLAR EQUIVALENT			SUPPLIER INVOICE REFERENCE		
NAME REGISTRY	EXIT ENTRY	NUMBER DATE CARGO DESCRIPTION	LONG TONS	LONG TONS	PERCENT OF TOTAL	TOTAL	PAID WITH LOAN FUNDS		NUMBER	DATE	CARGO VALUE
Green Harbour USA	Mobile Cirebon	# 1 10 Dec. 78 Conductor	352.04	352.04	100	48,711.30	48,711.30		273	14 Dec.78	505,783.47
Green Harbour USA	Mobile Cirebon	# 1 2 Apr. 79 Conductor	697.82	697.82	100	103,165.26	103,165.26		317	9 Apr.79	1,004,738.02
Atlantic Forest USA	New Orleans Cirebon	# 1 18 May 79 Conductor	274.89	274.89	100	42,672.31	42,672.31		388	22 May 79	393,616.32
Zoella Lykes USA	New Orleans Jakarta	# 10 23 Feb. 80 Conductor	53.32	53.32	100	10,302.23	10,302.23		399	27 Feb.80	76,481.89
Adabelle Lykes USA	Mobile Jakarta	# 1 8 Sep. 80 Conductor	5.52	5.52	100	1,401.47	1,401.47		481	11 Sep.80	11,224.13
			1,383.59	1,383.59	100	206,252.57	206,252.57				1,991,843.83
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BORROWERS SHIPPING STATEMENT DETAILS

CONTRACT NUMBER Pj. 050/PST/78			SUPPLIER Tension Stringing				USAID LOAN NUMBER 497-H-028			
VESSELS	PORTS	BILL OF LADING	TOTAL	U.S. VESSELS		FREIGHT COSTS U.S. DOLLAR EQUIVALENT		SUPPLIER INVOICE REFERENCE		
NAME REGISTRY	EXIT ENTRY	NUMBER DATE CARGO DESCRIPTION	LONG TONS	LONG TONS	PERCENT OF TOTAL	TOTAL	PAID WITH LOAN FUNDS	NUMBER	DATE	CARGO VALUE
Stella Lykes USA	Houston Jakarta	# 23 20 Mar. 79 Tensioning Equipment	42.66	42.66	100	14,898.48	14,898.48	799	2 Mar.79	317,388.60
Letitia Lykes USA	Houston Jakarta	# 10 17 May 79 Stringing Equipment	18.21	18.21	100	2,997.81	2,997.81	799	30 Apr.79	52,085.38
Louise Lykes USA	New Orleans Jakarta	# 1 20 Sep. 79 Stringing Equipment	5.85	5.85	100	1,899.21	1,899.21	7955	21 Sep.79	27,123.19
Albert Maersk USA	Houston Cirebon	# F-12041 17 Mar.80 Spare Parts	0.45	0.45	100	No Charge		8010	11 Mar.80	No Charge
	Adjustment for incorrect invoice							7955	21 Sep.79	4,039.20
			67.17	67.17	100	19,795.50	19,795.50			400,636.37

BORROWERS SHIPPING STATEMENT DETAILS

CONTRACT NUMBER Pj 051/PST/78 | SUPPLIER Ohio Brass | USAID LOAN NUMBER 497-H-028

VESSELS	PORTS	BILL OF LADING	TOTAL	U.S. VESSELS		FREIGHT COSTS U.S. DOLLAR EQUIVALENT		SUPPLIER INVOICE REFERENCE		
NAME REGISTRY	EXIT ENTRY	NUMBER DATE CARGO DESCRIPTION	LONG TONS	LONG TONS	PERCENT OF TOTAL	TOTAL	PAID WITH LOAN FUNDS	NUMBER	DATE	CARGO VALUE
Albert Maersk USA	Newark Jakarta	# F-832 7 Sep. 79 Lightning Arresters	12.96	12.96	100	7,331.30	7,331.30	39051	17 Sep.79	87,852.00
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BORROWERS SHIPPING STATEMENT DETAILS

CONTRACT NUMBER Pj. 052/PST/78 | SUPPLIER Irby Construction Company | USAID LOAN NUMBER 497-H-028

VESSELS NAME REGISTRY	PORTS EXIT ENTRY	BILL OF LADING NUMBER DATE CARGO DESCRIPTION	TOTAL LONG TONS	U.S. VESSELS LONG TONS	U.S. VESSELS PERCENT OF TOTAL	FREIGHT COSTS U.S. DOLLAR EQUIVALENT TOTAL	FREIGHT COSTS U.S. DOLLAR EQUIVALENT PAID WITH LOAN FUNDS	SUPPLIER INVOICE REFERENCE NUMBER	SUPPLIER INVOICE REFERENCE DATE	SUPPLIER INVOICE REFERENCE CARGO VALUE
Green Valley U S A	New Orleans Cirebon	# 5 21 Aug.78 Tools and Equipment	36.71	36.71	100	14,189.50	14,189.50	S/TE-1	25 Aug.78	243,442.97
Ruth Lykes U S A	New Orleans Cirebon	# 60 1 Dec.78 Disconnect Switches	163.60	163.60	100	41,672.08	41,672.08	S/TE-2	4 Dec.78	235,893.69
Ruth Lykes U S A	New Orleans Cirebon	# 61 1 Dec.78 Transformers	107.44	107.44	100	28,776.25	28,776.25	S/TE-3	6 Dec.78	352,164.76
Letitia Lykes U S A	New Orleans Cirebon	# 34 17 Jan.79 Pole Line Hardware	139.67	139.67	100	48,069.67	48,069.67	S/TE-4	18 Jan.79	357,990.24
Letitia Lykes U S A	New Orleans Cirebon	# 38 17 Jan.79 Transformers	142.15	142.15	100	45,225.80	45,225.80	S/TE-5	18 Jan.79	523,308.67
Howell Lykes U S A	New Orleans Jakarta	# 6 13 Mar.79 Trucks	50.50	50.50	100	42,745.38	42,745.38	S/TE-6	13 Mar.79	255,877.68
Howell Lykes U S A	New Orleans Jakarta	# 9 13 Mar.79 Transformers and Hardware	94.03	94.03	100	32,183.10	32,183.10	S/TE-7	14 Mar.79	312,626.74
Howell Lykes U S A	New Orleans Jakarta	# 10 13 Mar.79 Paint	0.46	0.46	100	No Charge		S/TE-8	15 Mar.79	No Charge
Genevieve Lykes U S A	New Orleans Jakarta	# 2 16 Apr.79 Trailer	2.86	2.86	100	4,661.31	4,661.31	S/TE-10	16 Apr.79	48,469.77
Ruth Lykes U S A	New Orleans Cirebon	# 18 24 Apr.79 Steel Structures	74.39	74.39	100	13,836.17	13,836.17	S/TE-11	26 Apr.79	104,366.63
Ruth Lykes U S A	New Orleans Jakarta	# 17 24 Apr.79 Trucks	85.29	85.29	100	77,561.08	77,561.08	S/TE-12	26 Apr.79	538,040.25
Ruth Lykes U S A	New Orleans Cirebon	# 19 24 Apr.79 Spare Parts	4.01	4.01	100	1,627.04	1,627.04	S/TE-13	26 Apr.79	36,854.51
Ruth Lykes U S A	New Orleans Jakarta	# 16 24 Apr.79 Pole Line Hardware	4.82	4.82	100	3,109.32	3,109.32	S/TE-14	26 Apr.79	144,552.00
Howell Lykes U S A	New Orleans Jakarta	# 12 25 Jun.79 Control Cable	2.87	2.87	100	1,154.95	1,154.95	S/TE-15	5 Jul.79	10,822.73
Letitia Lykes U S A	New Orleans Jakarta	# 24 9 Sep.79 Test Equipment	11.44	11.44	100	11,171.93	11,171.93	S/TE-16	17 Sep.79	118,108.97
Letitia Lykes U S A	New Orleans Cirebon	# 19 9 Sep.79 Tools and Equipment	8.71	8.71	100	4,319.92	4,319.92	S/TE-17	17 Sep.79	82,192.68
Letitia Lykes U S A	New Orleans Jakarta	# 22 9 Sep.79 Relay Panels	3.89	3.89	100	2,538.89	2,538.89	S/TE-18	17 Sep.79	197,663.21
Letitia Lykes U S A	New Orleans Jakarta	# 23 9 Sep.79 Paint	0.03	0.03	100	71.94	71.94	S/TE-19	17 Sep.79	97.51
Letitia Lykes U S A	New Orleans Cirebon	# 18 9 Sep.79 Pole Line Hardware	33.88	33.88	100	9,163.88	9,163.88	S/TE-20	17 Sep.79	117,506.36
Letitia Lykes U S A	New Orleans Cirebon	# 20 9 Sep.79 Corrosive Liquid	1.88	1.88	100	No Charge		S/TE-20.5	17 Sep.79	No Charge
Velma Lykes U S A	New Orleans Jakarta	# 29 21 Dec.79 Relay Panels	8.52	8.52	100	5,031.25	5,031.25	S/TE-21	28 Dec.79	137,558.78
Velma Lykes U S A	New Orleans Jakarta	# 27 21 Dec.79 Test Equipment	1.21	1.21	100	867.09	867.09	S/TE-22	28 Dec.79	18,906.53

BORROWERS SHIPPING STATEMENT DETAILS

CONTRACT NUMBER Pj. 052/PST/78 | SUPPLIER Irby Construction Company | USAID LOAN NUMBER 497-H-028

VESSELS NAME REGISTRY	PORTS EXIT ENTRY	BILL OF LADING NUMBER DATE CARGO DESCRIPTION	TOTAL LONG TONS	U.S. VESSELS LONG TONS	U.S. VESSELS PERCENT OF TOTAL	FREIGHT COSTS U.S. DOLLAR EQUIVALENT TOTAL	FREIGHT COSTS U.S. DOLLAR EQUIVALENT PAID WITH LOAN FUNDS	SUPPLIER INVOICE REFERENCE NUMBER	SUPPLIER INVOICE REFERENCE DATE	SUPPLIER INVOICE REFERENCE CARGO VALUE
Genevieve Lykes U S A	New Orleans Jakarta	# 4 24 Jan.80 Control Cable	2.64	2.64	100	1,396.62	1,396.62	S/TE-23	28 Jan.80	5,481.40
Zoella Lykes U S A	New Orleans Jakarta	# 22 23 Feb.80 Relay Panels	5.55	5.55	100	4,898.37	4,898.37	S/TE-24	26 Feb.80	107,946.22
Zoella Lykes U S A	New Orleans. Jakarta	# 23 23 Feb.80 Tools	1.25	1.25	100	1,153.72	1,153.72	S/TE-25	26 Feb.80	8,893.56
Zoella Lykes U S A	New Orleans Jakarta	# 21 23 Feb.80 Paint	0.08	0.08	100	No Charge		S/TE-25.5	26 Feb.80	No Charge
Velma Lykes U S A	New Orleans Jakarta	# 27 3 Apr.80 Control Panels	0.36	0.36	100	380.56	380.56	S/TE-26	4 Apr.80	7,927.13
Velma Lykes U S A	New Orleans Jakarta	# 26 3 Apr.80 Tools	1.01	1.01	100	699.99	699.99	S/TE-27	4 Apr.80	7,551.19
KLM Airlines Netherlands	New Orleans Jakarta	# 074 2085-5354 30 Apr.80 Instr.Books	0.06	-	-	-	-	S/TE-27.1	30 Apr 80	238.20
Louise Lykes U S A	New Orleans Jakarta	# 12 12 May 80 Test Equipment	0.24	0.24	100	289.87	289.87	S/TE-30	14 May 80	1,629.59
Louise Lykes U S A	New Orleans Jakarta	# 13 12 May 80 Tools	0.55	0.55	100	208.62	208.62	S/TE-31	14 May 80	6,142.40
			Reported	Prior		22,063.00	22,063.00	S/TE-32	16 May 80	54,063.00
Joseph Lykes U S A	New Orleans Jakarta	# 3A 3 Aug.80 Relay Panels	16.20	16.20	100	13,348.17	13,348.17	S/TE-33	5 Aug.80	605,587.01
Joseph Lykes U S A	New Orleans Jakarta	# 4 3 Aug.80 Pole Line Hardware	-	-	-	No Charge		S/TE-33A	5 Aug.80	No Charge
Joseph Lykes U S A	New Orleans Jakarta	# 4 23 Jul.80 Paint	0.43	0.43	100	No Charge		S/TE-33.5	5 Aug.80	No Charge
Joseph Lykes U S A	New Orleans Jakarta	# 5 3 Aug.80 Test Equipment	0.08	0.08	100	107.35	107.35	S/TE-34	5 Aug.80	5,471.41
Ruth Lykes U S A	New Orleans Jakarta	# 5 27 Aug.80 Relay Panels	4.28	4.28	100	4.450.59	4,450.59	S/TE-35	4 Sep.80	40,920.00
			1,011.09	1,011.03	99.99	436,973.41	436,973.41			4,688,295.79

BORROWERS SHIPPING STATEMENT DETAILS

CONTRACT NUMBER Pj. 053/PST/78 | SUPPLIER General Electric | USAID LOAN NUMBER 497-H-028

VESSELS NAME REGISTRY	PORTS EXIT ENTRY	BILL OF LADING NUMBER DATE CARGO DESCRIPTION	TOTAL LONG TONS	U.S. VESSELS LONG TONS	U.S. VESSELS PERCENT OF TOTAL	FREIGHT COSTS U.S. DOLLAR EQUIVALENT TOTAL	FREIGHT COSTS U.S. DOLLAR EQUIVALENT PAID WITH LOAN FUNDS	SUPPLIER INVOICE REFERENCE NUMBER	SUPPLIER INVOICE REFERENCE DATE	SUPPLIER INVOICE REFERENCE CARGO VALUE
President Polk U S A	Philadelphia Jakarta	# 174386 29 Sep.78 Bushings	17.25	17.25	100	7,181.25	7,181.25	606175	29 Sep.78	96,600.00
Green Harbour U S A	Philadelphia Cirebon	# 1 20 Nov.78 Circuit Breakers	57.53	57.53	100	74,725.00	74,725.00	382455	28 Nov.78	571,459.00
Green Harbour U S A	Philadelphia Cirebon	# 1 20 Nov.78 Circuit Breakers	88.25	88.25	100	99,375.00	99,375.00	382456	28 Nov.78	808,388.00
Green Valley U S A	Philadelphia Cirebon	# 1 22 Dec.78 Bushings	35.12	35.12	100	1,495.00	1,495.00	606844	28 Dec.78	12,713.25
Green Valley U S A	Philadelphia Cirebon	# 1 22 Dec.78 Transformer	0.87	0.87	100	804.00	804.00	385660	13 Dec.78	6,824.00
Green Valley U S A	Philadelphia Cirebon	# 1 22 Dec.78 Bushings	4.77	4.77	100	3,245.00	3,245.00	606843	28 Dec.78	27,600.00
Green Valley U S A	Philadelphia Cirebon	# 1 22 Dec.78 Circuit Breakers	2.72	2.72	100	7,515.00	7,515.00	606870	1 Jan.79	63,910.00
Green Valley U S A	Philadelphia Cirebon	# 1 22 Dec.78 Insulating Fluid	143.01	143.01	100	6,087.50	6,087.50	606845	28 Dec.78	51,774.25
Green Harbour U S A	Philadelphia Cirebon	# 1 21 Mar.79 Tank Lifters	0.09	0.09	100)			401358	19 Mar.79	996.00
Green Harbour U S A	Philadelphia Cirebon	# 1 21 Mar.79 CCVT	4.02	4.02	100)			401365	19 Mar.79	26,706.00
Green Harbour U S A	Philadelphia Cirebon	# 1 21 Mar.79 Bus Duct	4.08	4.08	100)			607343	19 Mar.79	20,726.00
Green Harbour U S A	Philadelphia Cirebon	# 1 21 Mar.79 CCVT	5.02	5.02	100)	2,352.03	2,352.03	385657	13 Dec.78	38,294.00
Green Harbour U S A	Philadelphia Cirebon	# 1 21 Mar.79 CCVT	1.10	1.10	100)			401361	19 Mar.79	7,515.00
Green Harbour U S A	Philadelphia Cirebon	# 1 21 Mar.79 CCVT	6.09	6.09	100)			401363	19 Mar.79	46,004.00
Green Harbour U S A	Philadelphia Cirebon	# 1 21 Mar.79 Switchgear	37.83	37.83	100)			402609	27 Mar.79	751,929.09
			407.75	407.75	100	202,779.78	202,779.78			2,531,438.59

BORROWERS SHIPPING STATEMENT DETAILS

CONTRACT NUMBER Pj. 087/PST/78	SUPPLIER Motorola	USAID LOAN NUMBER 497-H-028

VESSELS	PORTS	BILL OF LADING	TOTAL	U.S. VESSELS		FREIGHT COSTS U.S. DOLLAR EQUIVALENT		SUPPLIER INVOICE REFERENCE		
NAME REGISTRY	EXIT ENTRY	NUMBER DATE CARGO DESCRIPTION	LONG TONS	LONG TONS	PERCENT OF TOTAL	TOTAL	PAID WITH LOAN FUNDS	NUMBER	DATE	CARGO VALUE
Lufthansa Airlines West Germany	Chicago Jakarta	# 220-9047-0343 18 Jan.79 Radio Equip	3.76	-	-	14,989.44	14,989.44	5104	29 Dec.78	289,968.10
Philippine Air Lines Philippines	Chicago Jakarta	# 079-01754830 14 Mar.79 Radio Equip.	1.30	-	-	5,251.02	5,251.02	39-1106	12.Mar.79	53,118.23
Singapore Air Lines Singapore	Chicago Jakarta	# 618-2794767 2 Oct.79 Radio Equip.	0.02	-	-	39.36	39.36	59-9095	26 Sep [illegible]	10,017.35
Flying Tigers U S A	Chicago Jakarta	# 023-80746186 11 May 81 Radio Equip.	0.50	0.50	100.0	418.91	418.91	50103	1 May 81	16,082.87
			5.58	0.50	8.96	20,698.73	20,698.73			369,186.55

BORROWERS SHIPPING STATEMENT DETAILS

CONTRACT NUMBER Pj. 152/PST/77 | SUPPLIER Irby Construction Company | USAID LOAN NUMBER 497-W-032

VESSELS NAME REGISTRY	PORTS EXIT ENTRY	BILL OF LADING NUMBER DATE CARGO DESCRIPTION	TOTAL LONG TONS	U.S. VESSELS LONG TONS	U.S. VESSELS PERCENT OF TOTAL	FREIGHT COSTS - U.S. DOLLAR EQUIVALENT TOTAL	FREIGHT COSTS - U.S. DOLLAR EQUIVALENT PAID WITH LOAN FUNDS	SUPPLIER INVOICE REFERENCE NUMBER	SUPPLIER INVOICE REFERENCE DATE	SUPPLIER INVOICE REFERENCE CARGO VALUE
Green Valley U S A	New Orleans Cirebon	# 1 28 Jun.78 Insulators	326.34	326.34	100	59,893.20	59,893.20	T - 1	10 Jul.78	546,344.20
Mallory Lykes U S A	New Orleans Cirebon	# 11 10 Jul.78 Conductor and Insulators	806.95	806.95	100	136,070.14	136,070.14	T - 2	17 Jul.78	1,362,499.57
Green Valley U S A	New Orleans Cirebon	# 1,2 & 4 21 Aug.78 Hardware and Wire	973.12	973.12	100	167,665.11	167,665.11	T - 3	25 Aug.78	1,915,092.39
Cherry Chantek Singapore	Bombay Cirebon	# S-62 17 Oct.78 Tower Steel	469.16	-	-	20,974.36	20,974.36	T - 4	26 Oct.78	348,240.53
Ruth Lykes U S A	New Orleans Cirebon	# 47 30 Nov.78 Pole Line Hardware	8.20	8.20	100	2,142.97	2,142.97	T - 5	5 Dec.78	62,949.61
Cherry Chantek Singapore	Bombay Cirebon	# S-TP-12 28 Dec,78 Tower Steel	656.10	-	-	29,331.67	29,331.67	T - 6	22 Jan.79	474,431.04
Asean Leader Singapore	Bombay Cirebon	# C-2 26 Feb.79 Tower Steel	112.72	-	-	5,039.06	5,039.06	T - 7	22 Jan.79	114,522.06
Letitia Lykes U S A	New Orleans Cirebon	[illegible] 17 Jan.79 Tower Signs	2.80	2.80	100	596.68	596.68	T - 8	22 Jan.79	5,272.48
Asean Challenger Singapore	Bombay Cirebon	# [illegible] 26 Feb.79 Tower Steel	Included Above			No Charge		T - 9	12 Mar.79	No Charge
Asean Endeavour Singapore	Bombay Cirebon	# C-2 28 Feb.79 Tower Steel	312.21	-	-	13,957.46	13,957.46	T - 10	16 Mar.79	325,651.72
Ruth Lykes U S A	New Orleans Cirebon	# 20 24 Apr.79 Tower Signs	4.20	4.20	100	834.45	834.15	T - 11	26 Apr.79	10,517.34
Balatang Singapore	Bombay Cirebon	# C-1 30 Apr.79 Tower Steel	145.53	-	-	No Charge		T - 12	16 May 79	No Charge
Asean Challenger Singapore	Bombay Cirebon	# STP-7 25 May 79 Tower Steel	21.60	-	-	1,031.56	1,031.56	T - 13	19 Jun.79	17,938.00
Asean Endeavour Singapore	Bombay Cirebon	# STP-46&47 20 Jun 79 Tower Steel	651.57	-	-	31,115.36	31,115.36	T - 14	11 Jul.79	459,954.00
Cherry Sindia Singapore	Bombay Cirebon	# STP-72,73,74 Tower Steel 31 Jul79	481.95	-	-	22,770.21	22,770.21	T - 15	17 Aug.79	240,577.95
Letitia Lykes U S A	New Orleans Cirebon	# 17 9 Sep.79 Pole Line Hardware	119.25	119.25	100	33,518.01	33,518.01	T - 16	17 Sep.79	516,731.39
Velma Lykes U S A	New Orleans Jakarta	# 28 21 Dec.79 Shackles	2.69	2.69	100	118.93	118.93	T - 17	28 Dec.79	380.00
Cherry Maju Singapore	Bombay Cirebon	# STP-32 14 Mar.80 Tower Steel	63.53	-	-	Reported Prior		T-17.1	20 Mar.80	Reported Prior
KLM Airlines Netherlands	New Orleans Jakarta	# 074-2997-8675 28 Mar.80 Bolts	0.92	-	-	No Charge		T-17.2	28 Mar.80	No Charge
Cherry Molek Singapore	Bombay Jakarta	# J-21 27 Mar.80 Tower Steel	0.89	-	-	Reported Prior		T-17.3	15 Apr.80	Reported Prior
KLM Airlines Netherlands	New Orleans Jakarta	# 074-2085-5402 30 Apr.80 Comp.Joints	0.38	-	-	No Charge		T-17.4	30 Apr.80	No Charge
KLM Airlines Netherlands	New Orleans Jakarta	# 074-2085-5424 8 May 80 Hardware	0.10	-	-	No Charge		T-17.5	9 May 80	No Charge

BORROWERS SHIPPING STATEMENT DETAILS

CONTRACT NUMBER Pj. 152/PST/77	SUPPLIER Irby Construction Company	USAID LOAN NUMBER 497-W-032

VESSELS	PORTS	BILL OF LADING	TOTAL	U.S. VESSELS		FREIGHT COSTS U.S. DOLLAR EQUIVALENT		SUPPLIER INVOICE REFERENCE		
NAME REGISTRY	EXIT ENTRY	NUMBER DATE CARGO DESCRIPTION	LONG TONS	LONG TONS	PERCENT OF TOTAL	TOTAL	PAID WITH LOAN FUNDS	NUMBER	DATE	CARGO VALUE
Cherry Molek Singapore	Bombay Jakarta	# J-82 4 Apr.80 Tower Steel	3.87	-	-	No Charge		T-17.5a	9 May 80	No Charge
Louise Lykes U S A	New Orleans Jakarta	# 14 12 May 80 Dampers	0.46	0.46	100	No Charge		T-21	16 May 80	No Charge
KLM Airlines Netherlands	New Orleans Jakarta	# 074-2805-5704 5 Jun.80 Armor Rod	0.61	-	-	No Charge		T-22	6 Jun.80	No Charge
Joseph Lykes U S A	New Orleans Jakarta	# 3 3 Aug.80 Pole Line Hardware	5.34	5.34	100	2,729.46	2,729.46	T-24	6 Aug.80	49,337.22
Ruth Lykes U S A	New Orleans Jakarta	# 6 28 Aug.80 Pole Line Hardware	0.19	0.19	100	No Charge		T-25	5 Sep.80	No Charge
Nancy Lykes U S A	New Orleans Jakarta	# 16 12 Oct.80 Pole Line Hardware	7.33	7.33	100	3,262.11	3.262.11	T-26	14 Oct.80	11,397.01
Dolly Turman U S A	New Orleans Jakarta	# 21 23 Dec.80 Pole Line Hardware	0.08	0.08	100	No Charge		T-28	7 Jan.81	No Charge
Solon Turman U S A	New Orleans Jakarta	# 28 23 Apr.81 Pole Line Hardware	0.28	0.28	100	316.15	316.15	T-28a	28 Apr.81	2,740.83
			5,178.37	2257.23	43.59	531,366.89	531,366.89			6,464,577.34
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BORROWERS SHIPPING STATEMENT DETAILS

CONTRACT NUMBER Pj. 051/PST/78	SUPPLIER Ohio Brass	USAID LOAN NUMBER 497-W-032

VESSELS	PORTS	BILL OF LADING	TOTAL	U.S. VESSELS		FREIGHT COSTS U.S. DOLLAR EQUIVALENT		SUPPLIER INVOICE REFERENCE		
NAME REGISTRY	EXIT ENTRY	NUMBER DATE CARGO DESCRIPTION	LONG TONS	LONG TONS	PERCENT OF TOTAL	TOTAL	PAID WITH LOAN FUNDS	NUMBER	DATE	CARGO VALUE
Albert Maersk U S A	Newark Jakarta	# F-832 7 Sep.79 Lightning Arresters	12.96	12.96	100	7,331.30	7,331.20	39051	17 Sep.79	87,852.00
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BORROWERS SHIPPING STATEMENT DETAILS

CONTRACT NUMBER Pj. 052/PST/78		SUPPLIER Irby Construction Company						USAID LOAN NUMBER 497-W-032			
VESSELS	PORTS	BILL OF LADING	TOTAL	U.S. VESSELS		FREIGHT COSTS - U.S. DOLLAR EQUIVALENT			SUPPLIER INVOICE REFERENCE		
NAME REGISTRY	EXIT ENTRY	NUMBER DATE CARGO DESCRIPTION	LONG TONS	LONG TONS	PERCENT OF TOTAL	TOTAL	PAID WITH LOAN FUNDS		NUMBER	DATE	CARGO VALUE
Ruth Lykes U S A	New Orleans Cirebon	# 6 1 Dec. 78 Disconnect Switches	105.78	105.78	100	26,943.72	26,943.72		S/TE-2	4 Dec.78	152,520.68
Letitia Lykes U S A	New Orleans Cirebon	# 34 17 Jan. 79 Pole Line Hardware	256.84	256.84	100	70,885.30	70,885.30		S/TE-4	18 Jan.79	1,121,842.84
Letitia Lykes U S A	New Orleans Cirebon	# 38 17 Jan. 79 Transformers	478.45	478.45	100	152,218.65	152,218.65		S/TE-5	18 Jan.79	1,761,325.02
Genevieve Lykes U S A	New Orleans Jakarta	# 3 16 Apr. 79 Transformer	90.04	90.04	100	27,018.15	27,018.15		S/TE-9	16 Apr.79	406,969.30
Ruth Lykes U S A	New Orleans Cirebon	# 18 24 Apr. 79 Steel Structures	107.12	107.12	100	19,922.25	19,922.25		S/TE-11	26 Apr.79	122,877.50
Letitia Lykes U S A	New Orleans Jakarta	# 22 9 Sep. 79 Relay Panels	1.55	1.55	100	1,009.97	1,009.97		S/TE-18	17 Sep.79	78,630.79
Letitia Lykes U S A	New Orleans Cirebon	# 18 9 Sep. 79 Pole Line Hardware	50.83	50.83	100	13,745.81	13,745.81		S/TE-20	17 Sep.79	176,259.52
Velma Lykes U S A	New Orleans Cirebon	# 29 21 Dec. 79 Relay Panels	7.97	7.97	100	4,708.08	4.708.08		S/TE-21	28 Dec.79	128,722.88
Zoella Lykes U S A	New Orleans Jakarta	# 22 23 Feb. 80 Relay Panels	6.25	6.25	100	5,514.35	5,514.35		S/TE-24	28 Feb.80	121,520.53
Velma Lykes U S A	New Orleans Jakarta	# 27 3 Apr. 80 Control Panels	8.56	8.56	100	9,049.21	9.049.21		S/TE-26	4 Apr.80	188,496.07
Louise Lykes U S A	New Orleans Jakarta	# 11 12 May 80 Relay Panels	4.61	4.61	100	4,504.63	4,504.63		S/TE-29	14 May 80	72,924.90
KLM Airlines Netherlands	New Orleans Jakarta	# 074-2100-9822 23 Sep.80 Nameplates	0.21	-	-	-	-		S/TE-36	23 Sep.80	414.30
Nancy Lykes U S A	New Orleans Jakarta	# 17 12 Oct. 80 Tools and Equipment	8.55	8.55	100	9,131.32	9,131.32		S/TE-37	14 Oct.80	45,032.08
Dolly Turman U S A	New Orleans Jakarta	# 10,19,20 23 Dec 80 Relay Panels	94.31	94.31	100	33,823.99	33,823.99		S/TE-38	5 Jan.81	289,610.72
Solon Turman U S A	New Orleans Jakarta	# 29 23 Apr. 81 Pole Line Hardware	5.90	5.90	100	6,623.35	6,623.35		S/TE-40	28 Apr.81	66,492.26
Velma Lykes U S A	New Orleans Jakarta	# 14 8 Jun. 81 Pole Line Hardware	3.74	3.74	100	3,250.99	3,250.99		S/TE-41	16 Jun.81	11,530.70
Velma Lykes U S A	New Orleans Jakarta	# 13 8 Jun. 81 Paint	0.03	0.03	100	No	Charge		S/TE-41.5	15 Jun.81	No Charge
KLM Netherlands	Jackson, Miss Jakarta	#074-2122-1362 6 Jul.81 Elec.Equip	0.20	-	-	-	-		S/TE-41.5A	2 Jul.81	3,664.88

BORROWERS SHIPPING STATEMENT DETAILS

CONTRACT NUMBER Pj. 052/PST/78	SUPPLIER Irby Construction Company	USAID LOAN NUMBER 497-W-032

VESSELS	PORTS	BILL OF LADING	TOTAL	U.S. VESSELS		FREIGHT COSTS U.S. DOLLAR EQUIVALENT		SUPPLIER INVOICE REFERENCE		
NAME REGISTRY	EXIT ENTRY	NUMBER DATE CARGO DESCRIPTION	LONG TONS	LONG TONS	PERCENT OF TOTAL	TOTAL	PAID WITH LOAN FUNDS	NUMBER	DATE	CARGO VALUE
Cargolux Luxembourg	New Orleans Jakarta	# 172-0185-6035 21 Aug.81 Electrolyte	0.17	-	-	-	-	S/TE-42	24 Aug.81	241.66
Elizabeth Lykes U S A	New Orleans Jakarta	# 22 25 Aug. 81 Electrical Equipment	0.99	0.99	100	805.40	805.40	S/TE-43	27 Aug.81	22,796.12
KLM Netherlands	New Orleans Jakarta	# 074-2121-5106 19 Oct.81 Elec.Equip.	0.14	-	-	-	-	S/TE-44	20 Oct.81	509.16
KLM Netherlands	New Orleans Jakarta	# 074-2121-5386 3 Nov.81 Elec.Equip.	0.11	-	-	-	-	S/TE-45	4 Nov. 81	652.81
Howell Lykes U S A	New Orleans Jakarta	# 8 25 Nov. 81 Electric Equipment	2.40	2.40	100	2,180.47	2,180.47	S/TE-46	14 Dec.81	17,652.38
Ruth Lykes U S A	Houston Jakarta	# 5 8 Jan. '82 Electrical Equipment	1.51	1.51	100	1,644.11	1,644.11	S/TE-48	18 Jan.82	20,009.57
British Airways United Kingdom	New Orleans Jakarta	# 125-77578045 22 Jan. 82 Transformer Access.	0.30	-	-	-	-	S/TE-49	22 Jan.82	1,802.24
British Airways United Kingdom	New Orleans Jakarta	# 125-77578222 3 Mar. 82 Electrical Equipment	0.04	-	-	-	-	S/TE-50	5 Mar. 82	364.30
Zoella Lykes U S A	New Orleans Jakarta	#17 17 Feb. 82 Electrical Equipment	1.45	1.45	100	1,420.89	1,420.89	S/TE-51	10 Mar.82	17,843.62
Emery Air Freight U S A	Jackson, Miss Jakarta	# 00299 .25 Mar. 82 Flammable Gas and Liquid	0.04	0.04	100	-	-	S/TE-52	25 Mar.82	438.51
Emery Air Freight U S A	Jackson, Miss Jakarta	# 00452 25 Mar. 82 Electrical Equipment	0.99	0.99	100	-	-	S/TE-53	25 Mar.82	7,817.46
British Airways United Kingdom	New Orleans Jakarta	# 125-77578476 16 Apr. 82 Electrical Equipment	0.12	-	-	-	-	S/TE-54	16 Apr.82	No Charge
			1,239.20	1,237.91	99.90	394,400.64	394,400.64			4,838,962.80

BORROWERS SHIPPING STATEMENT DETAILS

CONTRACT NUMBER Pj. 053/PST/78	SUPPLIER General Electric	USAID LOAN NUMBER 497-W-032

VESSELS	PORTS	BILL OF LADING	TOTAL	U.S. VESSELS		FREIGHT COSTS U.S. DOLLAR EQUIVALENT		SUPPLIER INVOICE REFERENCE		
NAME REGISTR	EXIT ENTRY	NUMBER DATE CARGO DESCRIPTION	LONG TONS	LONG TONS	PERCENT OF TOTAL	TOTAL	PAID WITH LOAN FUNDS	NUMBER	DATE	CARGO VALUE
President Polk U S A	Philadelphia Jakarta	# 174386 29 Sep.78 Bushings	17.25	17.25	100	7,181.25	7,181.25	606175	29 Sep.78	96,600.00
Green Harbour U S A	Philadelphia Cirebon	# 1 20 Nov.78 Circuit Breakers	24.64	24.64	100	32,025.00	32,025.00	382457	28 Nov.78	244,911.00
Green Valley U S A	Philadelphia Cirebon	# 1 22 Dec.78 Bushings	35.12	35.12	100	1,495.00	1,495.00	606844	28 Dec.78	12,713.25
Green Valley U S A	Philadelphia Cirebon	# 1 22 Dec.78 Circuit Breakers	8.21	8.21	100	10,675.00	10,675.00	388258	28 Dec.78	81,637.00
Green Valley U S A	Philadelphia Cirebon	# 1 22 Dec.78 CCVT	5.79	5.79	100	5,148.00	5,148.00	385659	13 Dec.78	43,787.00
Green Valley U S A	Philadelphia Cirebon	# 1 22 Dec.78 Bushings	4.77	4.77	100	3,245.00	3,245.00	606843	28 Dec.78	27,600.00
Green Valley U S A	Philadelphia Cirebon	# 1 22 Dec.78 Circuit Breakers	8.21	8.21	100	10,675.00	10,675.00	386200	15 Dec.78	81,637.00
Green Valley U S A	Philadelphia Cirebon	# 1 22 Dec.78 Circuit Breakers	8.21	8.21	100	10,675.00	10,675.00	386199	15 Dec.78	81,637.00
Green Valley U S A	Philadelphia Cirebon	# 1 22 Dec.78 Circuit Breakers	24.88	24 88	100	32,530 00	32,530.00	386198	15 Dec.78	276,654.00
Green Valley U S A	Philadelphia Cirebon	# 1 22 Dec.78 Circuit Breaker	8.21	8.21	100	10,675.00	10,675.00	386197	15 Dec.78	81,637.00
Green Valley U S A	Philadelphia Cirebon	# 1 22 Dec.78 Circuit Breaker	2.72	2.72	100	7,515.00	7,515.00	606870	1 Jan.79	63,910.00
Green Valley U S A	Philadelphia Cirebon	# 1 22 Dec.78 Insulating Fluid	143.01	143.01	100	6,087.50	6,087.50	606845	28 Dec.78	51,774.25
Green Harbour U S A	Philadelphia Cirebon	# 1 21 Mar.79 Insulating Fluid	24.21	24.21	100	11,551.31	11,551.31	607370	26 Mar.79	8,036.75
Green Harbour U S A	Philadelphia Cirebon	# 1 21 Mar.79 Switchgear	11.96	11.96	100	5,706.47	5,706.47	402609	27 Mar.79	204,686.91
Green Harbour U S A	Philadelphia Cirebon	# 1 21 Mar.79 CCVT	4.35	4.35	100	2,075.51	2,075.51	401362	19 Mar.79	32,860.00
Green Harbour U S A	Philadelphia Cirebon	# 1 21 Mar.79 Circuit Breaker	8.54	8.54	100	4,074.38	4,074.38	401358	19 Mar.79	95,204.00
Green Harbour U S A	Philadelphia Cirebon	# 1 21 Mar.79 Circuit Breaker	13.58	13.58	100	6,479.42	6,479.42	401599	20 Mar.79	81,637.00
Green Harbour U S A	Philadelphia Cirebon	# 1 21 Mar.79 Insulating Fluid	46.82	46.82	100	22,281.96	22,281.96	606946	28 Dec.78	17,319.50
Green Harbour U S A	Philadelphia Cirebon	# 1 21 Mar.79 CCVT	1.00	1.00	100	477.13	477.13	401364	19 Mar.79	7,017.00
Green Harbour U S A	Philadelphia Cirebon	# 1 21 Mar.79 Switchgear	10.89	10.89	100	5,195.95	5,195.95	606871	2 Jan.79	255,640.00
Green Harbour U S A	Philadelphia Cirebon	# 1 21 Mar.79 Circuit Breaker	6.39	6.39	100	3,048.85	3,048.85	386196	15 Dec.78	85,035.00
Green Harbour U S A	Philadelphia Cirebon	# 1 21 Mar.79 Circuit Breaker	65.71	65.71	100	31,352.21	31,352.21	401357	15 Mar.79	134,201.50
Green Harbour U S A	Philadelphia Cirebon	# 1 21 Mar.79 Bushings	21.86	21.86	100	10,582.74	10,582.74	607337	16 Mar.79	124,200.00

BORROWERS SHIPPING STATEMENT DETAILS

CONTRACT NUMBER Pj. 053/PST/78	SUPPLIER General Electric	USAID LOAN NUMBER 497-W-032

VESSELS	PORTS	BILL OF LADING	TOTAL	U.S. VESSELS		FREIGHT COSTS U.S. DOLLAR EQUIVALENT		SUPPLIER INVOICE REFERENCE		
NAME REGISTRY	EXIT ENTRY	NUMBER DATE CARGO DESCRIPTION	LONG TONS	LONG TONS	PERCENT OF TOTAL	TOTAL	PAID WITH LOAN FUNDS	NUMBER	DATE	CARGO VALUE
Green Harbour U S A	Philadelphia Cirebon	# 1 21 Mar.79 Bus Duct	8.15	8.15	100	3,888.60	3,888.60	607343	19 Mar.79	41,444.00
Green Harbour U S A	Philadelphia Cirebon	# 1 21 Mar.79 Switchgear	5.39	5.39	100	2,571.72	2,571.72	385658	13 Dec.78	40,257.00
Green Harbour U S A	Philadelphia Cirebon	# 1 21 Mar.79 Switchgear	2.34	2.34	100	1,115.47	1,116.47	401360	19 Mar.79	16,373.00
Green Island U S A	Philadelphia Cirebon	# 1 23 Apr.79 Bushing	0.42	0.42	100	334.26	334.26	407418	26 Apr.79	2,770.00
Green Island U S A	Philadelphia Cirebon	# 1 23 Apr.79 Circuit Breaker	2.11	2.11	100	1,692.21	1,692.21	386195	15 Dec.78	28,345.00
Green Island U S A	Philadelphia Cirebon	# 1 23 Apr.79 Switchgear	127.71	127.71	100	102,431.23	102,431.23	407416	26 Apr.79	956,616.00
Green Harbour U S A	Philadelphia Cirebon	# 1 1 Jun.79 Switchgear	113.54	113.54	100	72,875.20	72,875.20	410882	22 May 79	89,422.66
KLM Airlines Netherlands	New York Jakarta	# 074-2887-9266 Paint 10 Apr.79	0.03	-	-	No Charge		607411	3 Apr.79	No Charge
President Taft U S A	Los Angeles Cirebon	# 166636 5 Sep.79 Wave Traps	7.53	7.53	100	9,374.00	9,374.00	421945	7 Sep.79	48,400.00
President Taft U S A	Oakland Cirebon	# 167160 17 Nov.79 Spare Parts	45.19	45.19	100	No Charge		608264	19 Oct.79	No Charge
Albert Maersk U S A	New York Jakarta	# 18657 14 Mar.80 Bushings	0.79	0.79	100	No Charge		733294	27 Feb.80	No Charge
Albert Maersk U S A	Philadelphia Jakarta	# 21047 19 Jul.80 Insulating Fluid	6.72	6.72	100	No Charge		757587	7 Jul.80	No Charge
President Fillmore U S A	New York Jakarta	# 180958 22 Aug.80 Switchgear	1.61	1.61	100	1,659.95	1,659.95	764345	14 Aug.80	65,622.19
President Fillmore U S A	New York Jakarta	# 180958 22 Aug.80 Switchgear	0.73	0.73	100	283.56	283.56	741662	8 Apr.80	11,202.00
Alex Maersk U S A	New York Jakarta	# 49190 6 Jan.81 Circuit Breakers	0.06	0.06	100	No Charge		780609	6 Nov.80	No Charge
Alex Maersk U S A	New York Jakarta	$ 49190 6 Jan.81 Circuit Breakers	0.08	0.08	100	No Charge		783573	26 Nov.80	No Charge
Japan Airlines Japan	New York Jakarta	# 131 6575 5255 18 Feb.81 Fuses	0.01	-	-	No Charge		797151	11 Feb.81	No Charge
Green Harbour U S A	Philadelphia Cirebon	# 1 21 Mar.79 Switchgear	19.06	19.06	100	9,094.08	9,094.08	607338	16 Mar.79	447,370.00
			847.80	847.76	100	446,073.96	446,073.96			3,938,157.01

SECTION XIII

TRAINING

Various types of training for PLN Personnel constituted an important part of the MAIN Scope of Services for the West Java Projects. Several training courses in USA were planned and implemented by MAIN and an impressive number of PLN personnel were trained in-country.

Details are these :

General Electric Power Systems Engineering Course, USA

This General Electric course in Schenectady, New York, has been recognized for many years as an outstanding training program providing study, research, practical training and utility and factory inspection trips in connection with power systems analysis, computations and reliability, advanced circuit analysis, surge phenomena, protective relaying, system operation and economics and planning.

A number of PLN attendees have participated in prior years under other USAID funding. PLN personnel sponsored by the West Java Projects were :

Ir. Bambang Irawan Supardi	1975 / 1976
Ir. Abdul Faridhan	1976 / 1977
Ir. Sahala Tambunan	1976 / 1977
Ir. Sande Simandjuntak	1977 / 1978
Ir. Tommy Wiharsa	1977 / 1978
Ir. Johannes Soekarta	1979 / 1980
Ir. Gatot Subandiono	1979 / 1980
Ir. Mustafa	1980 / 1981

Motorola, Co. - Communication Systems Supervision, USA

Ir. R. Semiawan and Ir. A. Faridhan, West Java Projects Manager and Assistant Manager, respectively, visited the manufacturing facilities of Motorola Co. in Schaumberg, Illinois, in 1980. Communication systems supervision, equipment production line techniques, manufacturing scheduling and quality control assurance were observed.

In connection with the above visit, Ir. Semiawan also visited the Jackson, Mississippi, headquarters of Irby Construction Company, one of the prime West Java Material Suppliers and Construction Contractors. Procurement, warehousing, inventory control and shipping procedures were reviewed.

Chas. T. Main International, Inc., In-house Orientation, USA

Ir. Moh. Basoeki, then Deputy Director of Construction Administration, PLN Pusat, and Ir. Djurzan, then West Java Projects Manager, visited the corporate headquarters of MAIN in Boston, Massachusetts. Processes of corporate management, construction management and various engineering techniques were covered.

Irby Construction Company - Substation Equipment Training, USA

Ir. Soemarsono, PLN Substation Engineer, received training in Substation Equipment Operation and Maintenance at Irby Construction Company, Jackson, Mississippi. As the supplier of much of the substation equipment for the West Java Projects, Irby provided detailed training in equipment operation and maintenance using actual equipment destined for shipment to Indonesia.

Geothermal Resources Seminar, USA

Under the sponsorship of the West Java Projects, Ir. H. Kullit, Construction Department, PLN Pusat, attended a seminar conducted by the Geothermal Resources Council in Davis, California. Although outside the specific Training Scope of Services under the West Java Projects, this seminar was considered to be of particular advantage to PLN and its personnel in order to provide information about other sources for the future energy needs of Indonesia.

In-Country Training

Formalized training courses and on-the-job training are estimated to have benefited over 100 PLN personnel and some 2500 other Indonesian workmen.

The following Training Courses were conducted by MAIN :

Transmission Line Survey

General principles of surveying, terms employed, mathematics involved and use and care of equipment.

Drafting Instruction

Use and care of drafting and reproducing machines, tools, pens and lettering guides, checking field profile notes and reducing vertical angle stadia notes to elevations and distances.

Distribution Line Survey

General principles of surveying, terms employed, mathematics involved, construction standards, field checking maps, estimating present and potential customers and use and care of equipment.

Distribution Construction Estimating

Construction unit estimating and item tabulations.

Distribution Mapping

Staking, mapping, line layout, line design, distribution design criteria, pole line construction, stringing, hardware and materials, wood poles, construction equipment and conductor.

English Language Training

Conversational and technical English using cassette tapes, books and personal instruction.

Transmission Tower Foundation Training

Classroom plus field training in tower foundation design and construction, stub angle settings, contract specifications, drawing familiarization, concrete testing, surveying, construction safety and technical English. Five (5) tower foundations were installed and inspected. A special training course was held for representatives of the Contractors for the West Java I tower foundations.

Transmission Tower Erection Training

Tower type identification, tower steel identification, layout, rigging, tower erection, soil resistivity, grounding, first aid and technical English. Practical exercises included the assembly and erection of towers on the foundations installed by the Tower Foundation Training Course participants.

Conductor Stringing Training

Fundamentals of safety, equipment set up, use and care of equipment, pulling and stringing of conductor. Movies and visual aids were utilized and several days were spent in the field observing PLN wire stringing operations.

Communications Training

Radio Equipment installation, maintenance, trouble-shooting, communications procedures and practices.

Vehicle and Equipment Training

Trouble-shooting and maintenance procedures for vehicle automatic transmissions, carburetion and ignition systems.

Operation, maintenance and care of mobile cranes and tensioning equipment.

Substation Equipment Erection and Wiring

Substation design and equipment, metering, site preparation, control house design and equipment layout and erection. Extensive on-the-job training in installation and adjustment of electrical equipment was conducted.

Substation Operation and Maintenance

Operation and maintenance procedures and practices for various items of substation equipment including indoor medium voltage switchgear, oil circuit breakers, power transformers, protective relays, control equipment, lightning arresters, and other associated equipment. Much of this training was conducted on energized substations.

C.T. MAIN TRANSM
TOWER ERECTION
CIBOGO TRAINI

CLASS

1. Inspectors (5) & Crew Chiefs (4)
2. Linemen (14)
3. Crew "A" plus 2 Inspectors
4. Crew "B" plus 3 Inspectors

Notes :

1. Third period on Fridays will end at 1100 hours
2. During Field instruction, BREAK is at discretion of Instructor
3. No classes on Saturday 24 December or Monday morning 26 December

	TIME	MONDAY				TUESDAY				WEDNESDAY			
		CLASS	SUBJECT	PLACE	INSTR	CLASS	SUBJECT	PLACE	INSTR	CLASS	SUBJECT	PLACE	INSTR
WEEK 1	07.00-08.00	1,2	Orientation	Pre Room	1,2,3	1,2	Tech English	B 3-3	2,3	1,2	Tech. English	B 3-3	2,3
5-10 DEC.	08.00-09.30	"	Course Outline	"	"	1,2	Basic Electricity & Safety	"	1,3	1,2	Tower Blueprints	B 3-3	1,3
	09.30-10.00		BREAK				BREAK				BREAK		
	10.00-11.30	1,2	Tour of Facilities	Field	1,2,3	1,2	Types of Towers & Bases	B 3-3	3,2,3	3,4	Tower Steel Identif.	Field	1,2,3
	11.30-13.00		LUNCH				LUNCH				LUNCH		
	13.00-14.30	1,2	Responsibilities-Insp.	Pre Room	1,2,3	1,2	Tower Blueprints	B 3-3	3,2,3	1,2	Tower Blueprints	B 3-3	1,2,3
	14.30-15.00		BREAK				BREAK				BREAK		
	15.00-16.30	1,2	Duties-Line Crews	Pre Room	1,2,3	3,4	Tower Steel Identif.	Field	1,3,2,3	3,4	Tower Steel Identif	Field	1,2,3
WEEK 2	0700-0800					1,2	Electrical Hazards	B 3-3	1,3	1,2	Tech. English	B 3-3	2,3
12-17 DEC.	0800-0930					"	Safety Films	"	"	1,2	Construction Safety	B 3-3	4,3
	0930-1000						BREAK				BREAK		
	1000-1130		HOLIDAY			1,2	Construction Safety	B 3-3	4,3	3,4	Practice in Identif. Tower Steel & Hardware	Field	4,3 1,3
	1130-1300						LUNCH				LUNCH		
	1300-1430					1,2	Stub Angles & Tower Foundations	B 3-3	4,3	1,2	Climbing & Safety Belts	B 3-3	1,2,3,4
	1430-1500						BREAK				BREAK		
	1500-1630					3,4	Tour of Tower Foundations	Field	4,3 1,3	1,2	Tower Steel Layout	B 3-3	1,2,3,4
WEEKS	0700-0800	1,2	Safety Films & Tower Erection Films	B 3-3	1,2,3	1,2	Tech English	B 3-3	2,3	1,2	Tech. English	B 3-3	2,3
3,4,5,7,	0800-0930	"	Tower Blueprints	"	"	3,4	Tower Erection	Field	1,2,3	3,4	Tower Erection	Field	1,2,3
19-23 DEC	0930-1000		BREAK				BREAK				BREAK		
26-31 DEC.	1000-1130	1,2	Gin Poles & Sand Safety	B3-3	1,2,3	3,4	Tower Erection	Field	1,2,3	3,4	Tower Erection	Field	1,2,3
2-7 JAN	1130-1300		LUNCH				LUNCH				LUNCH		
16-21 JAN	1300-1430	1,2	Types of Tow. Assembly	B3-3	1,2,3	3,4	Tower Erection	Field	1,2,3	3,4,	Tower Erection	Field	1,2,3
	1430-1500		BREAK				BREAK				BREAK		
	1500-1630	3,4	Tower Layout	Field	1,2,3	3,4	Tower Erection	Field	1,2,3	3,4	Tower Erection	Field	1,2,3
WEEK 6	0700-0800	1,2	Wire & Hardware Identification	B3-3	1,2,3	1,2	Tech English	B 3-3	2,3	1,2	Tech English	B 3-3	2,3
9-14 JAN.	0800-0930	"	"	"	"	1,2	Wire Stringing Equipment	B 3-3	1,2,3,4	1,2	Dead Ending	B3-3	1,2,3,4
	0930-1000		BREAK				BREAK				BREAK		
	1000-1130	1,2	Insulators Wire Stringing & Sagging	B3-3	1,2,3,5	3,4	Insulator Cleaning & Inspecting	Field	1,2,3,4	3,4	Wire Stringing	Field	1,2,3,4
	1130-1300		LUNCH				LUNCH				LUNCH		
	1300-1430	1,2	Insulators, Wire Stringing & Sagging	B3-3	1,2,3,5	3,4	Insulator Cleaning & Hanging	Field	1,2,3,4	3,4	Wire Stringing	Field	1,2,3,4
	1430-1500		BREAK				BREAK				BREAK		
	1500-1630	1,2	Splicing & Safety	B3-3	1,2,3,5	3,4	Insulator Cleaning & Inspecting	Field	1,2,3,4	3,4	Wire Stringing	Field	1,2,3,4
WEEK 8	0700-0800	1,2	Wire Sagging & Safety	B3-3	1,2,3,4,6	1,2	Tech English	B 3-3	2,3	1,2	Tech English	B 3-3	2,3
23-28 JAN	0800-0930	1,2	"	"	"	3,4	Wire Sagging	Field	1,2,3,4,6	1,2	Armor Rods & Dampers	B 3-3	1,2,3,4,6
	0930-1000		BREAK				BREAK				BREAK		
	1000-1130	3,4	Wire Sagging	Field	1,2,3,4,6	3,4	Wire Sagging	Field	1,2,3,4,6	3,4	Armor Rodding	Field	1,2,3,4,6
	1130-1300		LUNCH				LUNCH				LUNCH		
	1300-1430	3,4	Wire Sagging	Field	1,2,3,4,6	3,4	Wire Sagging	Field	1,2,3,4,6	3,4	Armor Rodding	Field	1,2,3,4,6
	1430-1500		BREAK				BREAK				BREAK		
	1500-1630	3,4	Wire Sagging	Field	1,2,3,4,6	3,4	Wire Sagging	Field	1,2,3,4,6	3,4	Armor Rodding	Field	1,2,3,4,6

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ANSMISSION TRAINING
ION & WIRE STRINGING
RAINING CENTER.

TYPICAL TRAINING SCHEDULE

INSTRUCTORS

1. W.A. Arnold
2. P. Wilson
3. H. Kengauw
4. J.F. Christensen
5. C.C. Guice
6. N.F. Dennis

AY		THURSDAY				FRIDAY				SATURDAY			
PLACE	INSTR	CLASS	SUBJECT	PLACE	INSTR	CLASS	SUBJECT	PLACE	INSTR	CLASS	SUBJECT	PLACE	INSTR
[illegible]	2,3	1,2	Tech. English	[illegible]	2,3	1,2	Tech. English	[illegible]	2,3	—	—	—	—
B 3-3	1,3	3,4	Inventory of Tower Steel	Field	1,2,3	1,2	Check of Inventories	B 3-3	1,2,3	1,2	Review & Discussion	[illegible]	1,2
			BREAK				BREAK				BREAK		
Field	1,2,3	3,4	Inventory of Tower Steel	Field	1,2,3	1,2	Check of Inventories	B 3-3	1,2,3	1,2	Tech English	B 3-3	2
			LUNCH				RELIGION & LUNCH						
B 3-3	1,2,3	3,4	Inventory of Tower Steel	Field	1,2,3		"						
			BREAK			1,2	Tower Erection Films & Discussion	B 3-3	1,2,3				
Field	1,2,3	3,4	Inventory of Tower Steel	Field	1,2,3	"		"	"				
[illegible]	2,3	1,2	Tech. English	[illegible]	2,3	1,2	Tech English	[illegible]	2,3	—	—	—	—
B 3-3	4,3	1,2	Familiar W/Linemen's Tools	B 3-3	1,2,3	1,2	Groundmen's Duties, Handlines & Knots	B 3-3	1,2,3	1,2	Review & Discussion	[illegible]	1,2
			BREAK				BREAK				BREAK		
Field	[illegible]	1,2	Tower Steel Layout	B 3-3	1,2,3	3,4	Practice in Handlines & Knot Tying	Field	1,2,3	1,2	Tech. English	B 3-3	2
			LUNCH				RELIGION & LUNCH						
B 3-3	1,2,3,4	3,4	Practice in Tower Steel Layout	Field	1,2,3		"						
			BREAK			3,4	Practice in Tower Steel Layout	Field	1,2,3				
B 3-3	1,2,3,4	3,4	Practice in Tower Steel Layout	Field	1,2,3	"	"	"	"				
[illegible]	2,3	1,2	Tech. English	[illegible]	2,3	1,2	Tech English	[illegible]	2,3	—	—	—	—
Field	1,2,3	3,4	Tower Erection	Field	1,2,3	3,4	Tower Erection	Field	1,2,3	1,2	Review & Discussion	[illegible]	1,2
			BREAK				BREAK				BREAK		
Field	1,2,3	3,4	Tower Erection	Field	1,2,3	3,4	Tower Erection	Field	1,2,3	1,2	Tech English	B 3-3	2
			LUNCH				RELIGION & LUNCH						
Field	1,2,3	3,4	Tower Erection	Field	1,2,3		"						
			BREAK			3,4	Tower Erection	Field	1,2,3	1,2	(0800-1430 (X Day only) Four Crew Organization	[illegible] Field	1,2,4,6
Field	1,2,3	3,4	Tower Erection	Field	1,2,3	"	"	"	"				
[illegible]	2,3	1,2	Tech English	[illegible]	2,3	1,2	Tech. English	[illegible]	2,3	—	—	—	—
B 3-3	1,2,3,4	3,4	Wire Stringing & Splicing	Field	1,2,3,4	3,4	Wire Stringing & Splicing	Field	1,2,3,4	1,2	Review & Discussion	[illegible]	1,2
			BREAK				BREAK				BREAK		
Field	1,2,3,4	3,4	Wire Stringing & Splicing	Field	1,2,3,4	3,4	Wire Stringing & Splicing	Field	1,2,3,4	1,2	Tech English	B 3-3	2
			LUNCH				RELIGION & LUNCH						
Field	1,2,3,4	3,4	Wire Stringing & Splicing	Field	1,2,3,4		"						
			BREAK			3,4	Wire Stringing & Splicing	Field	1,2,3,4				
Field	1,2,3,4	3,4	Wire Stringing & Splicing	Field	1,2,3,4	"	"	"	"				
[illegible]	2,3	1,2	Tech English	[illegible]	2,3	1,2	English Examination	[illegible]	2,3	—	—	—	—
B 3-3	1,2,3,4,6	3,4	Practical Examination	Field	1,2,3,4,5	3,4	PE	Field	1,2,3,4,5	1,2	Review & Discussion	[illegible]	1,2
			BREAK				BREAK				BREAK		
Field	1,2,3,4,6	3,4	PE	Field	1,2,3,4,5	3,4	PE	Field	1,2,3,4,5	1,2	Tech English	B 3-3	2
			LUNCH				RELIGION & LUNCH						
Field	1,2,3,4,6	3,4	PE	Field	1,2,3,4,5		"						
			BREAK			1,2	Summary & Review	B 3-3	1,2,3,4,5				
Field	1,2,3,4,6	3,4	PE	Field	1,2,3,4,5	"	"	"	"				

C.T. MAIN TRANSMISSION TRAINING
TOWER ERECTION & WIRE STRINGING
— CIBOGO TRAINING CENTER —

MAIN

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SECTION XIV

PLN LIBRARY

Included in the MAIN Scope of Work for PLN's West Java Projects is the establishment of a PLN Library containing technical books and periodicals related to the electric power industry.

Following is a listing of over 350 volumes of such publications now in the PLN Library.

Publication	Volumes
Proceedings of American Power Conference	- 17
Engineering Contracts and Specifications	- 1
ANSI National Electric Safety Code	- 3
Concrete Primer	- 1
National Electric Code NFPA	- 1
Carpentry for Beginners	- 1
NFPA Handbook - National Electric Code	- 1
Modern Power Systems	- 1
Principles of Public Utility Rates	- 7
Micro Power Circuits	- 1
Mechanical Specifications for Buildings and Plants	- 1
Electrical Engineering for Professional Engineer's Examinations	- 1

Publication	Volumes
Drawings Requirements Manual	- 2
Complete Manual of Home Repair	- 1
Introduction to Heat Transfer	- 1
Fundamentals of Acoustics	- 1
Air Conditioning and Refrigeration	- 1
Manual of Steel Construction	- 1
Shock and Vibration Engineering	- 1
Reliability Engineering	- 1
Insurance Principles and Practices	- 1
Handbook of Rigging	- 1
Design of Machine Elements	- 1
Basic Geology	- 1
Essentials of Structural Design	- 1
Editing for Engineers	- 1
Handbook of National Electric Code	- 1
Engineering Manual	- 1
Elements of Industrial Systems Engineering	- 1
Fuel Cells and Fuel Batteries	- 1
Principles of Refrigeration	- 1
Estimator's Manual	- 5
Estimating Building Construction	- 2
Engineer in the Industrial Corporation	- 1
Probability and Statistics	- 1
Electrical Engineers Handbook	- 1

Publication	Volumes
Mechanical Engineers Handbook	- 1
Purchasing Handbook	- 1
Civil Engineering Handbook	- 1
Architects and Builders Handbook	- 1
Economic Operation of Power Systems	- 1
Reinforced Concrete	- 1
Timber Design and Construction Handbook	- 1
Gear Handbook	- 1
Production and Inventory Control Handbook	- 1
Transistor Handbook	- 1
Marine Insurance	- 1
Simplified Design of Structural Steel	- 1
Computers and Common Sense	- 1
Transmission Lines and Waveguides	- 1
Heat Exchanger Design	- 1
Route Location and Design	- 2
Structural Engineering Handbook	- 1
Engineering Materials Handbook	- 1
Control of Electric Motors	- 1
Motor Application and Maintenance Handbook	- 1
Probability and Random Processes	- 2
Electronic Integrated Circuits and Systems	- 1

Publication	Volumes
Handbook of Radar Measurement	- 1
Electrical Engineering Materials	- 1
Electric Machinery and Transformers	- 1
Electrical Power Systems Engineering	- 1
Computer Methods in Power Systems Analysis	- 1
Economics of American Forestry	- 1
The Chemistry of Wood	- 1
Timber Construction Manual	- 1
Pumps and Blowers	- 1
Centrifugal Pumps and Blowers	- 1
Engineering Hydrology	- 1
Irrigation	- 1
Sewage and Sewage Treatment	- 1
Cofferdams	- 1
Vibrations of Soils and Foundations	- 1
Information Theory and Coding	- 1
Basic Principles of Data Processing	- 1
Thermal Engineering	- 1
Dictionary of Mechanical Engineering	- 1
National Fire Codes	- 15
ASTM Standards	- 8
Profitability and Economic Choice	- 2

Publication	Volumes
Mathematics and Computing	- 2
The Economics of Computers	- 1
Solenoid Magnet Design	- 1
Carbon and Graphite Handbook	- 1
Power System Stability	- 2
Probability, Statistics and Decision	- 1
Mechanisms and Dynamics of Machinery	- 1
Elementary Steam Power Engineering	- 1
Precision Gearing	- 1
Railroad Engineering	- 1
Principles of Inverter Circuits	- 1
Engineering Economy	- 1
Economics of Water Resources and Planning	- 1
Introduction to Electric Circuits	- 1
Physical Geology	- 1
Handbook of Oscilloscopes	- 1
Handbook of Industrial Engineering & Management	- 1
Computer Science	- 1
Reactivity of Solids	- 1
Hydrogeology	- 1
Introduction to Network Analysis	- 1
Accountants Office Manual	- 1
Power Station Engineering and Economy	- 1

Publication	Volumes
Graphics for Engineers	- 1
Accounting for Capital & Construction	- 1
Construction Drafting	- 1
Accident Prevention Manual	- 24
Distribution System Fault Currents	- 7
ANSI Standards	- 8
NEMA Standards	- 1
Architectural Specifications	- 1
Manual of Concrete Practice	- 3
Earthquake Engineering	- 1
EEI Rate Book	- 1
Americana Annual	- 2
Foundation Design and Practice	- 1
Economic Development Projects	- 1
Engineering Drawing	- 1
Cost Allocation Manual	- 1
Switchgear and Control Handbook	- 1
Uniform Construction Index	- 3
Blue Print Reading and Sketching	- 1
Basic Electronics	- 2
Applied Protective Relaying	- 1
Historical Statistics	- 1
Strength of Materials	- 1

Publication	Volumes
Advanced Structural Analysis	- 1
Electric Circuits	- 1
Accounting Methods	- 1
Transmission and Distribution	- 4
Distribution Systems	- 1
Warehouse Operations	- 1
Electrical Wiring	- 1
Surveying	- 1
Drainage Engineering	- 1
Fundamentals of Soil Science	- 1
Electronic Switching Theory	- 1
Introduction to Nuclear Theory	- 1
Electronic Circuits	- 1
Engineering Mathematics Handbook	- 1
Protective Relays	- 1
Transformer Engineering	- 1
Proportioning Concrete Mixes	- 1
Microwave Measurements	- 1
Electrical Fundamentals	- 1
Encyclopedia Americana	- 30
Reinforced Concrete Design Handbook	- 1
Design and Control of Concrete Mixtures	- 1

Publication	Volumes
Liquid Petroleum Piping Systems	- 1
Welding Standards	- 3
Conductor Installation Guide	- 1
ICS Course in Mechanical Engineering	- 18
Electric Utility Systems and Practices	- 1
Switchgear and Control Handbook	- 1
Slide Rule Handbook	- 1
Miscellaneous Books	- 23
Miscellaneous Surveying Manuals	- 10
Miscellaneous Standards Manuals	- 19
Miscellaneous Industry Magazines	- 75

DEDICATION CEREMONY

Bogor Substation

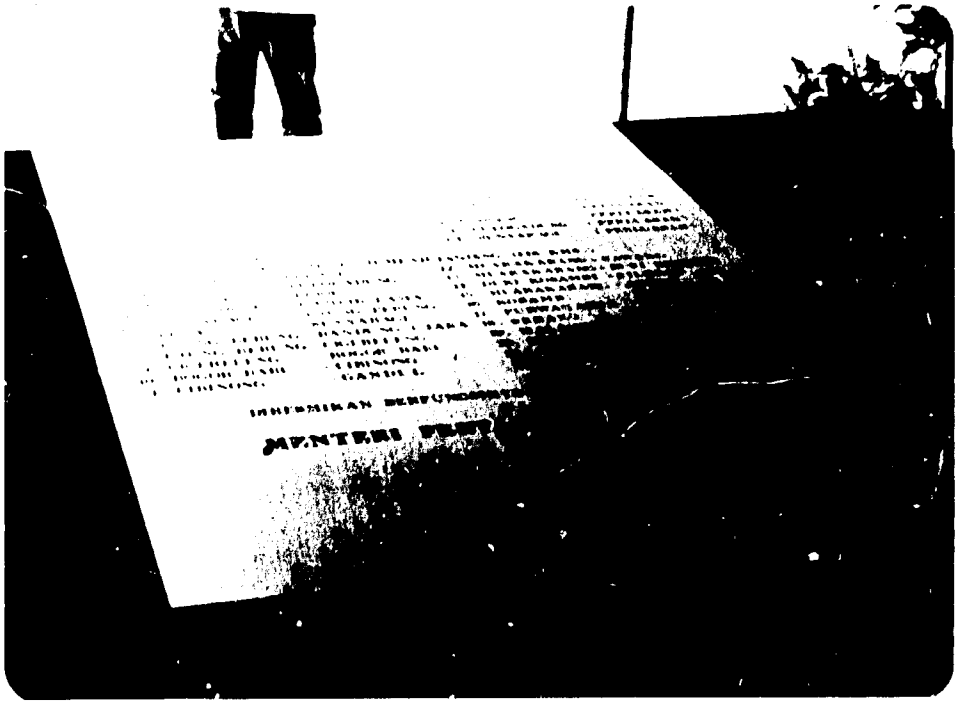
3 May 1982

Ir. Sardjono - President Director PLN

Prof. Dr. Subroto - Minister of Mines and Energy

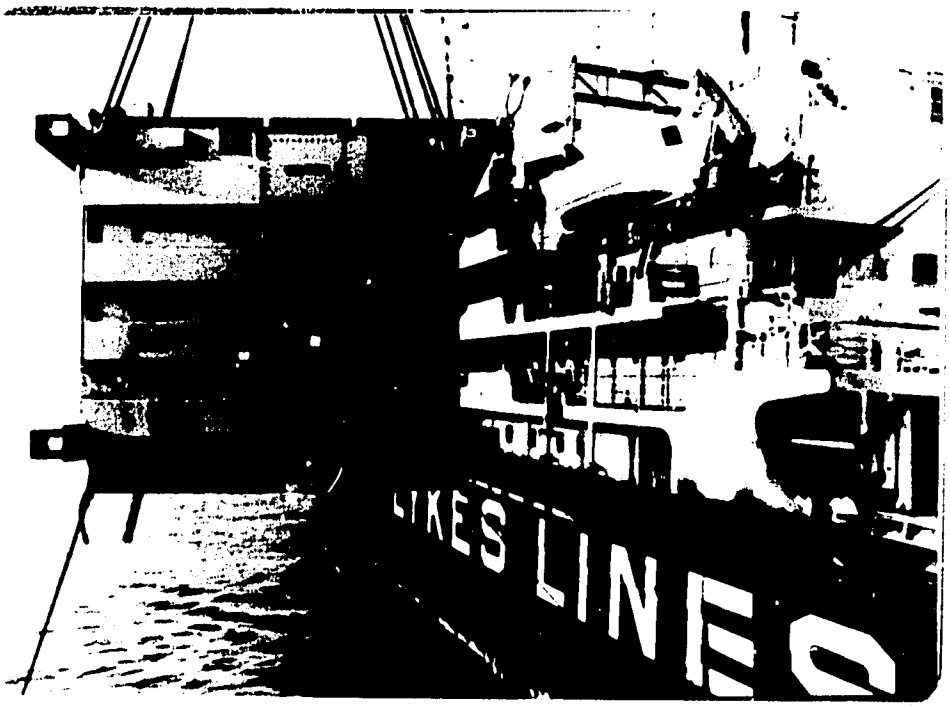
Governor Tjokropranolo - Governor of Jakarta

Ir. R. Semiawan - Projects Director - West Java and Jakarta



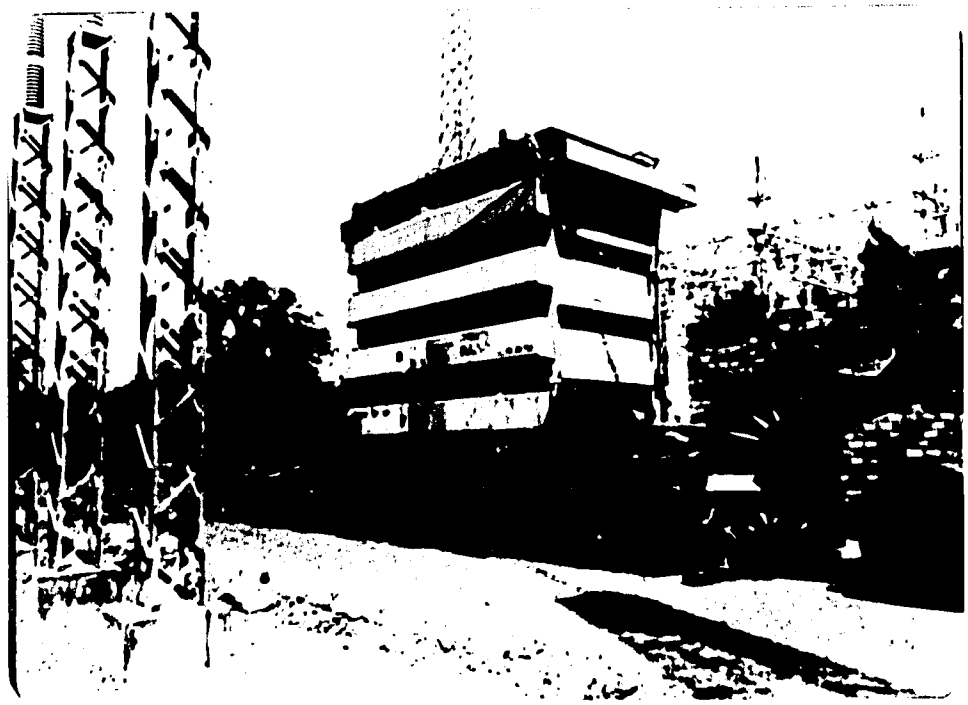
Dedication Plaque

150/70 KV 60 MVA TRANSFORMER



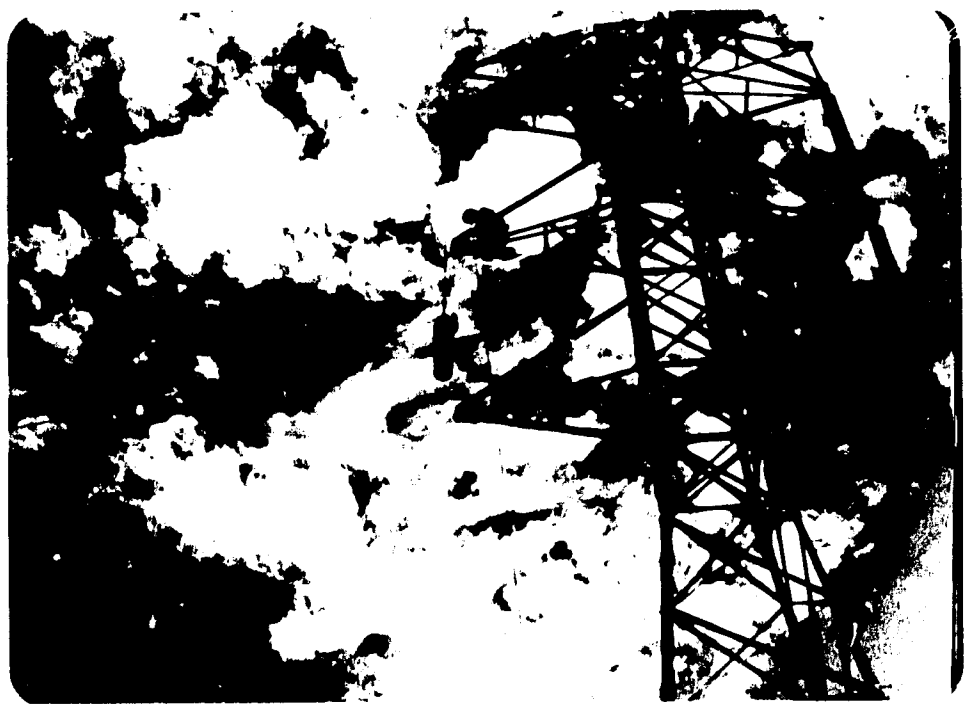
Unloading at
Tanjung Priok Port

Transportation to
Substation Site



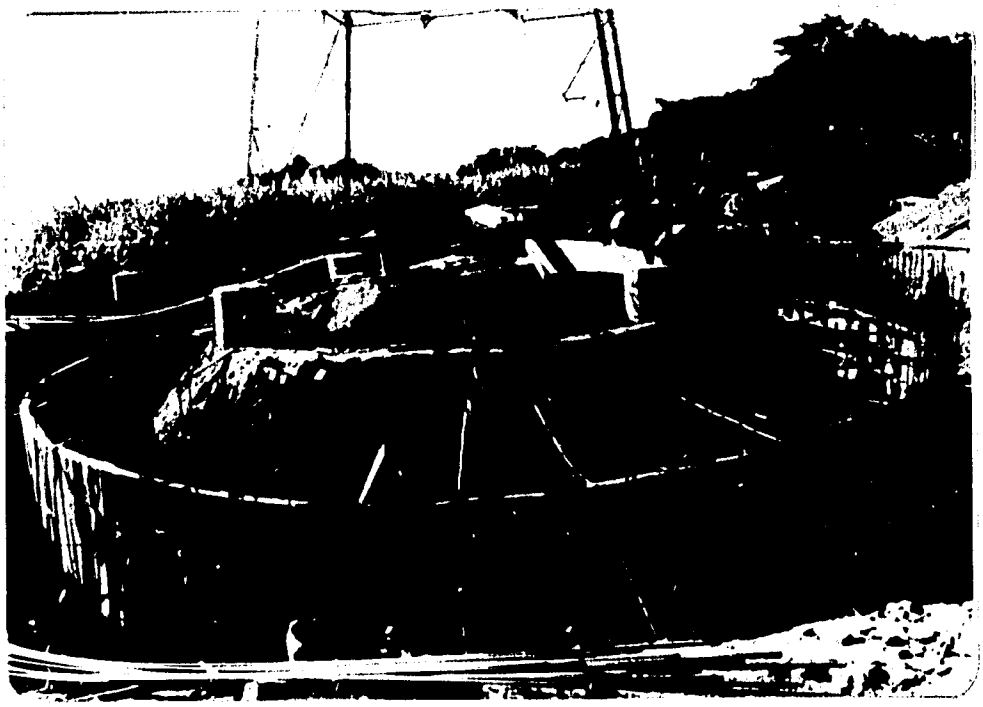
TRANSMISSION CONSTRUCTION

Installing
Conductor Deadends

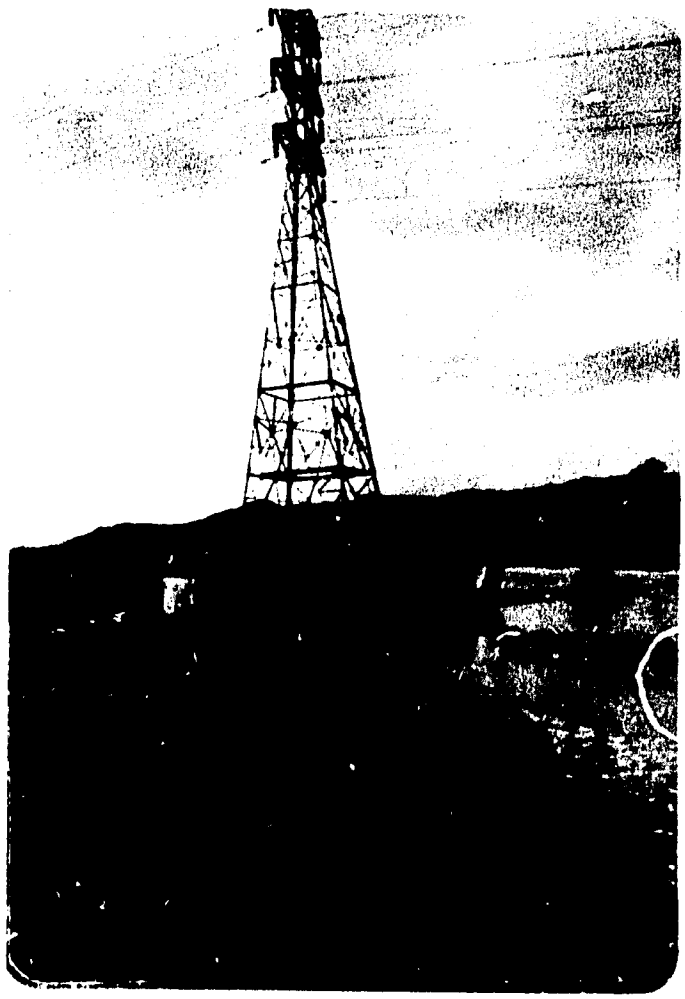


Installing Suspension
Insulator Strings

TRANSMISSION TOWER CAISSON



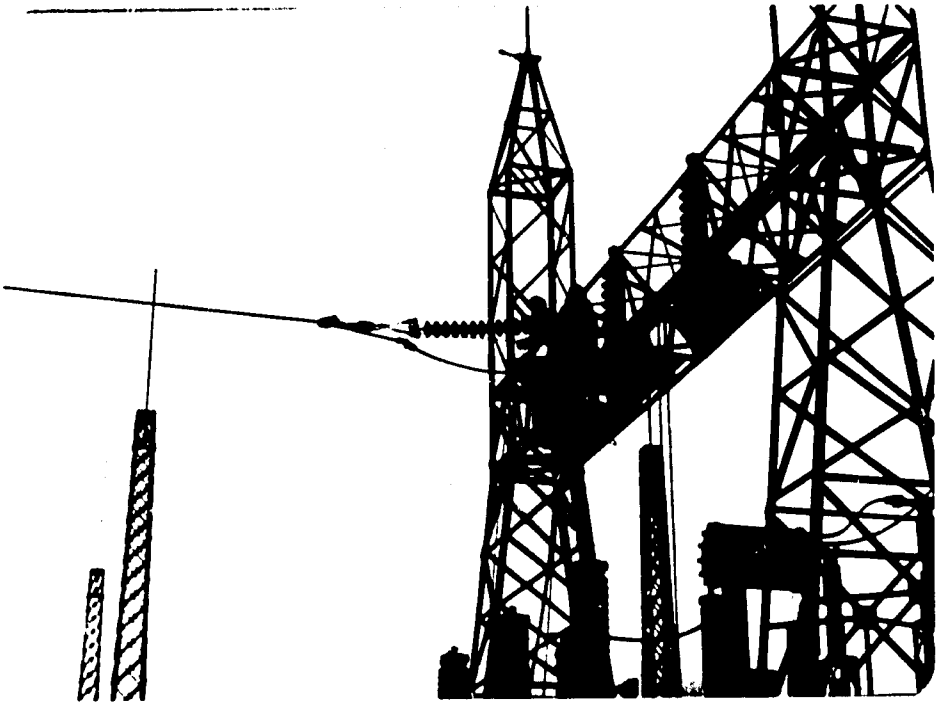
Caisson Construction



New Tower and Caisson
(Abandoned foundation
still exists - See Page 53)

SUBSTATION CONSTRUCTION

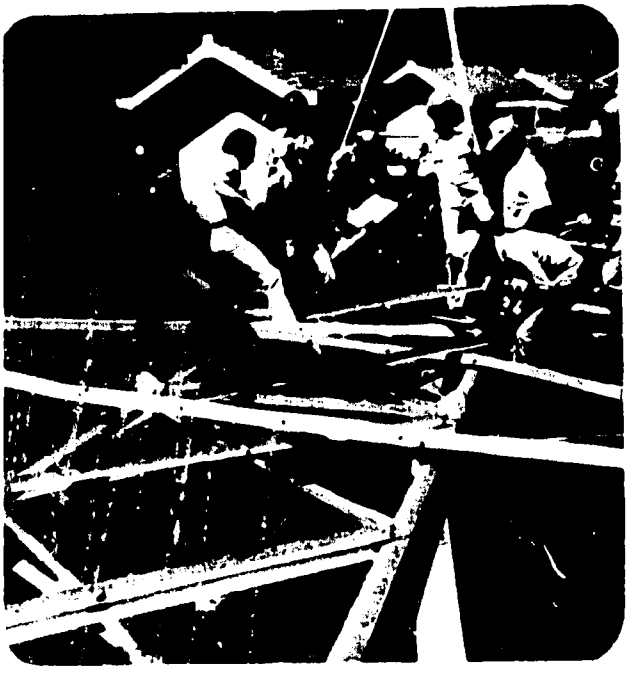
Control House
under Construction



Terminating Facilities
in Switchyard

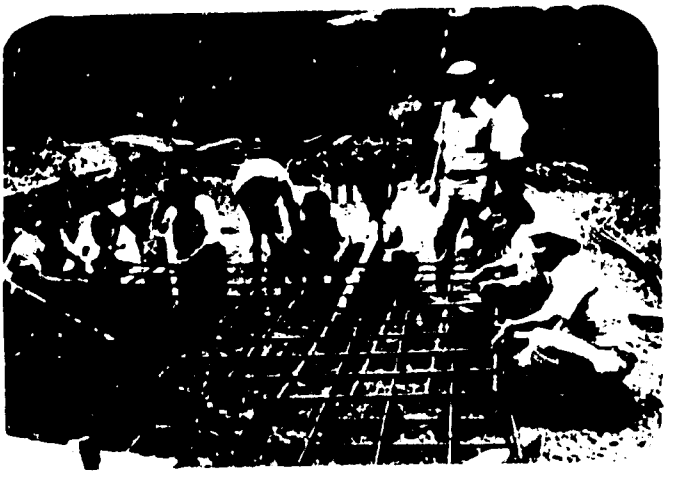
CIBINONG TRAINING SCHOOLS

Foundation Stub Angle Setting



Tower Steel Layout

Pole Climbing Technique



Foundation Rebar Tying