THE KINGDOM OF NEPAL

Basic Design Report

on

Reinforcement of Kathmandu Valley Distribution Network

August 1980

Japan International Cooperation Agency

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PREFACE

It is with great pleasure that I present this Report on Basic Design of the Kathmandu Valley Electricity Distribution Network Project to the Government of the Kingdom of Nepal.

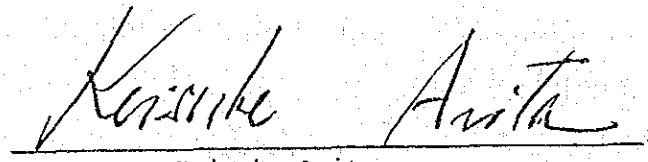
The Report embodies the result of a Basic Design Survey which was carried out from May 20th to June 18th, 1980 by a Japanese survey team commissioned by the Japan International Cooperation Agency following the request of the Government of the Kingdom of Nepal to the Government of Japan.

The survey team, headed by Mr. Ko Nakajima, Nippon Koei Co., Ltd., had a series of discussions with the officials concerned of the Government of the Kingdom of Nepal and conducted an extensive field survey and data analyses.

I sincerely hope that this report will be useful as a basic reference for development of the project.

I wish to express my deep appreciation to the officials concerned of the Government of the Kingdom of Nepal for their close cooperation extended to the survey team.

September, 1980



Keisuke Arita

President

Japan International Cooperation Agency

THE KINGDOM OF NEPAL

BASIC DESIGN REPORT

ON

REINFORCEMENT OF KATHMANDU VALLEY DISTRIBUTION NETWORK

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SUMMARY

SUMMARY

1. General

In response to the request of His Majesty's Government (H.M.G.) of Nepal, the Government of Japan had decided to investigate and to plan the improvement and extension of the existing distribution network in the Kathmandu Valley in order to meet its rapidly increasing power demand, and entrusted the Japan International Corporation Agency (JICA) with execution of the investigation and planning of the reinforcement of the distribution network.

For this purpose, JICA sent a basic design team to Kathmandu from May 20, 1980 to June 18, 1980.

The team investigated the areas requested by H.M.G. of Nepal to be urgently implemented the reinforcement and discussed the basic design criteria with officials of H.M.G. of Nepal.

This report was prepared for the basic design, estimation of the construction cost and the implementation program and plan, analyzing the data and information obtained through the field investigation and also basing on the results of the discussion.

2. Scope of Work

The following works were selected for the urgent implementation according to the order of priority given by H.M.G. of Nepal.

(a)	11 kV new extension:	
	overhead line	62.7 km
	underground cable line	10.4 km
(b)	Upgrading of voltage and conductors:	
	overhead line	25.2 km
	underground cable line	3.0 km

(c) Pole-mounted distribution transformers: 28 MVA

(d) Feeder switching panels 19 sets

(e) 400/230 V low tension lines 129.2 km

(f) Watthour meters: 5,000 pcs.

(g) Maintenance tools 1 lot

3. Estimation of Construction Cost

The cost of abovementioned scope of works was estimated at the price level as of June, 1980, will be as follows;

CIF of materials and equipment:	¥890,000,000
Inland transportation cost of the above:	¥200,000,000
Site erection cost:	¥260,000,000
Engineering fee:	¥150,000,000
Total:	¥1,500,000,000

4. Implementation Program

In order to complete the project by the end of March, 1982 in time of the commissioning of the Kulekhani No.1 hydro-electric power project, the implementation program should become very tight. From the viewpoint of the necessity of the urgent implementation of this project, the team proposed the schedule of the respective completion date of each component of the project as follows:

(a) Preliminary tender notice in Japan : beginning of the 1st month

(b) Issue of formal tender documents in Japan : beginning of the 2nd month

(c) Tender close : 10 days after the issue of formal tender documents

(d) Evaluation, selection of and negotiation with successful tenderer and the recommendation on contract awarding by the Engineers to H.M.G. : 10 days

(e) Issue of Letter of Intent by H.M.G. : end of the 3rd month

(f) First shipment of materials and equipment : beginning of the 7th month

(g) Commencement of site work : beginning of the 8th month

(h) Completion of the project : end of the 19th month

Accordingly, H.M.G. of Nepal is advised to take necessary procedures in advance to keep the date.

5. Project Evaluation

Implementation of the abovementioned reinforcement of the existing distribution network will bring;

- to increase the network distribution capacity by more than 55% compared with the present one
- to meet the demand by new customers of about 40% of the present ones
- to reduce the present line voltage drop and distribution loss to a considerable extent
- to reduce the frequency and range of line shutdown due to faults.

Thus, the energy produced at and sent from Kulekhani No.1 power station will be effectively utilized.

The reinforced distribution network ensures the stable supply of good quality electric energy and certainly contributes such social and industrial development, as encouraging private investors to develop small/medium scale industries, ensuring stable supply of city water with pumps, improving the hospital activities, modernizing the life style of inhabitants and so on.

SECTION 1

INTRODUCTION

SECTION 1
INTRODUCTION

1.1 General

The feasibility report for Kathmandu valley transmission and distribution network (Report No. MPN/CR(2)/78-49, January, 1979) revealed that the valley was facing the serious shortage of power source for and facilities of distribution network and also that the rapidly growing power demand of the present consumers and the strong requests from the waiting consumers were suppressed. The current shortage of power source will be mitigated by completion of Kulekhani No.1 hydro-power project under construction. The report, accordingly recommended the urgent implementation of the expansion and reinforcement of the existing distribution network in the valley.

Summary of the report on the existing distribution network and implementation program was as follows:-

(1) The power demand forecast for the valley was made based on the detailed analysis of the past power records, industrialization plan and trend projection in view of social and economic situation.

The result of the forecast is shown in Table 1-1 and Fig. 1-1 comparing with the recent demand forecasts worked out by Electricity Department (hereinafter referred to ED) and Nepal Electricity Corporation (hereinafter referred to NEC).

(2) New power sources for supply to the growing demand in the valley are under construction at the Gandaki hydro-power station with 15 MW capacity and at Kulekhani No.1 hydro-power station with 60 MW capacity. Besides, other hydro-power stations of Kulekhani No.2 and Devigat are being planned to be implemented with the capacity of 14.4 MW and 33 MW, respectively.

However, none of the above projects is inclusive of the reinforcement of the distribution network in the valley.

(3) The feeding capacity of the existing distribution network in the valley is insufficient for even the present demand. Accordingly, it is very urgently required to implement the reinforcement of the network, in order to meet the suppressed power demand and to effectively utilize the electric power from the abovementioned power sources.

(4) The reinforcement of the distribution network is planned in two (2) stages:-

Stage I should be completed by the end of 1982 for delivering the power generated at the Kulekhani No.1 power station to meet the power demand in the valley up to 1985/86, and Stage II by the end of 1985 for delivering the power of Kulekhani No.2 hydro-power station to meet the power demand in the valley up to 1990/91.

Taking into account the tight schedule for the implementation and the fund available, this report explains the basic plan adequate for the urgent reinforcement of the distribution network in the valley basing on the fundamental plan recommended in the feasibility report and the results obtained by the site survey and discussion with Nepalese officials.

1.2 Implementation Plan

The extent of the first stage works of implementation recommended in the report is as follows:-

(1)	11 kV transmission line between Teku and new Teku S/S ..	3 km
(2)	New 11 kV distribution lines	125 km
(3)	Renewed 11 kV distribution lines	60 km
(4)	Distribution transformers	72,000 kVA
(5)	New and renewed 400/230 V low tension lines	180 km
(6)	Watthour meters, tools and miscellaneous materials	1 lot

However, in case that the available fund may not allow the implementation of these works at a single stage, and accordingly part of the works may be reduced.

The works to be urgently implemented within the limit of available fund should be selected referring to the priority given by ED and NEC in the following order to the areas, where

(a) the interconnection between substations or lines is required for delivery of Kulekhani power to the network or for stable power supply to the important demands,

(b) the present demand has reached to the limit of the existing line capacity,

(c) the power demand expected in 1985/86 will reach to the limit of the existing line capacity,

(d) new power supply has been looked for a long time.

Geographically, the reinforcement to be made under this selection is concentrated at the areas covered by the substations of new Teku, Teku, Patan, Kathmandu (K2) and Balaju, as the power demand of more than three quarters in the valley is in these areas.

Power demand and basic plan for the reinforcement are explained in the next Section-2, and design criteria in Section-3. Cost estimate and construction schedule are stated in Section-4.

Table 1-1 Demand Forecast for Kathmandu Valley

(peak demand)

(kW)

	JICA	ED	NEC
1977/78	35,520	34,800	32,740
78/79	38,480	40,000	34,470
79/80	43,300	44,640	40,750
80/81	47,110	52,080	46,510
81/82	50,270	56,000	59,760
82/83	54,660	62,400	65,260
83/84	59,360	72,000	72,360
84/85	64,870	81,520	78,990
85/86	70,540	89,760	85,300
86/87	79,350	98,960	92,120
87/88	89,680	108,960	
88/89	101,230	120,400	
89/90	113,110	133,040	
90/91	126,640	145,600	

Remarks:

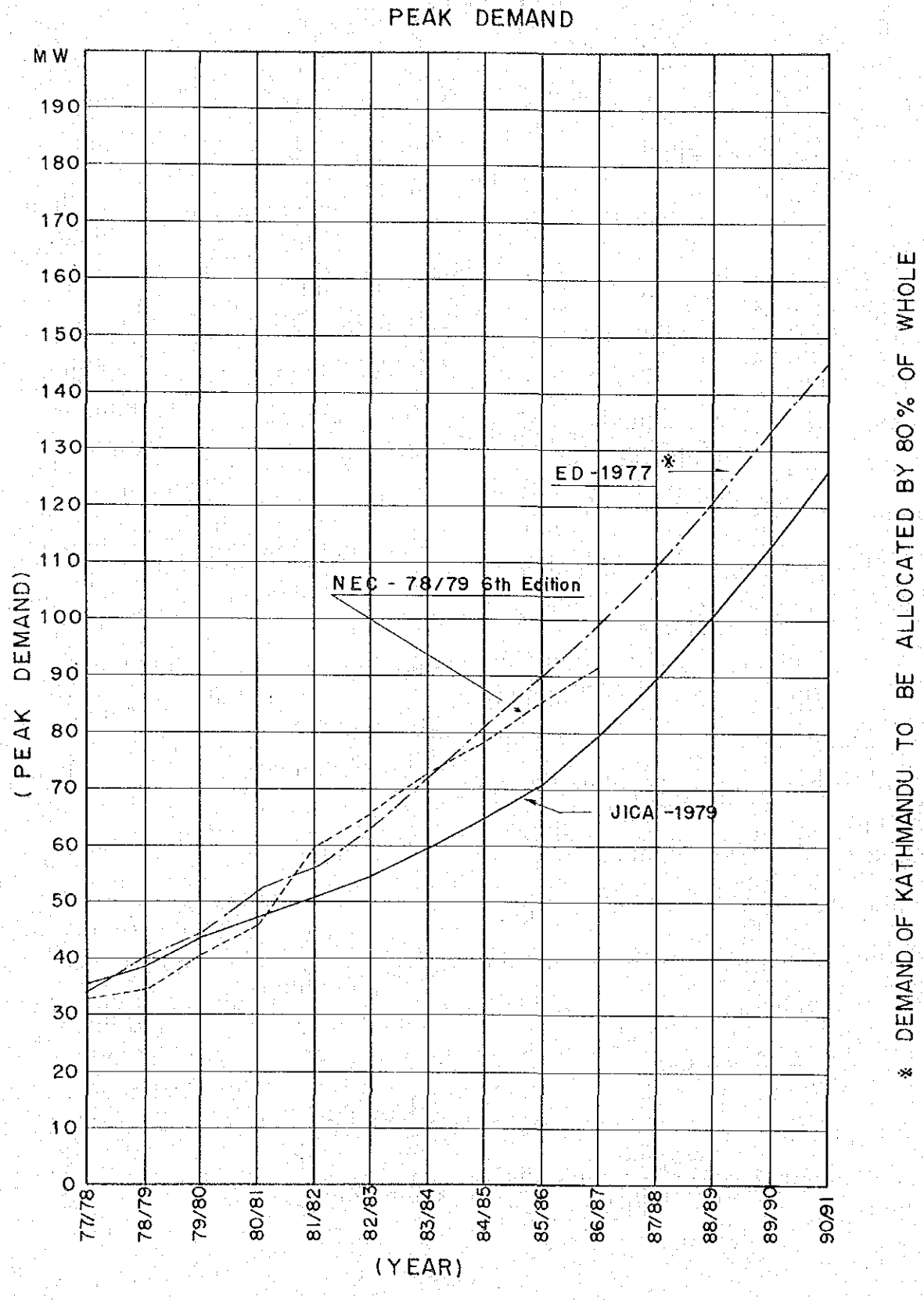
(1) ED forecast is extracted from ED's report for "Long Term Perspective (October, 1977)".

(2) NEC forecast is extracted from NEC's report for "Load Growth Study & 10 year Generation Plan - (sixth edition)".

(3) Demands for Kathmandu Valley in ED's and NEC's forecasts are worked out to be 80% of the whole demands in Central Nepal Power System, in accordance with advices of the officials of Nepal.

FIG 1-1

DEMAND FORECAST (KATHMANDU-VALLEY)



SECTION 2

BASIC PLAN

SECTION 2
BASIC PLAN

2.1 Power Demand in the Valley

Power demand forecast in the valley is summarized in Table 1-1 and illustrated in Fig. 1-1. The demand forecast for each substation was worked out by JICA in 1978. NEC also did it recently. From those forecasts, the peak load at each substation relating to the current reinforcement project is abstracted as given in the undermentioned Table 2-1 and illustrated in Fig. 2-1.

Table 2-1 Peak Demand Forecast for Each Substation

(kW)

		1977/78	1980/81	1983/84	1985/86	1990/91
K2 S/S	(JICA)	11,010	13,800	16,860	19,130	32,280
	(NEC)	12,800	14,853	20,183	23,376	-
TEKU S/S	(JICA)	8,220	11,630	14,190	17,250	31,000
	(NEC)	9,905	13,487	17,434	21,622	-
PATAN S/S	(JICA)	4,010	5,170	7,110	8,640	17,520
	(NEC)	5,562	9,431	11,881	13,857	-
BALAJU S/S	(JICA)	3,540	4,630	5,670	6,890	12,480
	(NEC)	5,334	7,524	9,480	11,404	-
M'GUNJ S/S	(JICA)	2,270	3,020	3,990	4,980	9,990
	(NEC)	2,057	4,119	5,331	6,218	-
CHABEL S/S	(JICA)	3,850	5,140	6,450	7,850	14,530
	(NEC)	4,724	6,116	7,705	8,986	-

Peak demands estimated by NEC in the above table were worked out by simply summing up the peak demand of each feeder. Since a diversity factor among the feeders is not taken into account, the total peak demand at each substation forecasted by NEC seems bigger than JICA's forecast.

It is noted that the above figures include the potential demands in the various categories which will be developed by the expansion of power sources and the reinforcement of the distribution network.

The energy loss of the network was recorded in 1978/79 at more than 30% and it is assumed to continue till the implementation of network reinforcement.

In addition, NEC estimated in detail the peak demand for every outgoing feeder from each substation basing on the past trend of energy consumption and numbers of waiting consumers. The forecast for each feeder is as seen in the following Table 2-2.

Table 2-2

Peak Demand Forecast of Each Feeder

(kVA)

Substation	Feeder	1977/78	1978/79	1980/81	1982/83	1985/86
K2	Jyatha	800	864	606	706	724
	Standby Diesel	1,524	762	-	-	-
	Singhdurbar	4,572	3,334	5,359	6,973	8,784
	Mahabaudha	2,095	2,263	2,940	3,807	4,796
	Kingsway	1,619	2,124	3,284	3,958	4,986
	Tangal	857	926	725	846	1,066
	Kamaladi	1,333	1,440	1,939	2,397	3,020
	Total	12,800	11,713	14,853	18,687	23,376
TEKU	Pulchowk	2,095	2,263	1,684	1,965	2,475
	Kalimati	952	1,872	2,788	3,512	4,569
	Kirtipur	1,810	1,955	2,980	3,475	4,377
	Mint	2,667	2,880	2,474	2,886	4,924
	Tahachal	1,238	1,087	2,121	2,509	3,161
	Thankot	762	823	960	1,120	1,412
	Teku	381	411	480	559	704
	Total	9,905	11,291	13,487	16,026	21,622

Substation	Feeder	1977/78	1978/79	1980/81	1982/83	1985/86
PATAN	Jawalakhal	1,219	1,676	1,955	2,280	2,872
	Patan	914	987	2,107	2,458	3,096
	Pharping	1,524	1,646	2,970	3,465	4,334
	Godawari	1,905	2,057	2,399	2,798	3,525
	Total	5,562	6,366	9,431	11,001	13,857
BALAJU	Swoyambhu	1,524	1,646	2,695	3,144	3,961
	Nayabazar	2,286	2,469	2,385	2,782	3,852
	BID	1,524	1,796	2,444	2,851	3,591
	Total	5,334	5,911	7,524	8,777	11,404
CHABEL	Airport	2,286	2,469	2,880	3,359	4,231
	Tangal	1,714	1,851	2,323	2,710	3,414
	Sundarijal	724	782	913	1,065	1,341
	Total	4,724	5,102	6,116	7,134	8,986
M'GUNJ	Kingsway	1,619	1,749	3,567	4,295	5,406
	B'Kantha	438	473	552	644	812
	Total	2,057	2,222	4,119	4,939	6,218

Basic planning for the network reinforcement was studied referring to the abovementioned NEC's forecast.

2.2 Request for Reinforcement by ED and NEC

ED and NEC requested the extent of the reinforcement of the distribution network in the valley so that the reinforcement may meet the forecasted demand in 1985/86, as detailed in the attached Appendix-2. Its summary is as shown below:-

11 kV new overhead line in town area	33.66	cct-km
11 kV new underground line in town area	9.54	"
11 kV new overhead line in suburb	50.45	"
Conductor size-up on existing 11 kV line	26.16	"
Voltage upgrade in town and suburb	10.16	"
Additional pole-mounted transformers	28,025	kVA
400/230 V new low-tension line	186.30	km
Additional switching panels	33	sets
Maintenance tools and equipment	1	lot

The work items in the request were given the order of priority by ED and NEC for JICA teams reference when selecting these due to the limitation of the available fund.

2.3 Details of Works to be implemented

Following are details of the works selected as to be implemented under the fund. As for locations of these areas refer to the attached maps, in which the relation between the existing lines and the reinforcement are shown. Further detailed reinforcement of the main works are shown in the schematic sketches in Fig. 2-3 for the purpose of the following explanation. Work quantities of each item are summarized with scope of work in Table 2-3.

2.3.1 Interconnection of Teku and New Teku Substations

New Teku substation (called Shyuchatar substation at present because of as the substation was finally located there) is under construction as a part of Kulekhani No.1 hydro-power project in the suburb of Kathmandu, to receive power from Kulekhani through the existing Hetauda-Balaju 66 kV transmission line by pai-branching the 66 kV line. The power will be further transmitted therefrom to Patan, where the extension work is also under construction in the Kulekhani Project with a new 66 kV line connecting both substations.

New Teku substation sends the power also to the existing Teku substation. For the purpose, a new line of about 3 km long is needed between the new Teku and the existing Teku substations. The necessary transmitting capacity of this interconnecting line is 15 to 20 MW, for which 11 kV double circuit line will be required. At the receiving end, Teku substation, two (2) switching panels of 11 kV rating will additionally be installed for incoming line. Design of the panel is detailed in Clause 3.7.

The line route passes through so densely populated area that it is practically impossible to obtain new right of way for the construction of the 11 kV double circuit line between both substations. Accordingly, the new line will be constructed by removing the existing 11 kV Teku-Thankot line which is running from Teku substation to Thankot passing nearby the new Teku substation. (Power supply to Thankot is shut down in daytime during the construction. In night time, completed part of new line and un-removed part of the existing line is temporarily connected to supply the power to Thankot.) After completion of the new line between both substations, power supply to Thankot area will be made from new Teku substation.

2.3.2 New 11 kV Line Expansion

(a) New Teku-Soltee

New Teku substation is provided with seven (7) sets of 11 kV switchgears for outgoing feeders for local supply. Utilizing one of those switchgears, a new feeder will be extended from the new Teku substation to Soltee district, about 1.3 km long distance, for the supply of about 2 MW expected in 1985/86. The new line will distribute power to the houses along the line through pole-mounted distribution transformers.

(b) New Teku-Rope Way-Kirtipur

At present, the existing Teku substation is supplying power to the Hetauda-Kathmandu rope-way and Kirtipur.

As seen in the map, the existing 11 kV line to the rope way is running near the new Teku substation. Kirtipur is much closer to the new Teku substation than from Patan substation. Therefore, the power supply to these had better be done from new Teku substation.

A new double circuits line will be constructed from the new Teku substation to the existing rope way line. Out of double circuits, one circuit will be connected to the existing rope way line to divert the supply from the existing Teku substation. Another circuit will be extended to Kirtipur district on single circuit poles. Then, Kirtipur will be stably supplied power by both the new Teku and Teku substations. ACSR (Aluminium Conductors Steel Reinforced) 58 mm^2 is selected as a conductor to Kirtipur for supply of about 4,400 kVA expected in 1985/86.

(c) Teku-Thapathali

Thapathali is one of the biggest load centers, which peak demand is forecasted as 8,800 kVA in 1985/86. At present, this district is fed from K2 substation which is located in the center of Kathmandu town. K2 substation is supplied power through the main ring line by both Balaju and Patan substations as seen in the attached Fig. 2-2.

The forecasted peak demand of K2 substation will rise up to about 19,100 to 23,300 kVA in 1985/86. (See Table 2-1) As will be explained in Clause 2.3.7, the existing conductors will be overloaded, if this peak load current will flow through the main ring line from Patan substation to K2 substation. In order to lighten the main line from the heavy loading, the supply of 8,800 kVA to Thapathali district should be diverted from K2 substation to Teku or Patan substation. From the viewpoints of distance and availability of right of way for a new line, the diversion of supply should be from Teku substation. The new line will be of 11 kV double circuits line with ACSR 75 mm^2 for overhead line portion and AL-CVTAZV (Aluminium cored, cross-linked polyethlene

insulated and PVC sheathed power cable) 3C x 150 mm^2 for underground line portion. By this diversion of power supply, the voltage drop and energy loss of the main ring line will be much reduced due to considerable reduction of heavy burden of the main ring line.

(d) Godawari Line-Pharping Line

As seen in the sketch, Godawari area and Pharping area are supplied power by individual lines from Patan substation. The peak demand of Godawari line will increase from the present 2,200 kVA to 3,500 kVA in 1985/86, while, that of Pharping line will be from the present 1,800 kVA to 4,300 kVA including a new demand of 1,000 kVA of drinking water pumping station under construction and the demand of 1,000 kVA of a cement factory. The pumping station will become the main source of water supply to Patan town.

In order to increase the reliability of power supply to these areas and also to electrify their neighbouring villages, a new interconnection line of about 3.7 km will be constructed between the ends of both lines, making a loop of a single circuit of ACSR 58 mm^2.

(e) New Electrification

Although there are many applicants for new electrification, they have been forced to wait owing to no additional power source. Upon completion of Kulekhani No.1 hydro-power project, they might be electrified. Following 11 kV lines will be constructed in Patan and Kathmandu areas with the installation of new pole-mounted distribution transformers.

Kathmandu Town	Patan Town
(1) Baneswar heights line	(1) Kopundole, Sanepa and Santahkawan
(2) Battis Putali west line	(2) Chyasel line
(3) Battis Putali east line	(3) Talsikhell and Menbhawan line
(4) Dhobidhara line	

(5) Babar Mahal line
(6) Stadium line
(7) Chhouni line
(8) Sungargaon line
(9) Maligaon line
(10) Dhunbarahi line
(11) Lamtangin and Tusal line
(12) Basundharadele line
(13) Koteswar line
(14) Prime Minister's quarter

(4) Pinchhe Tole line
(5) Chakpat line
(6) Satdobato line
(7) St. Marry school line
(8) Dhobighat line

Total length of the new overhead lines and total capacity of new pole-mounted distribution transformers are 2.96 km and 1,600 kVA in Kathmandu town and 2.29 km and 1,100 kVA in Patan town, respectively. Conductors used for the overhead lines will be HAL (Hard drawn Aluminium stranded conductor) 22 mm^2 having a current capacity of 130 A.

Kathmandu Suburb

(1) Pharping Soukhel line
(2) Satikhel line
(3) Sitapaila line
(4) Gothatar line
(5) Dhapasi Basundhara line
(6) Chapali Bhadrakali line
(7) Indrayani line
(8) Mulpani line
(9) Mahankal line
(10) Alapoth and Bhadrabasline
(11) Chovar line
(12) Syuchatar line
(13) Mane Maiju line
(14) Goldhunga line
(15) Rankot line
(16) Purano Naikap line
(17) Trolley bus line

Patan Suburb

(1) Jharuarasi line
(2) Dhapakhel line
(3) Bisankhu Narayan line

Total length of the new overhead lines and total capacity of new pole-mounted distribution transformers are 33.76 km and 2,125 kVA in Kathmandu suburb and 5.35 km and 275 kVA in Patan suburb, respectively.

2.3.3 Rearrangement of 11 kV Outgoing Lines

(a) Teku-Kalimati and Teku-Mint Lines

Demands at Kalimati and Mint districts are forecasted to reach 4,600 kVA and 4,900 kVA, respectively.

At present, a single circuit on its initial 400 m from Teku substation is commonly used to Mint, Kalimati and Bimsensthan-supermarket lines, and impedes the current flow. In order to secure the reliable supply and to increase the line capacity, the initial 400 m portion will be reinforced by dividing the existing common single circuit to three (3) individual lines and the conductors thereafter toward Mint, Kalimati and Bimsensthan areas will be upgraded.

The existing overhead line conductors of ACSR 52 mm^2 on each line will be upgraded to HAL 95 mm^2 having a current capacity of 320 A equivalent to 6,000 kVA capacity which is more than the peak demand in Mint area in 1985/86.

(b) Patan-Patan Line

The existing Patan-Patan line is feeding the power to both Bhulagh area and Balakhu area by a single circuit on the initial 500 m from Patan substation.

Similarly to the abovementioned Teku-Kalimati and Teku-Mint lines, the initial part will be reinforced from the existing single circuit to two (2) individual lines.

The new line along the initial part will be constructed as the underground cable line of CVTAZA3C x 150 mm^2. While, the existing conductors on the single circuit overhead line will be upgraded to HAL 95 mm^2 to increase the line capacity.

On the other hand, the existing 3.3 kV overhead line thereafter will be upgraded to 11 kV line with HAL 95 mm^2 conductors. This line will further be extended toward Tangal by the underground cables for new electrification.

(c) BID Line

BID (Balaju Industrial District) is supplied power by Balaju substation through a single circuit line, which also feed the power to other domestic and commercial consumers. BID is suffering from frequent shut down of power supply due to line faults caused by other consumers.

In order to secure a reliable supply to BID and also to meet its growing demand, 3,600 kVA in 1985/86, a new independent line to BID will be constructed from Balaju substation. Conductor of HAL 95 mm^2 and underground cable of AL-CVTAZV 3c x 150 mm^2 will be used for the new line.

(d) Kingsway Line of Maharajgunj

Peak demand of Kingsway line is forecasted to be 5,400 kVA in 1985/86. The current capacity of the existing conductors is insufficient to meet such a big demand. Besides, its initial 1.2 km portion from Maharajgunj substation is a single circuit line and thereafter the line is divided into two (2) lines.

Similarly to BID line, its initial portion will be rearranged by separating the present single circuit to two (2) circuits, one circuit to Kingsway and another to other area. Since there is no space to construct a new overhead line in the 1.2 km portion, a new underground cable line will be constructed with AL-CVTAZV 3c x 150 mm^2.

(e) Airport and Tangal Lines of Chabel

As seen in the sketch attached, lines from Chabel substation are very congested. The airport line to supply power to Kathmandu international airport is one of the most important line.

In order to prevent the total shut down of all lines from a fault caused by another line, the routing rearrangement of those congested outgoing lines will be needed, by dividing them into independent line.

2.3.4 Upgrading of Line Voltages and Conductors from K2 Substation

(a) Upgrading of 2.3 kV and 3.3 kV to 11 kV

The center of Kathmandu town is supplied power from K2 substation by 2.3 kV and 3.3 kV lines as well as 11 kV lines. The 2.3 kV and 3.3 kV lines are giving big line voltage drop and line energy loss.

In order to increase the line capacity, by which the line voltage drop and line energy loss may be much reduced, the line voltage will be upgraded to 11 kV. The lines to be upgraded are Mahendra 2.3 kV line and Tangal and Mahabaudha 3.3 kV lines. Mahendra line and Mahabaudha lines will be connected each other to make a loop. The line will be of underground cable line, because there are no spaces in the thickly housed area to upgrade from the current 2.3 kV or 3.3 kV overhead lines to 11 kV overhead line.

(b) Upgrading of Conductor

The current capacity of the existing conductor on K2-Tangal 11 kV line is only 200 A. Since the line is not only a supply line to Tangal district but also a main line in the network, the line capacity is to be increased up to 5,000 kVA to 6,000 kVA.

In changing the existing conductors to HAL 95 mm^2, the existing supports and insulators may be used as they are, because their mechanical strength and electrical capacity are sufficient for bigger size conductors.

2.3.5 Upgrading of Conductors on Existing Lines

The conductor sizes on the following lines are SWG. No.8 (equivalent to ACSR 12.97 mm^2), ACSR 25.91 mm^2 or ACSR 52.21 mm^2. The present line voltage drop and line energy loss of those lines are reported to be more than 20% to 30%. Current capacities of the existing conductors on some lines will become soon insufficient for the growing demand.

Therefore, the existing conductors on the lines will be replaced by bigger sized conductors. In these cases too, the existing supports, conductor cross-arms and insulators will be used as they are, except those presently damaged or teared/weared.

(a) Kathmandu Area

(1)	Naxal-Bhagawatistan section	:	ACSR 52.21mm^2 to HAL 95mm^2
(2)	Naxal-Chabel section	:	- ditto -
(3)	Gaushala-Harijentole section	:	- ditto -
(4)	Gaushala-Chabel section	:	- ditto -
(5)	Palace S.Gate-Bunamaharani section	:	- ditto -
(6)	Hatisar-Police Head Quarter section	:	- ditto -
(7)	M'gunj-Kingsway section	:	- ditto -
(8)	K2-Kingsway section	:	- ditto -
(9)	Teku-Kalimati section	:	- ditto -
(10)	Teku-Dharahara section	:	- ditto -
(11)	Bunamaharani-Hatisar section	:	- ditto -
(12)	Naxal-Dillibazar section	:	- ditto -
(13)	K2-Baneswar section	:	- ditto -

(b) Patan Area

(1)	Santabhawan-Pinchhen section	:	ACSR 12.97mm^2 to ACSR 58mm^2
(2)	Santabhawan-Pulchok section	:	- ditto -
(3)	S. Bhainsepati-Pharping section	:	ACSR 12.97mm^2 to ACSR 58mm^2

2.3.6 New Extension of 400/230 V Low Tension Lines

Necessary materials for the new low tension lines to be extended corresponding to new 11 kV expansion will be procured. Conductors to be used for the lines will be OW (outdoor used vinyl conductors) 5 mm diameter.

Total route length of the low tension lines will be 129 km for suburbs of Kathmandu and Patan.

2.3.7 New Construction of Lainchour Switching Station

Main 11 kV ring line in the valley is consisted of ACSR 207 mm^2 double circuits, connecting Patan, K2, Balaju and Teku substations.

There are two (2) biggest load centers in Kathmandu valley; one is Thapathali district located between Patan and K2 substations and another is Lainchour district located between Balaju and K2 substation. Both districts are now supplied power from K2 substation.

Peak demand of K2 substation in 1985/86 is forecasted at 19,000 to 23,400 kVA by JICA (1979) and NEC as seen in Table 2-1.

Supposing all the demand is supplied from Patan substation to K2 substation through the ring line between both substations, the current capacity of the existing conductor, 510 A, is not sufficient for a necessary capacity of about 650 A.

Supposing the peak demand is equally supplied to K2 substation from Patan and Balaju substations, the current capacity of the existing conductors is sufficient in normal operation although the line voltage drop and line energy loss are considerably big. But in the case of one circuit fault, the capacity becomes insufficient.

Out of its total demand, approximate 8,800 kVA will be consumed in Thapathali district. As stated in clause 2.3.2 (c), Thapathali demand of 8,800 kVA will be supplied by a new 11 kV double circuits line from Teku substation.

Load diversion of this 8,800 kVA from K2 substation to the new line of Teku-Thapathali will mitigate the burden of K2 substation and the ring line between Patan and K2 substations.

Another heaviest load center, Lainchour, (8,700 kVA in 1985/86) is supplied power by K2-Jyatha, K2-Kingsway and K2-Kamaladi lines. The demand in Lainchour can not be diverted from K2 substation to Balaju substation, because there is no space for construction of new overhead lines and the distance is too long for undergrond cable lines.

Under such circumstances, a new switching station will be needed and constructed in NEC's land at Lainchour intersecting the main ring line between Balaju and K2 substations.

Table 2-3 (1)

Work Items to be Implemented

WORK ITEM	DISTANCE (km)	NO. OF CIRCUIT	CONDUCTOR & CABLE	OTHERS
11 kV New Lines				
Teku S/S - New Teku S/S	3.00	2	ACSR 240 mm^2	Switching panel 2 sets
New Teku S/S - Soltee	1.23	1	HAL 22 mm^2	
New Teku S/S - Ropeway	1.13	2	ACSR 58 mm^2	
Ropeway - Kirtipur	0.89	1	- ditto -	
Teku S/S - Thapathali	1.43	2	ACSR 75 mm^2	Switching panel 2 sets
Godawari - Pharping	3.76	1	ACSR 58 mm^2	
Baneswar heights	0.15	1	HAL 22 mm^2	
Battis Pultai west	0.25	1	- ditto -	
Battis Pultai east	0.18	1	- ditto -	
Dhobidhara	0.17	1	- ditto -	
Babar Mahal	0.38	1	- ditto -	
Stadium	0.03	1	- ditto -	
Chhouni	0.11	1	- ditto -	
Sungargaon	-	-	- ditto -	
Maligaon	0.15	1	- ditto -	
Dhumbarahi	0.31	1	- ditto -	
Lamtangin & Tusal	0.97	1	- ditto -	
Basundharadole	0.11	1	- ditto -	
P.M's quarter	0.15	1	- ditto -	
Kopundale, Sanepa & Santabhawan	1.33	1	- ditto -	
Chyasel	0.12	1	- ditto -	
Talsikhel & Menbhawan	0.30	1	- ditto -	

WORK ITEM	DISTANCE (km)	NO. OF CIRCUIT	CONDUCTOR & CABLE	OTHERS
Pinchhen Tole	0.12	1	HAL 22 mm^2	
Chakpat	0.19	1	- ditto -	
Satdobato	0.08	1	- ditto -	
St. Marry school & Dhobigat	0.15	1	- ditto -	
Pharping Soukhel	1.07	1	ACSR 19 mm^2	
Satikhel	2.40	1	- ditto -	
Sitapaila	1.07	1	- ditto -	
Gothatar	1.73	1	- ditto -	
Dhapasi Basundhara	2.11	1	- ditto -	
Chapali Bhadrakali	1.85	1	- ditto -	
Indrayani	0.96	1	- ditto -	
Mulpani	1.00	1	- ditto -	
Mahankal	2.42	1	- ditto -	
Alapoth & Bhadrabas	1.89	1	- ditto -	
Chovar	1.52	1	- ditto -	
Syuchatar	1.76	1	- ditto -	
Mane Maiju	1.03	1	- ditto -	
Goldhunga	6.40	1	- ditto -	
Ramkot	2.26	1	- ditto -	
Purano Naikap	1.90	1	- ditto -	
Trolley bus	0.10	1	- ditto -	
Jharuwasari	3.53	1	- ditto -	
Dhapakhel	0.57	1	- ditto -	
Bisankhu Narayan	1.25	1	- ditto -	

WORK ITEM	DISTANCE (km)	NO. OF CIRCUIT	CONDUCTOR & CABLE	OTHERS
Rearrangement				
Teku-Kalimati & Mint	0.17 & 1.13	1	HAL 95 mm^2 & CVTAZV 3Cx150	Switching panel 2 sets
Teku-Bhimsensthan	0.82 & 0.20	1	- ditto -	
Patan S/S - Patan town	1.21 & 1.93	1	- ditto -	
BID	1.11 & 0.46	1	- ditto -	Switching panel 1 set
Maharajgunj - Kingsway	1.20	1	CVTAZV 3C x 150 mm^2	- ditto -
Airport and Tangal	0.35 & 0.16	1	ACSR 58 mm^2 & CVTAZV 3Cx150mm^2	Switching panel 2 sets
K2 S/S - town	4.99	1	CVTAZV 3C x 150 mm^2	Switching panel 1 set
Upgrading of Conductor and Voltage				
K2 S/S - Kingsway	0.09 & 3.01	1	HAL 95 mm^2 & CVTAZV 3Cx150mm^2	
Teku S/S - Kalimati	0.47	1	HAL 95 mm^2	
Teku - Dharahara	2.30	1	- ditto -	
Naxal - Bhagawatistan	0.52	1	- ditto -	
Nexal - Chabel	2.04	1	- ditto -	
Gaushala - Harijentole	1.11	1	- ditto -	
Gaushala - Chabel	0.97	1	- ditto -	
Palace S.G - B'harani	2.13	1	- ditto -	
Hatisar - Police H.Q	0.52	1	- ditto -	
M'gunj - Kingsway	3.66	1	- ditto -	
Bunamaharani - Hatisar	1.02	1	- ditto -	

WORK ITEM	DISTANCE (km)	NO. OF CIRCUIT	CONDUCTOR & CABLE	OTHERS
Naxal - Dillibazar	1.26	1	HAL 95 mm^2	
Santabhawan - Pinchhen	1.14	1	- ditto -	
Santabhawan - Pulehok	2.95	1	- ditto -	
S.Bhainsepati - Pharping	5.00	1	- ditto -	
400/230 V Low Tension Lines				
Jharuwarasi	9.48	1	OW 5 mm dia.	
Dhapakhel	6.00	1	- ditto -	
Bishakhu Narayan	4.00	1	- ditto -	
Bumgamati	2.40	1	- ditto -	
Pharping Soukhel	6.10	1	- ditto -	
Satikhel	5.15	1	- ditto -	
Sitapaila	12.00	1	- ditto -	
Gothatar	6.20	1	- ditto -	
Dhapasi	8.00	1	- ditto -	
Chapali	5.10	1	- ditto -	
Indrayani	2.00	1	- ditto -	
Mulpani	4.62	1	- ditto -	
Mahanbal	4.10	1	- ditto -	
Alapoth & Bhadrabas	3.50	1	- ditto -	
Chovar	7.20	1	- ditto -	
Syuchatar	3.00	1	- ditto -	
Mane Maiju	5.00	1	- ditto -	
Goldhunga	11.40	1	- ditto -	

WORK ITEM	DISTANCE (km)	NO. OF CIRCUIT	CONDUCTOR & CABLE	OTHERS
Ramkot	4.50	1	- ditto -	
Purano Naikap	12.00	1	- ditto -	
Koteswar	2.00	1	- ditto -	
Lainchour Switching Station				Switching panel 8 sets
Pole-mounted Transformers				
3-phase, 10 kVA				4 sets
3-phase, 25 kVA				67 sets
3-phase, 100 kVA				54 sets
3-phase, 250 kVA				74 sets

FIG. 2-1

DEMAND FORECAST FOR EACH S/S

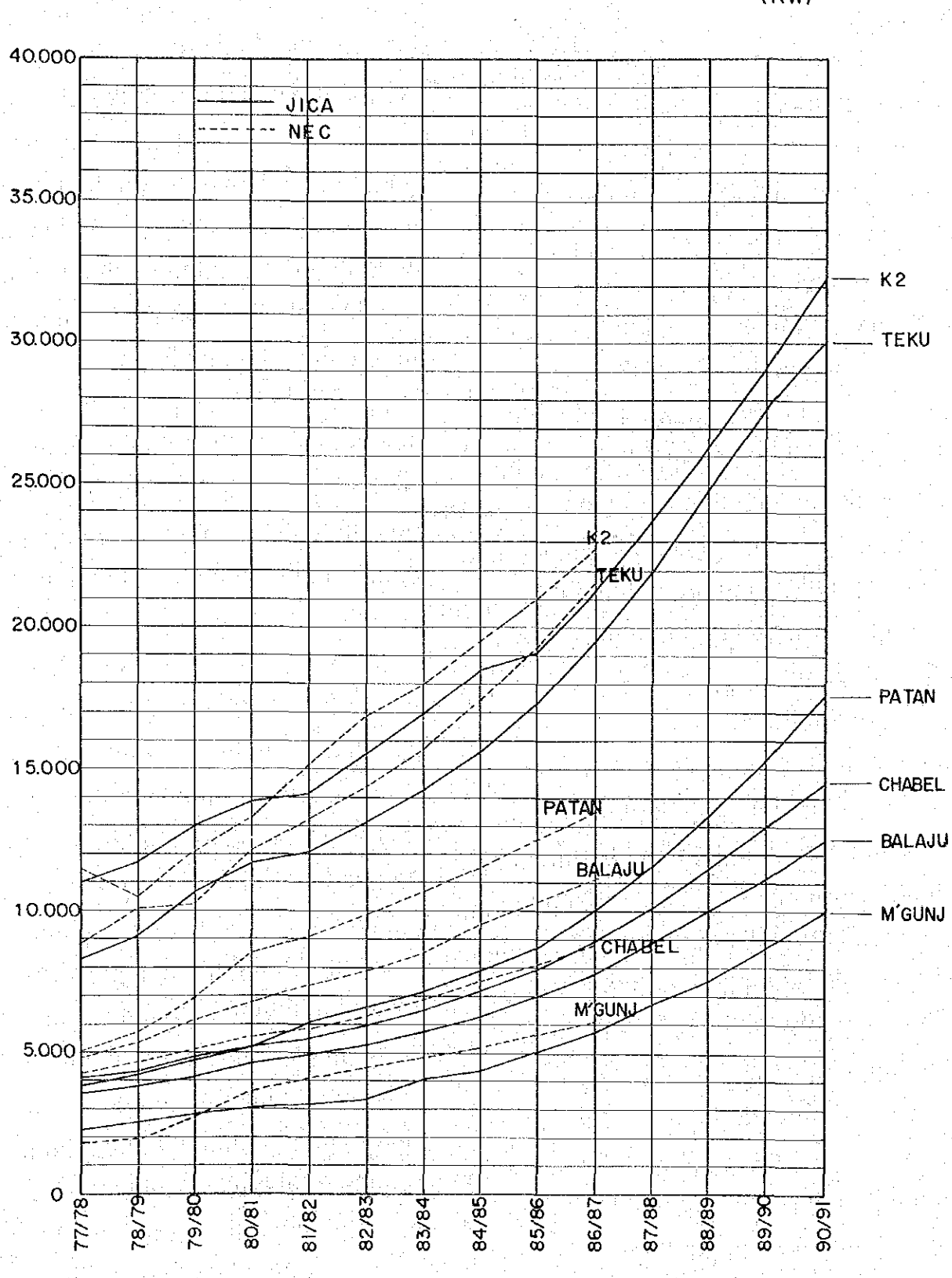


FIG 2—2 TRANSMISSION AND MAIN DISTRIBUTION LINES IN THE VALLEY

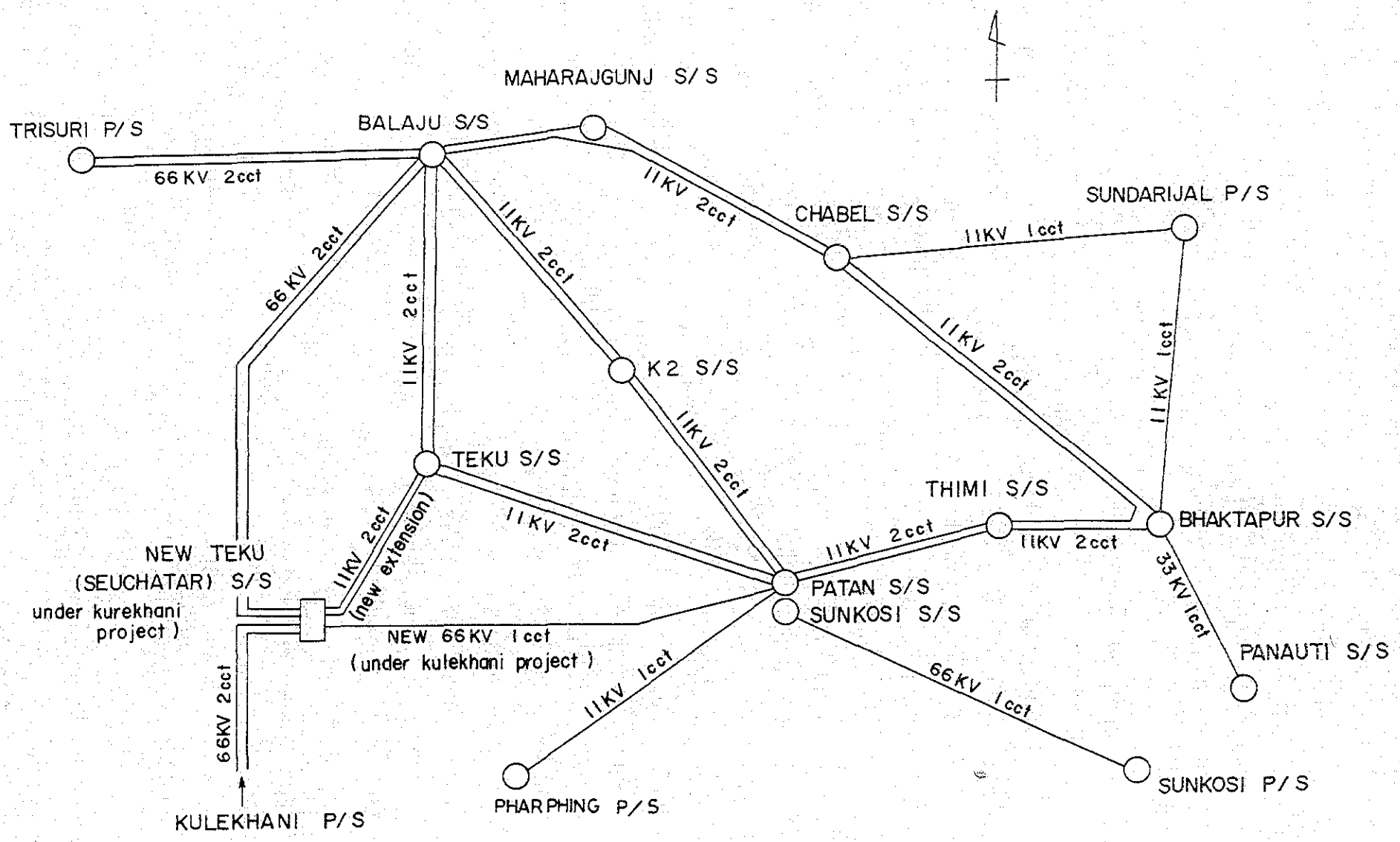
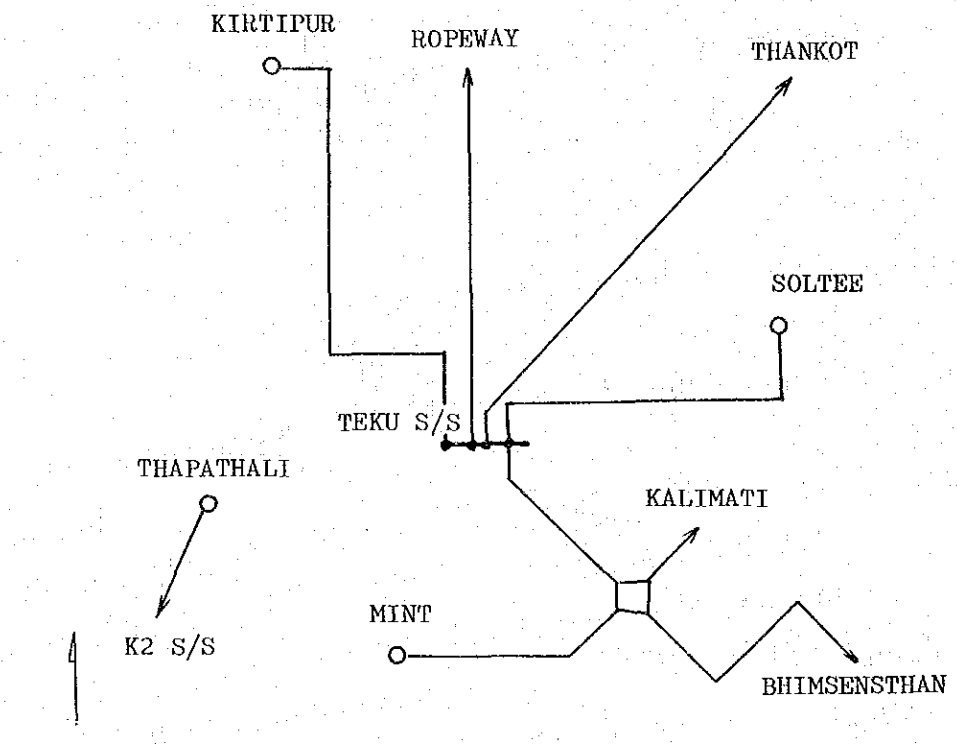


FIG. 2-3 (1) Schematic Sketches of Implementation



(EXISTING NETWORK)

(REINFORCEMENT NETWORK)

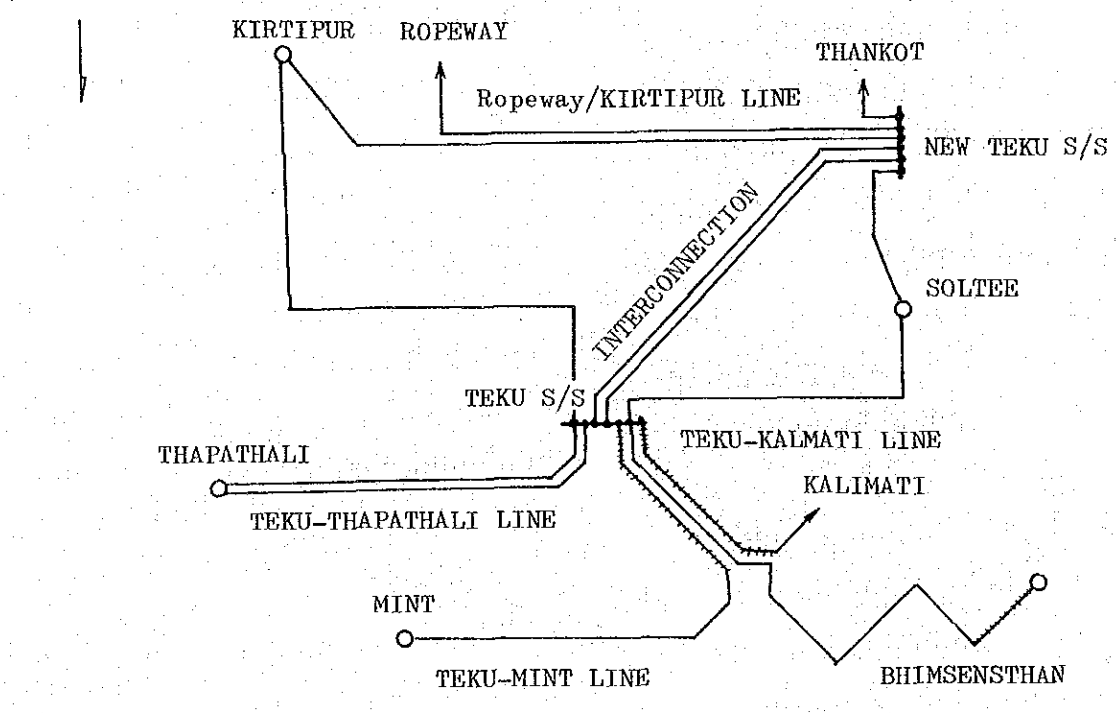


FIG. 2-3 (2) Schematic Sketches of Implementation

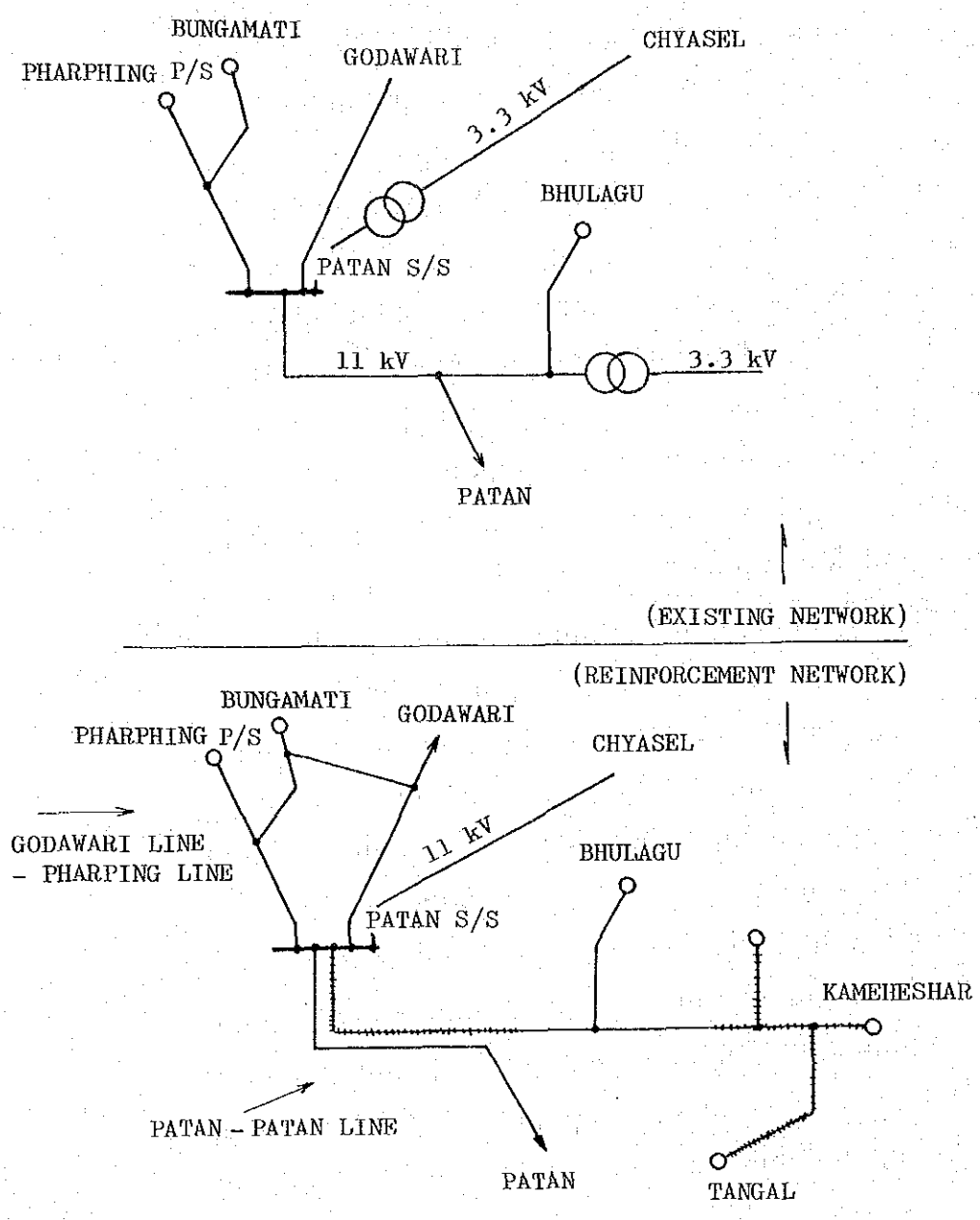
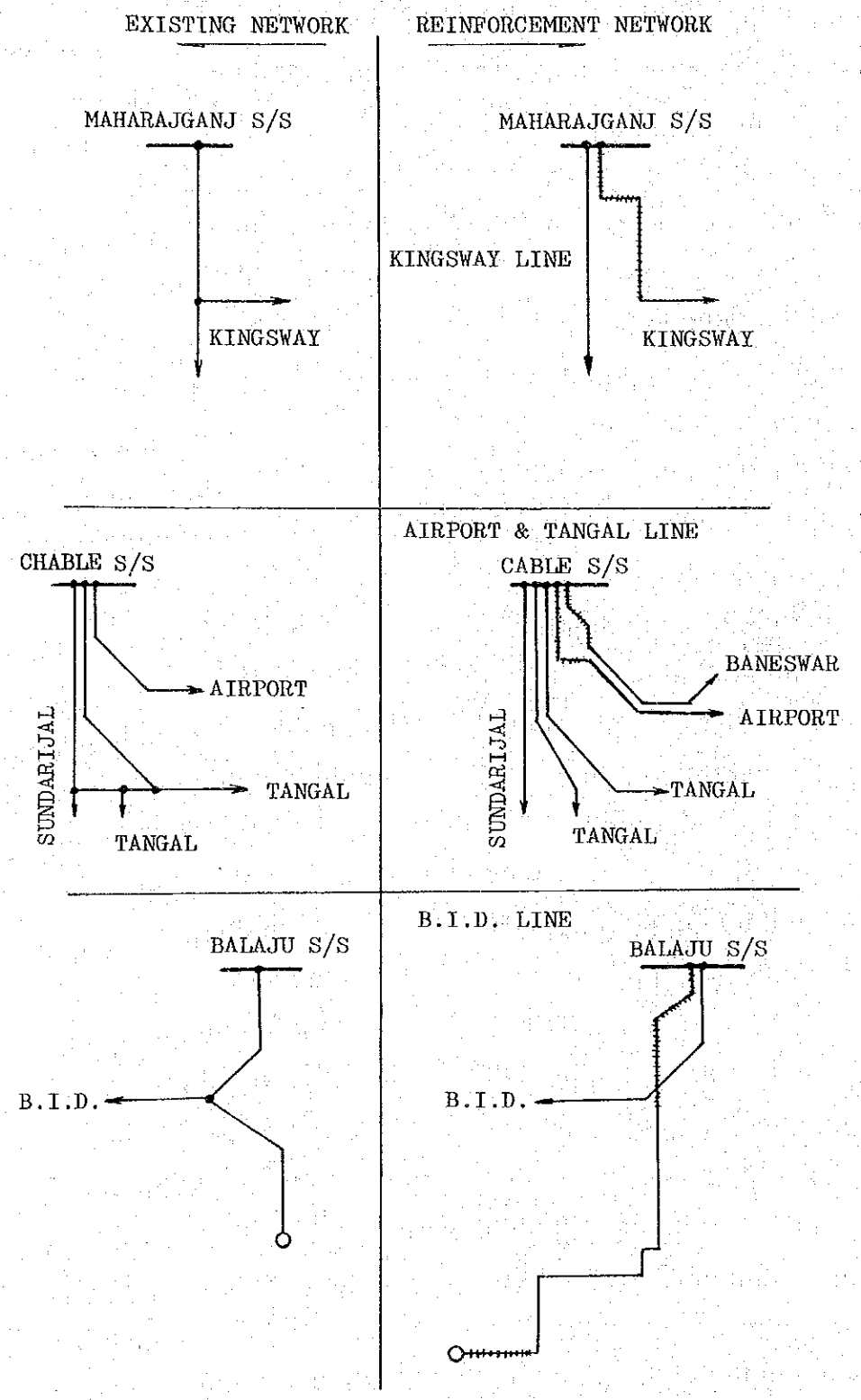


FIG. 2-3 (3) Schematic Sketches of Implementation



SECTION 3

DESIGN CRITERIA

SECTION 3
DESIGN CRITERIA

Design criteria to be applied for materials and equipment are as follows, which were discussed with and agreed by the officials of ED and NEC.

3.1 Standards

Japanese standards or equivalent standards will be applied for all materials and equipment required for this reinforcement project.

3.2 Basic Loads to Conductors and Supports

Maximum wind pressures on conductors, overhead groundwires, poles, etc. will be taken as follows:-

(a) conductors and overhead groundwires: 35 kg/m^2 on the project area
(b) supports : 31 kg/m^2 on the project area
(c) insulators : 55 kg/m^2 on the project area

The abovementioned wind pressures are obtained basing on the wind velocity of 25 m/s specified in BS being applied in Nepal. Although the extremely highest wind velocity recorded in Kathmandu international airport was 52 knots (equivalent to 26.75 m/s), the velocity of 25 m/s for the design of distribution lines is reasonable considering the reduction effect for the lower structures in the town areas or thickly housed areas.

Air temperatures recorded in the airport are as shown below:-

(a) maximum average air temperature : 25.2°C
(b) extremely highest air temperature: 27.8°C
(c) minimum average air temperature : 11.7°C
(d) extremely lowest air temperature : -3.9°C

For sag calculation of conductors and overhead groundwires, the maximum temperature of the conductors will be assumed at 70°C taking account

of temperature rise due to current flow, while the maximum temperature of the groundwires will be at 40°C considering the recorded extremely highest air temperature and temperature rise of the wires under the direct sunshine.

The recorded extremely lowest air temperature was minus 3.9°C in January, while the highest wind velocity was recorded in April. Since the extremely lowest air temperature and the highest wind velocity will not be expected to occur simultaneously, the minimum temperature of the conductors and overhead groundwires will be assumed at 0°C for sag calculation.

3.3 Support

Existing supports are made of steel tubular poles, concrete poles and wooden poles. Supports for the new expansion will be made of steel tube for easy transportation and erection. Since traffic roads from Raxual to Kathmandu limits the allowable maximum length of cargo to about 7 m, the poles will be jointed by conventional welding two (2) pieces at the site.

Design criteria for the steel tubular poles are as follows:-

(a) Span Length

The maximum span length for 11 kV overhead lines will be 150 m, however most of span length for new lines will be 50 to 80 m in accordance with the results of field survey by JICA's team.

(b) Ground Clearance

Standard ground clearances of conductors to be applied are as follows:

	11 kV	400/230 V
Road crossing	6.0 m	4.8 m
Along road	5.8 m	4.8 m
Other areas	5.0 m	4.8 m

(c) Conductor Spacing

Standard spacing of bared conductors will be 75 cm for 11 kV.

(d) Safety Factor

Safety factors for mechanical strength should be more than 2.5 against the ultimate strength for both steel structures and their foundations.

(e) Soil Bearing Capacity

Soil bearing capacity for pole foundations will be assumed as follows referring to the field test results carried out at new Teku-Patan substations under the Kulekhani project.

ultimate bearing capacity: 40 t/m^2
angle of repose of soil : 20 degrees
unit weight of soil : 1.5 t/m^3

(f) Type of Pole

Steel tubular poles will be classified as follows:-

Type A: to be applied at straight line section and light angle point up to 5 degrees, provided with pin type insulators. Light angle poles may be reinforced by applying guy wire assemblies.

Type B: to be applied at angle point up to 15 degrees, provided with pin type or suspension type disc insulators with guy wire assemblies.

Type C: to be applied at heavy angle point up to 30 degrees, provided with suspension type disc insulators with guy wire assemblies.

Type D: to be applied at heavy angle point up to 60 degrees or at dead end with guy wire assemblies.

Type T: to be applied for installing a pole mounted distribution transformer with cutout fuses and lightning arresters with guy wire assemblies.

The above types of poles will further be classified depending on the kind of conductors and standard span length. The typical drawings of steel tubular poles are as shown in attached drawings.

3.4 Conductors

All of new 11 kV overhead lines will be of Aluminium Conductor Steel Reinforced (ACSR) or Hard Drawn Aluminium Stranded Conductor (HAL). Underground cable will be of Aluminium Cored, Cross-linked Polyethlene Insulated and PVC Sheathed Cable (AL-CVTAZV). Conductors for 400/230 V low tension line will be of Outdoor-use Vinyl Conductor (OW).

(a) OH Groundwire

An overhead groundwire will be installed on new Teku and Teku 11 kV line for protecting the double circuit conductors from direct lightning strokes with a shield angle of 30 degrees. The groundwire will be of galvanized steel stranded wire.

(b) Safety Factor

Safety factors should be more than 2.5 for ACSR and HAL and more than 2.2 for galvanized steel wires against their ultimate breaking strength.

(c) Underground Cable

Underground cables will directly be buried at deeper than 70 cm below ground surface. The buried cables will be protected by the brick covering from traffic loads and maintenance works.

3.5 Insulators

Pin type and 10-inch dia. suspension type disc insulators will be used for 11 kV overhead lines.

(a) Material & Type

Insulators for 11 kV line will be of porcelain glazed brown coloured. Spool insulators will be employed for low tension lines. Suspension type insulator discs will be of clevis-tongue type.

(b) Number per String

One (1) suspension type insulator disc per string will be applied for 11 kV overhead lines at every heavy angle and dead-end poles. However, heavy angle poles for crossing over heavy traffic roads will be provided with two (2) serial discs per string.

(c) Safety Factor

Mechanical safety factor for insulators will be more than 2.5 against the ultimate strength.

(d) Electrical Characteristics

Electrical characteristics of insulators will be as follows:-

	Pin-type	Suspension type
Dimension :	7 1/2"x 5 1/3"	10"x 5 3/4"
Leakage distance :	13"	11 1/2"
Low frequency flashover voltage, dry:	95 kV	80 kV
" , wet:	60 kV	50 kV
Impulse flashover voltage, positive :	150 kV	125 kV
" , negative :	190 kV	130 kV
Low frequency puncture voltage :	130 kV	110 kV

Drawing of the insulators abovementioned is attached.

3.6 Pole-mounted Distribution Transformers

(a) The transformers will be of three (3) phase oil immersed outdoor use and pole-mounted type.

(b) The secondary side of the transformers will be rated at 400/230 V.

(c) Voltage tap range on the primary side of the transformers will be +5% to -10% of the rating at 11 kV with 2.5% step.

(d) Unit capacity of transformers will be 10 kVA, 25 kVA, 100 kVA and 250 kVA.

(e) Vector group of the transformers will be Dy-11.

(f) The transformers will be provided with a fuse box on their secondary sides.

3.7 Feeder Switch Panel

Each panel required for new feeders from the existing substations and to be installed at the new Lainchour switching station will be provided with the following equipment and meters.

1 x draw-out type OCB, 400 MVA, 800 A or 600 A, 11 kV
6 x current transformer, 400-200 A/5 A, 11 kV
1 x potential transformer, 1 ϕ, 11 kV/110 V
1 x cable head for 3c x 150 mm^2, 11 kV
1 x watthour meter
1 x power factor meter
1 x ammeter with selector switch
1 x demand ammeter
3 x over-current relay
1 x earth fault protection relay
1 x automatic recloser (single shot)
3 x differential relay

The current capacity of the bus to be provided on the panel will be more than 1,200 A.

SECTION 4

COST ESTIMATE AND IMPLEMENTATION PROGRAM

SECTION 4

COST ESTIMATE AND IMPLEMENTATION PROGRAM

4.1 General

As the fund for this reinforcement project is limited, the work quantities were to be adjusted so that as much works as possible might be executed and yet the total cost not exceed the limit.

As for the implementation program, due consideration was paid in the fact that the completion of the project was urgently required being coupled with the commissioning of Kulekhani No.1 power station.

In estimating the cost and planning the time schedule, following conditions were assumed to be applied;

(1) An experienced consulting firm will be employed for detailed design, tender call, selection of successful tenderer, inspection before shipment, construction management and supervision at site.

(2) All materials and equipment for the project are made in Japan. They will be supplied and erected by an experienced contractor selected by a limited tender among the prequalified tenderers on a package basis.

It is noted, however, that the site erection of low tension lines, drop wires to customers, wattour meters and indoor wiring will be executed by NEC and not included in the scope of work.

(3) Full cooperation with top priorities will be given by H.M.G. of Nepal and NEC in the following but not limited to:-

- Preparation and acquiring the necessary lands, land right, right of ways, right of access, work permits, immigration permits and the like.

- Necessary action for custom clearance of imported materials and equipment with due consideration for the extremely tight schedule.

- Shut-down of lines and suspension of traffic for the works in accordance with the schedule with necessary notices to the public.

- Such associated works to be done by NEC as removal of existing switching panels for re-arrangement, re-connection of feeders to new panels at Lainchour switching station, etc.

4.2 Work Quantities and Cost Estimate

The work quantities requested by H.M.G. of Nepal are as shown in Appendix-2, and those to be implemented under this project are listed in Table 2-3.

(1) Extent of Implementation

(a)	11 kV new extension:	overhead line	62.7 km
		underground cable line	10.4 km
(b)	Upgrading of voltage and conductor size:		
		overhead line	25.2 km
		underground cable line	3.0 km
(c)	Pole-mounted distribution transformers		25,615 kVA
(d)	Feeder switching panels		19 sets
(e)	400/230 V low tension lines		129.2 km*
(f)	Watthour meter		5,000 pcs.
(g)	Maintenance tools		1 lot

*1 The conductors removed from the existing lines for the purpose of upgrading will be re-used for extension of low tension lines.

It is noted that the abovementioned quantities of works might be increased or decreased at the time of contract awarding, depending on the tender prices so that the total project cost may not give an excess nor shortage to the available fund.

(2) Main materials and equipment to be procured

(a) Conductors and cables

- ACSR 240 mm^2	:	19.00 km in total length
- ACSR 75 mm^2	:	9.00 km in total length
- ACSR 58 mm^2	:	38.30 km in total length
- ACSR 19 mm^2	:	115.70 km in total length
- HAL 95 mm^2	:	73.40 km in total length
- HAL 22 mm^2	:	20.70 km in total length
- CVTAZV 3c x 150 mm^2	:	13.57 km in total length
- OW 5 mm dia. cable	:	390.00 km in total length

(b) Steel tubular poles

- type A poles	:	406 sets
- type B poles	:	86 sets
- type C poles	:	41 sets
- type D poles	:	86 sets
- type T poles	:	135 sets
- low tension poles	:	2,150 sets

(c) Insulators

- 11 kV pin type insulators	:	2,600 pcs
- 10 inches suspension type insulators	:	1,450 pcs
- low tension spool insulators	:	9,960 pcs

(d) Tools and equipment for maintenance work

Reference is made to Table 4-1.

The estimated cost for the above works, estimated at the price level as of June 1980, is detailed in Table 4-2 and summarized below:-

CIF of materials and equipment	:	¥890,000,000
Inland transportation of the above	:	¥200,000,000
Site erection cost	:	¥260,000,000
Engineering fee	:	¥150,000,000
Total		¥1,500,000,000

4.3 Implementation Program

An ordinary conceivable time schedule would be as follows; even planned on an urgent implementation basis;

Detailed design and tender document	3 months
Tender call	2 "
Tender evaluation and contract awarding	2.5 "
First shipment of material	4 "
Overseas and inland transport	2.5 "
Site erection	12 "
Total	26 months

Therefore, even if the detailed design is started from the beginning of September 1980, the completion will be the end of October 1982 at the earliest. The completion virtually required is much earlier than this date.

The total time requirement by the contractor, namely from contract awarding to work completion, is estimated at 18.5 months in the above schedule. Although this estimate seems very tight, it is assumed that this time requirement may be shortened by one and half month, namely the total requirement is 17 months.

An extra-ordinary procedure of tender document preparation, tender call and contract awarding is therefore needed to award the contract within two months from the commencement of detailed design.

The only conceivable steps of the said extra-ordinary procedure are as follows;-

(1) Immediately after the signing of the exchange note between both governments of Nepal and Japan on the project, the contract of consulting service is to be concluded and the tender document preparation be commenced based on a basic design. The tender document is to be ready for issue by the end of the 2nd month.

(2) A notice of tender is to be issued by the consultant, in several days immediately after the appointment of consultant, about one month ahead the issue of tender document.

The notice includes the outline of the project, preliminary work quantities, general design criteria and time schedule, by which any experienced contractors may be able to study the project and prepare most of their offers in advance.

(3) A tender is called for at the beginning of the 2nd month, giving 10 days for presentation of offers, and the selection of successful tenderer is to be made within 10 days by the Consultant basing on a simple but substantial evaluation of tenders (eliminating non-substantial documentation and comparison tables). Within 10 days thereafter, H.M.G. of Nepal is to issue a Letter of Intent to the selected successful tenderer in consultation with the Consultant, so that the Contractor may commence the fabrication of materials immediately. The formal contract agreement will be made within a month from the issue of the Letter of Intent.

Thus, the Contractor may start his work from the beginning of the 3rd month, and ship the first lot of goods by the middle/end of the 7th month.

The site erection work will be commenced upon arrival of first lot of goods from the middle of the 9th month, although preparatory works be commenced from the beginning of the 8th month, and may be completed by the end of 19th month after the exchange of note.

IMPLEMENTATION PROGRAM OF KATHMANDU DISTRIBUTION NETWORK

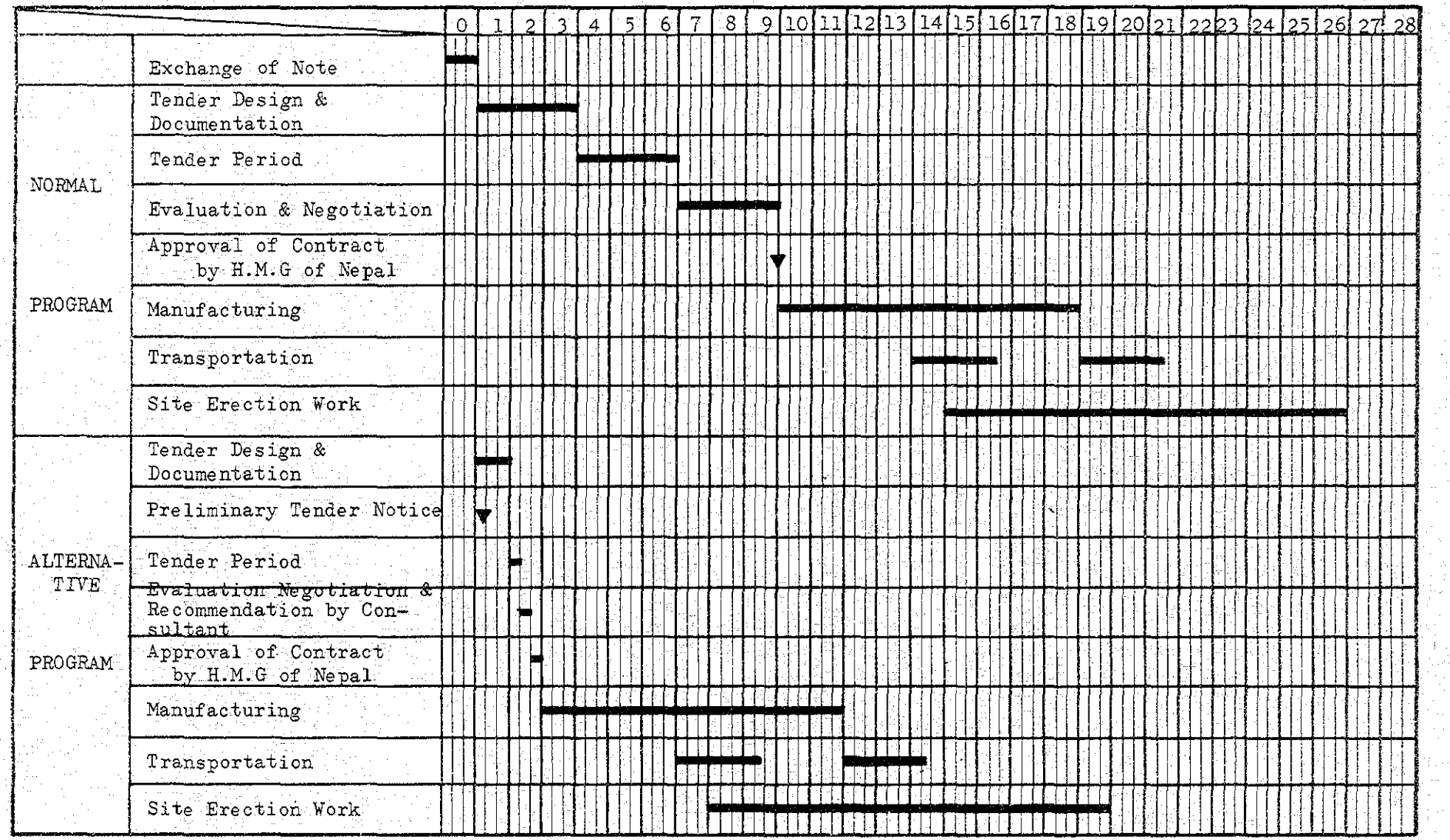


Table 4-1

Maintenance Tools and Equipment

(Following tools and equipment will be procured.)

	Items	Q'ty
1.	Stringing Tools	
	(a) 100 t hydraulic compressor with dies	2
	(b) Conductor drum stand	5
	(c) Turnbuckle, 3 tons capacity	20
	(d) Chain block, 5 tons capacity	5
	(e) Aluminium-made pulley	100
	(f) Hand-operated winch	10
	(g) Steel snatch block, 100 mm dia.	10
	(h) Wire cutter with dies	3
	(i) Stringing roller	20
	(j) Wire tensioner	10
	(k) Tension meter	2
	(l) Theodolite with a tripod	2
	(m) Screw anchor	30
	(n) Conductor protection tube (m)	100
2.	Vehicles	
	(a) Excavator	1
	(b) Pole-erection and line-maintenance	1
	(c) 4-wheel driven type working car	2
	(d) 4-wheel driven type and pick-up type car	2
3.	Cable Fault Detector	2
4.	Oil Filter and Oil Testing Set	2
5	Meter Testing Set	1
6.	Transformer Testing Apparatus	1
7.	Megger, 2000 volts	3

Table 4-2

Detailed Cost Estimate

CIF	11 kV new extension lines	210,000,000
	11 kV rearrangement	115,000,000
	Upgrading of voltages and conductors	60,000,000
	400/230 V low tension line extension	227,000,000
	Distribution transformers with accessories	150,000,000
	Feeder switching panels with miscellaneous materials for Lainchour S/S	50,000,000
	Maintenance tools and materials	70,000,000
	Others	8,000,000
		¥890,000,000
Inland Transportation Cost (Calcutta-Kathmandu)		¥200,000,000
Erection Cost		¥260,000,000
Engineering Fee		¥150,000,000
Grand Total		¥1,500,000,000

(Note)

The above costs are estimated at the price level as of June, 1980.

SECTION 5

PROJECT EVALUATION

SECTION 5

PROJECT EVALUATION

Implementation of the reinforcement of the distribution network will bring the following merits in technical aspects.

(1) The total capacity of the network distribution capacity in the areas concerned will be increased from the existing 50,000 kVA to 78,000 kVA by 56% in capacity. Taking into account that the peak demand in the areas concerned is about 75% of that of the whole Kathmandu valley, the capacity of 78,000 kVA is quite adequate for the demand in 1985/86, referring to the demand forecast shown in Table 1-1.

(2) The extension of new 11 kV lines and new low tension lines will increase number of customers from the present 50,000 to 70,000 by 40%. Most of the waiting consumers in the areas concerned will be met to their demand.

(3) The present line voltage drop and energy loss are recorded as 20 to 30% or more at the customers' end. But those will be reduced to 10 to 15% or less owing to the upgrading of conductor sizes and line voltages.

(4) The rearrangement for separation of the commonly used single circuit line at present to individual line will reduce the frequency and range of line shut down owing to the lessened affection by faults on the other lines.

The reinforcement of distribution network not only enlarges the service areas and reduces the loss energy, thus improves the management of NEC, but also much levels up the quality of services in energy supply, coupled with the commissioning of Kulekhani No.1 power station.

The stable supply of good quality electric energy, ensured by this reinforcement, will certainly contribute to the social and industrial developments as follows but not limited to:

(a) Promotion of small/medium scale industries in private sectors which have been depressed for long time due to poor supply of electric power.

(b) Promotion of a tourism industry by upgrading the hotel and accomodation services.

(c) Stable supply of city water with a pumping station under construction.

(d) Improvement of welfare in health by better services of hospitals.

(e) Modernization of civilian life through wider electrification of residences and shops.

APPENDIXES

APPENDIX 1

COUNTERPARTS
AND
SITE SCHEDULE OF TEAM

Officials and Counterparts

Electricity Department

Mr. H. M. Shrestha	Chief Engineer
Mr. B. M. Singh	Deputy Chief Engineer
Mr. H. O. Shrestha	Senior Engineer
Mr. B. S. Malla	Senior Engineer

Nepal Electricity Corporation

Mr. S. K. Malla	Executive Chairman
Mr. R. M. Sakya	Executive Chief of Planning and Generation Department
Mr. N. T. Bhutia	Chief of Planning and Research Division
Mr. K. B. Shrestha	Chief of Construction Division
Mr. T. M. Sakya	Assistant Engineer
Mr. K. L. Joshi	Assistant Engineer
Mr. K. G. Shrestha	Assistant Engineer
Mr. G. R. Suwal	Assistant Engineer
Mr. R. C. Pandey	Assistant Engineer

Schedule of Members of Team at Site

Date	Mr. K. Nakajima	Mr. K. Katoh	Mr. W. Hirakawa
20/May (T)	Trip(Narita-Bangkok)	Trip(Narita-Bangkok)	Trip(Narita-Bangkok)
21/" (W)	Trip (Bangkok-Kathmandu) Courtesy call to ED, NEC and Japanese Emabassy	Trip (Bangkok-Kathmandu) Courtesy call to ED, NEC and Japanese Embassy	Trip (Bangkok-Kathmandu) Courtesy call to ED, NEC and Japanese Embassy
22/" (Th.)	Meeting with Nepalese officials & counter-parts. Investigation of K2 S/S	Meeting with Nepalese officials & counter-parts. Investigation of K2 S/S	Meeting with Nepalese officials & counter-parts. Investigation of K2 S/S
23/" (F)	Discussion with Nepalese officials & counterparts on H.M.G's proposal	Discussion with Nepalese officials & counterparts on H.M.G's proposal	Discussion with Nepalese officials & counterparts on H.M.G's proposal
24/" (S)	General investigation of Patan, Balaju & K2 areas	General investigation of Patan, Balaju & K2 areas	General investigation of Patan, Balaju & K2 areas
25/" (Su.)	Discussion and investigation of areas concerned	Discussion and investigation of areas concerned	Discussion and investigation of areas concerned
26/" (M)	Discussion on basic design	Site investigation	Site investigation
27/" (T)	- ditto -	- ditto -	Market research
28/" (W)	- ditto -	- ditto -	Study on NEC revenue & expenditure and tariff
29/" (Th.)	- ditto -	- ditto -	Survey and interview to local contractors
30/" (F)	Discussion on Lain-chour and Thapathali switching stations	- ditto -	- ditto -
31/" (S)	Survey of transportation route	- ditto -	Survey of transportation route

Date	Mr. K. Nakajima	Mr. K. Katoh	Mr. W. Hirakawa
1/June (Su.)	Survey of transportation route	Site investigation	Survey of transportation route
2/" (M)	Discussion on proposed extension	- ditto -	- ditto -
3/" (T)	- ditto -	- ditto -	Survey and interview to local contractors
4/" (W)	Site investigation	- ditto -	- ditto -
5/" (Th.)	- ditto -	- ditto -	Market research
6/" (F)	- ditto -	- ditto -	- ditto -
7/" (S)	- ditto -	- ditto -	Site investigation
8/" (Su.)	- ditto -	- ditto -	- ditto -
9/" (M)	- ditto -	- ditto -	- ditto -
10/" (T)	Map study on new lines to suburb	- ditto -	- ditto -
11/" (W)	- ditto -	Mapping and counting of required materials & equip.	Mapping and counting of required materials & equip.
12/" (Th.)	- ditto -	- ditto -	- ditto -
13/" (F)	- ditto -	- ditto -	- ditto -
14/" (S)	- ditto -	- ditto -	- ditto -
15/" (Su.)	Drafting of investigation report	- ditto -	Drafting of investigation report
16/" (M)	- ditto - and reporting the project outline to Joint Secretary of Ministry of Finance	- ditto -	- ditto -
17/" (T)	Finalizing of investigation report	- ditto -	Finalizing of investigation report
18/" (W)	Trip (Kathmandu-Bangkok)	Trip (Kathmandu-Bangkok)	Trip (Kathmandu-Bangkok)
19/" (Th.)	Trip (Bangkok-Narita)	Trip (Bangkok-Narita)	Trip (Bangkok-Narita)