N. V. Energie Bedrijven Suriname (EBS)
The Republic of Suriname

No. 1

BASIC DESIGN STUDY REPORT ON THE PROJECT FOR THE EXPANSION OF TRANSMISSION AND DISTRIBUTION GRID FOR THE DISTRICTS COMMEWIJNE AND SARAMACCA IN THE REPUBLIC OF SURINAME

NOVEMBER, 1999

JAPAN INTERNATIONAL COOPERATION AGENCY
YACHIYO ENGINEERING CO., LTD.

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PREFACE

In response to a request from the Government of the Republic of Suriname, the Government of Japan decided to conduct a basic design study on the Project for the Expansion of Transmission and Distribution Grid for the Districts Commewijne and Saramacca in the Republic of Suriname and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Suriname a study team from April 25 to June 6, 1999.

The team held discussions with the officials concerned of the Government of Suriname, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Suriname in order to discuss a draft basic design, and as this result, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Suriname for their close cooperation extended to the teams.

November, 1999

Kimio Fujita
President
Japan International Cooperation Agency

LETTER OF TRANSMITTAL

November, 1999

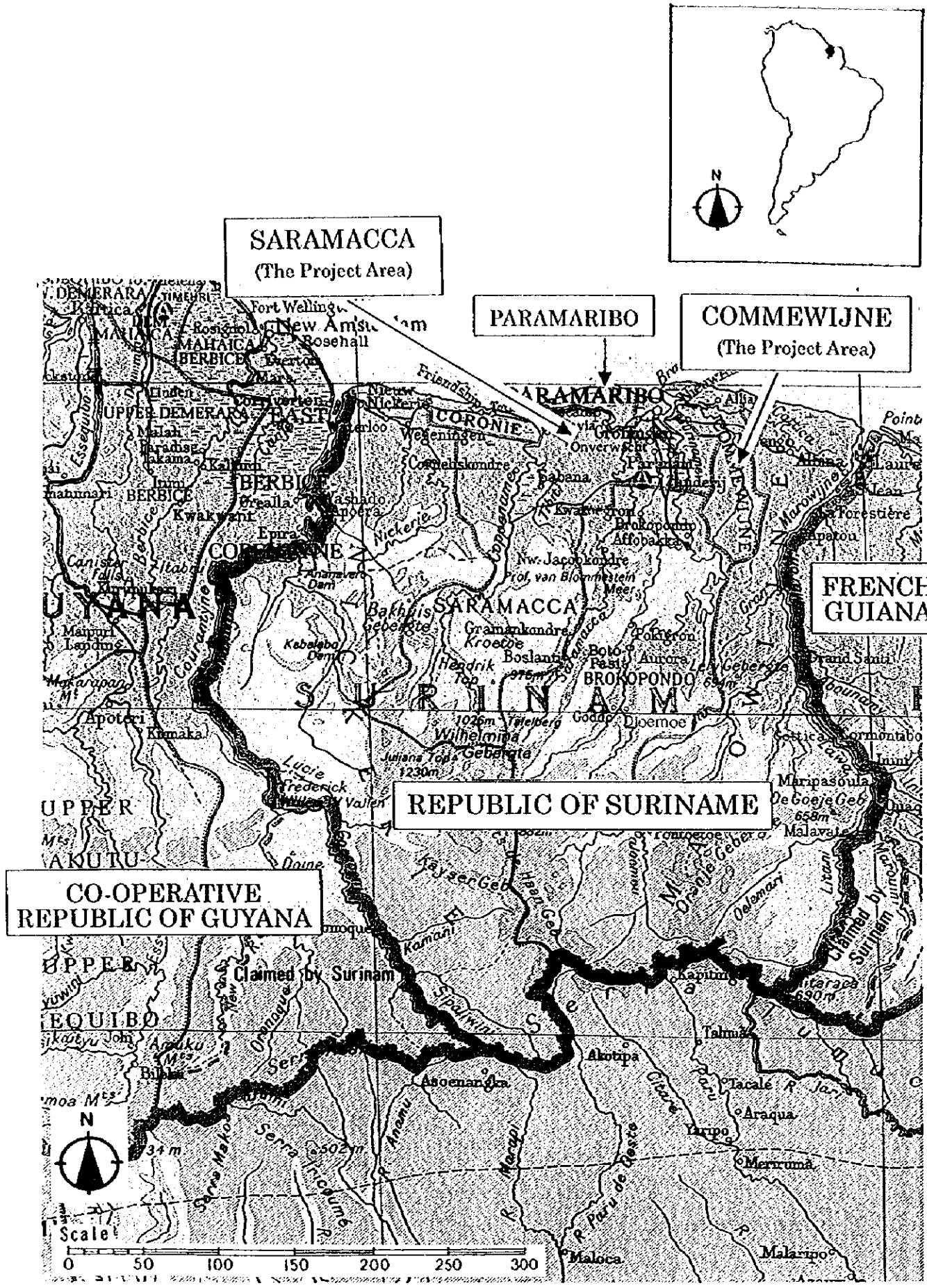
We are pleased to submit to you the basic design study report on the Project for the Expansion of Transmission and Distribution Grid for the Districts Commewijne and Saramacca in the Republic of Suriname.

This study was conducted by Yachiyo Engineering Co., Ltd., under a contract to JICA, during the period from March 29, 1999 to November 9, 1999. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Suriname and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

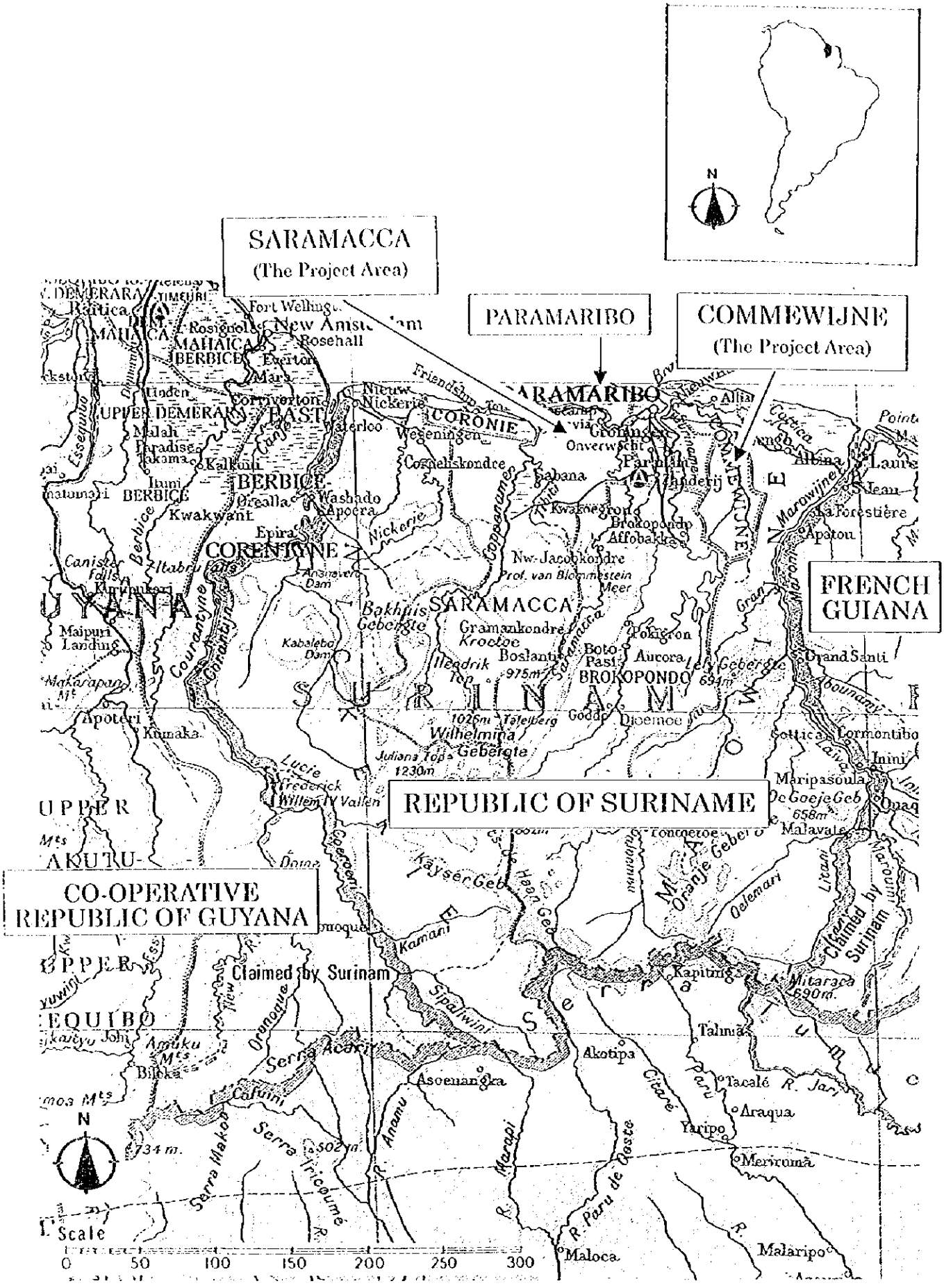
Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,

Mitsuhisa Nishikawa
Project Manager,
Basic design study team on the Project for
the Expansion of Transmission and Distribution Grid for
the Districts Commewijne and Saramacca
Yachiyo Engineering Co., Ltd.



Map of Suriname



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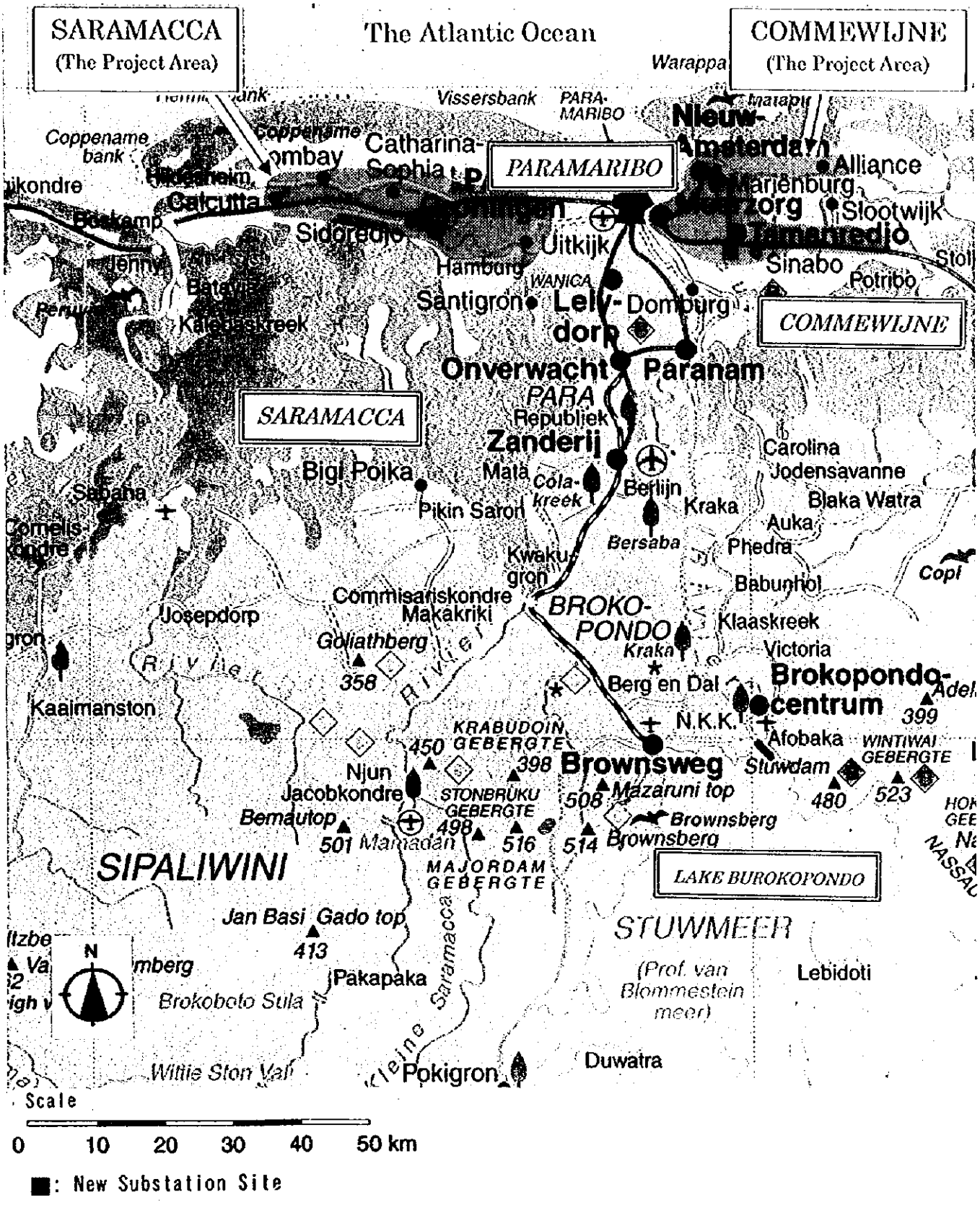


Map of Project Site

Map of Project Site

ABBREVIATIONS

CBB	Centaal Bureau voor Burgerzaken (Central Bureau for Statistics)
EBS	N.V. Energie Bedrijven Suriname
EC	European Commission
E/N	Exchange of Notes
GDP	Gross Domestic Product
IEC	International Electrotechnical Commission
JEAC	Japan Electric Association Code
JEC	Japanese Electrotechnical Committee
JEM	Standards of Japan Electrical Manufacturers' Association
JICA	Japan International Cooperation Agency
JIS	Japanese Industrial Standards
IPP	Independent Power Producer
O & M	Operation and Maintenance
OJT	On-the-Job Training
OLTC	On-Load Tap Changer
SCADA	Supervisory Control and Data Acquisition
Sf	Suriname Guilder (official rate: 1 US$ = 790 Sf as of the end of May, 1999)

CONTENTS

LIST OF FIGURES AND TABLES

CHAPTER 1

BACKGROUND OF THE PROJECT

CHAPTER 1
BACKGROUND OF THE PROJECT

The Republic of Suriname (hereinafter referred to as Suriname) was governed by the Netherlands until its independence in 1975. Even today, the Netherlands is still Suriname's largest donor and maintains a close relationship with the country. The main industry of Suriname is the production and export of bauxite. Although the export of such natural resources as wood and oil is hoped for in addition to bauxite, the social instability since independence and the sluggish prices of these export products have prevented the development of export industries. Suriname has a population of approximately 434,000 (1997 statistics), most of which live on the fertile plains in the north. Some 228,000 people, more than half of the total population, live in the capital, Paramaribo (1997 statistics). While there is still continuous migration to the capital region, the slow progress of social infrastructure development due to the budgetary shortage of the competent authorities has prevented improvement of the local standard of living and industrial development.

Northern parts of both Commewijne District and Saramacca District which comprise the Project Area are adjacent to the capital region and are expected to see industrial development as well as to absorb the increasing population in the capital region. Accordingly, the Government of Suriname believes that improvement of the social infrastructure in these districts is essential.

The electricity sector in Suriname is run by the N.V. Energie Bedrijuen Suriname (EBS). While the EBS supplies electricity to residential areas in the capital region as well as to local areas, there is no national transmission grid. Although the diesel power stations owned by the EBS supply electricity to Paramaribo and the surrounding area, the electricity demand is mainly met by means of the purchase of electricity from the hydropower and thermal power stations owned by a private mining company (SURALCO). Sufficient electricity is supplied to Paramaribo and the surrounding area by these power sources via the local transmission and distribution grid. In contrast, most of the northern parts of the Commewijne and Saramacca Districts are not connected to the power grid serving Paramaribo. Meanwhile, the stability of the electricity supply and equipment capacity are inadequate in most parts of the northern Commewijne and Saramacca Districts and some areas do not even have electricity supply.

Against this background, the Government of Suriname formulated the National Multi-Annual Development Programme (1994 - 1999) for the Commewijne and Saramacca Districts to improve the standard of living by means of improving the social infrastructure, including the electricity supply and road networks. In the electricity sector, there is a transmission and

distribution grid expansion project to connect these two districts to the power grid around Paramaribo with a view to providing these districts with a stable supply of electricity and this project commands high implementation priority. Nevertheless, there is no realistic prospect of project implementation because of the government's budgetary shortage, resulting in a request to the Government of Japan for the implementation of the project for the Expansion of Transmission and Distribution Grid for the Districts Commewijne and Sarawacca (hereinafter referred to as the Project) with Japan's grant aid.

[Contents of the Request]

(1) Construction of Substations

1) Construction of New La Paix Substation in Commewijne District

One main transformer (10 MVA; 33/12.6 kV); three 33 kV switchgear panels; seven 12.6 kV switchgear panels; one set of remote control and protection panels; one DC supply system; all necessary civil and building work

2) Construction of New Sidodadiweg Substation in Saramacca District

One main transformer (10 MVA; 33/12.6 kV); three 33 kV switchgear panels; seven 12.6 kV switchgear panels; one set of remote control and protection panels; one DC supply system; all necessary civil and building work

3) Expansion of Existing Substation B

One 33 kV switchgear panel; one remote control and protection panel; others

4) Expansion of Existing Substation D

One 33 kV switchgear panel; one remote control and protection panel; others

5) Spare Parts and Operation and Maintenance Manuals

Spare parts (for one year); operation and maintenance manuals; set of tools

(2) Procurement of Equipment and Materials for Construction of Transmission and Distribution Lines

1) Equipment and Materials for 33 kV Transmission Line in Commewijne District

(a) Underground cables and accessories from the existing Substation B to the riverside of Suriname River Bridge (approximately 1.6 km)

(b) Cables and accessories to cross Suriname River Bridge (approximately 1.7 km)

(c) Materials (Conductors, grounding wires, insulators, steel arms, steel poles, etc., excluding wooden poles) for new 33 kV overhead transmission line (approximately 16.5 km) from Meerzorg, the crossing point of Suriname River, to the La Paix Substation to be newly constructed under the Project

2) Equipment and Materials for 12.6 kV Distribution Line in Commewijne District

(a) Materials (Conductors, grounding wires, insulators, steel arms and pole-mounted transformers, etc., excluding wooden poles) for new 12.6 kV distribution line (approximately 13 km)

(b) Underwater cables and accessories to cross Commewijne River (approximately 1.5 km)

3) Equipment and Materials for 33 kV Transmission Line in Saramacca District

(a) Materials (Conductors, grounding wires, insulators, steel arms, steel poles, etc., excluding wooden poles) for new 33 kV overhead transmission line from the connection point of the existing 33 kV transmission line (Garnizoenspad) to the new Sidodadiweg Substation (approximately 23 km)

(b) 33 kV underground cables and accessories for the Saramacca Bridge section (approximately 0.8 km)

4) Materials for 12.6 kV Distribution Line in Saramacca District

(a) Materials (cables, grounding cables, insulators, steel arms, pole-mounted transformers, etc., excluding wooden poles) for new 12.6 kV distribution line (approximately 42 km)

(b) 12.6 kV underground cables and accessories for the Saramacca Bridge section (approximately 0.8 km x two lines)

5) Installation and Operation and Maintenance Manuals

Set of installation and operation and maintenance manuals for 1) through 4) above.

In the original request, the use of underwater cable was planned to cross Suriname River, running from existing Substation A located at the Paramaribo Power Station to Meerzorg Town on the opposite bank. At the time of explanation of the draft Basic Design Report to the Surinamese side, however, it was confirmed that Suriname Bridge under construction is likely to be completed by May, 2000. Consequently, it was decided to use the said bridge as the cabling route in view of the improved safety of the transmission line construction work and ease of future maintenance work. Following this change of the cabling route, it was also decided to change the substation for the installation of a 33 kV switchgear panel from the originally requested Substation A of the Paramaribo Power Station to Substation B.

In regard to the extension of the 33 kV transmission line to the Saramacca District, the original request listed existing Substation E for the installation of a 33 kV switchgear feeder panel. However, such installation would require major remodelling of the said substation, necessitating large funding. Moreover, it was found possible to use one of the two transmission lines connecting existing Substation D to Substation E. In view of this prospect, the installation site of the new 33 kV switchgear feeder panel to be procured under the Project was changed to existing Substation D located in the western part of Paramaribo.

In the case of the procurement of pole-mounted transformers for distribution grid, the Suriname side requested the inclusion of such transformers to serve consumers waiting to be connected to the existing distribution grid. While the procurement of pole-mounted transformers for areas with many waiting consumers and of high priority is included in the Project, the procurement of such transformers for other areas to be connected to the existing distribution grid is excluded from the Project and is left to the self-reliant efforts of the Surinamese side.

Overhead grounding wires for the 33 kV transmission line in Saramacca District which were requested by the Surinamese side during the field survey are included in the scope of procurement under the Project in view of their necessity to protect the new substation.

CHAPTER 2

CONTENTS OF THE PROJECT

CHAPTER 2
CONTENTS OF THE PROJECT

2.1 Objective of the Project

No medium-term or long-term economic development plan was formulated for a long time in Suriname following its independence in 1975. Twenty years after independence, the Multi-Annual Development Programme was formulated for the first time with its main emphasis on the improvement of social infrastructure together with the promotion of agriculture and fisheries. Under this Programme, Commewijne District and Saramacca District (comprising the Project Area) lying to the east and west of Paramaribo respectively are expected to benefit from increasing decentralisation, industrial development and the improvement of basic infrastructure following the population increase in the expanding capital region.

The Project is considered to be part of the social infrastructure improvement which is essential to achieve an improved standard of living, stable operation of social and public facilities and industrial development to promote "the development of agriculture and fisheries and the improvement of social infrastructure" as a major policy of the Multi-Annual Development Programme. The objective of the Project is the construction of 33 kV transmission and 12.6 kV distribution grids capable of meeting the power demand upto the year 2006 in order to establish a consistent transmission and distribution grid through the connection of the new grids to the existing 12.6 kV distribution grid to create an efficient power supply system in unelectrified areas and electrified areas where the power supply is unstable despite their proximity to the capital region.

2.2 Basic Concept of the Project

Suriname has a population of approximately 434,000 (1997 statistics), most of which live on the fertile plains in the north. Some 228,000 people, more than half of the total population, live in the capital, Paramaribo (1997 statistics). While there is still continuous migration to the capital region, the slow progress of social infrastructure development due to the budgetary shortage of the competent authorities has prevented improvement of the local standard of living and industrial development.

The electricity sector in Suriname is run by the EBS. While the EBS supplies electricity to residential areas in the capital region as well as local areas, there is no national transmission grid. The electricity demand in Paramaribo and the surrounding area is met by a diesel power station (rated output: approximately 60 MW) operated by the EBS and purchased electricity

from the hydropower and thermal power stations owned by a private mining company (SURALCO).

The transmission and distribution grid in Paramaribo is uniformly managed by the EBS but the extension of the main 33 kV transmission line to the ever expanding distribution area has made slow progress. As a result, power supply to meet the demand in the suburban areas located in Saramacca and Commewijne Districts uses the 12.6 kV distribution lines crossing either Saramacca River or Suriname River. Power supply to the other 10 scattered user areas is independently conducted by small diesel power generating units.

The consumer areas around Paramaribo, including the northern parts of Saramacca and Commewijne Districts, suffer from a large voltage drop because of the distribution distance involved. In addition, the power supply is unstable and uneconomical because of the distribution capacity shortage. Moreover, some areas are not even electrified. Under these circumstances, the EBS hopes to establish an efficient as well as stable power supply system by means of the new construction of 33 kV transmission lines and substations in these areas to create a consistent grid through their connection to the existing 12.6 kV distribution grid.

Although the Government of Suriname and the EBS have been constructing the transmission and distribution grid with their own funding, the scale of the work has so far been small. The transmission and distribution grid extension project for Saramacca and Commewijne Districts for which a request has currently been made to the Government of Japan was, in fact, previously requested to the EC in 1996. As the EC adopted a policy of loan extension for the project, both sides failed to agree on the loan conditions, resulting in cancellation of the project. The Government of Suriname then reviewed and revised the project as "the Project for Expansion of Transmission and Distribution Grid for the District of Saramacca" with a view to obtaining grant aid and made a request for assistance to the Government of Japan.

The basic concept of the Project is, therefore, expansion of the transmission and distribution grid serving Paramaribo and the surrounding area (EPAR system) to the northern parts of Saramacca and Commewijne Districts to create a sufficient power supply capacity which will constitute important social infrastructure in areas of an expected continuous population increase and industrial development due to expansion of the capital region. To be more precise, substations and the 33 kV transmission grid will be newly constructed together with the procurement of equipment and materials to expand and reinforce the existing 12.6 kV distribution grid for the purposes of improving the local standard of living and ensuring stable socioeconomic activities.

2.3 Basic Design

2.3.1 Design Concept

(1) Natural Conditions

1) Temperature

The temperature in the Project Area is constantly high throughout the year, ranging from approximately 22°C (mean annual minimum temperature) to 34°C (mean annual maximum temperature). As the planned substations will be equipped with outdoor use metal-enclosed type switchgear panels, their structure should be carefully designed, including the installation of a ventilation system, so that a temperature increase inside the switchgear due to the high ambient temperature and direct sunlight does not disrupt the operation and maintenance of the equipment because of an increase of the temperature inside the switchgear panels beyond the temperature range for normal operation.

2) Relative Humidity and Rainfall

The relative humidity is 60 - 90% throughout the year, causing discomfort, particularly during the rainy season. The installation of a space heater will be considered for closed substation and transmission/distribution equipment to prevent condensation due to temperature fluctuations. Rainwater drainage facilities, etc. will be constructed on the substation premises to prevent standing rainwater from disrupting the operation and maintenance of the substation equipment.

(2) Social Conditions

While a certain level of convenience is expected in Paramaribo, the capital of Suriname, there is a large gap between the capital and local areas in terms of the living infrastructure, highlighted by the low level of infrastructure development in terms of not only the power supply but also the water supply and telecommunications networks in local areas, including the Project Area. Local areas also lack adequate medical facilities, posing an inconvenience for long stays by foreigners. It will, therefore, be necessary for the planning of the substation construction project to incorporate the introduction of many temporary facilities.

(3) Local Construction Industry

There has been no large-scale construction work in Paramaribo, reflecting Suriname's sluggish economic situation. Even though there are several general construction companies

in the capital region, these are of a relatively small size with some 200 employees, including around 10 engineers.

The number of construction works is even smaller in the Project Area and infrastructure development has been long delayed. Consequently, no local construction company exists, making reliance on a construction company in Paramaribo necessary. Accordingly, it will be necessary for the implementation plan to take the transportation method of the construction equipment and materials from the capital and the introduction of the necessary facilities for the site offices into careful consideration.

Equipment installation work at substations has so far been directly conducted by the EBS in many cases. As a result, there is no private company with the high technical capability and specialist expertise required for the installation, test operation and adjustment of substation equipment. The dispatch of Japanese engineers is, therefore, desirable to supervise the substation equipment installation work under the Project.

(4) Use of Local Construction Companies and Materials

1) Use of Local Construction Companies

As described earlier, there are several general construction companies in Paramaribo. As the local procurement of transport vehicles and construction equipment as well as the recruitment of local workers are relatively easy, the subcontracting of the foundation work, exterior work and building work of the control house, etc. to local companies is possible.

Meanwhile, the use of local companies for the installation of substation equipment will be difficult because of their lack of experience of this type of work which requires a high level of technical ability and specialist expertise. Consequently, apart from the recruitment of local works and the procurement of transport vehicles, etc. in Suriname, the dispatch of Japanese engineers will be required together with the possible dispatch of equipment testing and adjustment staff to ensure both schedule and quality control.

2) Use of Locally Available Materials

The project implementation plan should consider the use of locally available materials as much as possible.

(5) Maintenance Capability of Project Implementation Agency

The EBS has been directly engaged in the operation and maintenance of the transmission and distribution grid, including 33 kV transmission lines, in the capital region. It also conducts the appropriate operation and maintenance of substations similar to those planned under the Project and these substations are operating in good condition.

Judging from the current maintenance conditions of the existing facilities, EBS operators are believed to have good expertise in regard to the maintenance of common substation as well as transmission/distribution equipment. However, it may be the case that their knowledge of the latest equipment to be installed under the Project is inadequate. Therefore, Japanese engineers will provide OJT (on the job training) on the operation and maintenance of the new substation equipment during the construction/installation period in view of the effective and efficient operation of the new equipment.

As it is possible that the EBS does not fully possess the latest operation and maintenance skills for the installation equipment of the 12.6 kV underwater cable, OJT on the relevant equipment will be provided by engineers of the Japanese cable manufacturer.

(6) Scope and Grade of Facilities, Equipment and Materials

The scope for the procurement and installation of the equipment and materials under the Project and their technical grades and level are determined based on the following principles, taking the conditions described in (1) - (5) above into consideration.

1) Scope of Facilities, Equipment and Materials

The minimum configuration of the facilities and their specifications should be selected in view of the construction of new substations and 33 kV transmission grid and the procurement of substation and transmission equipment and materials to expand and reinforce the existing 12.6 kV distribution grid with a view to improving the local standard of living, making social welfare facilities active and ensuring stable socioeconomic activities by means of creating an adequate power supply capacity as an important component of the social infrastructure in the northern parts of the Commewijne and Saramacca Districts, where continuous population increase and industrial development are expected to take place due to the expansion of the capital region, by the target year of 2006.

2) Grade

Special consideration must be given to the grades of the substation and transmission/distribution equipment to be procured under the Project so that the technical requirements do not exceed the technical capability of the EBS which will be responsible for the operation and maintenance of such equipment after the completion of the Project. The transmission and distribution equipment and materials should be selected to suit the level of installation skill of the EBS as the EBS will be responsible for their installation.

2.3.2 Basic Design

(1) Preconditions

1) Power Demand Forecast for the Project Area

(a) Increasing Trend of Peak Demand in Capital Region (EPAR System)

The EBS, the project implementation agency on the Suriname side, has recorded the peak demand of the EPAR system since 1966. Table 2-3-1 shows the peak demand of the EPAR system for the past 12 years and the trend of the GDP for the same period.

Table 2-3-1 Peak Demand of EPAR System and GDP

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Peak Demand of EPAR System (MW)	53.3	53.8	55.1	58.5	60.3	64.2	62.1	58.9	62.1	67.9	72.6	80.7
GDP (excl. Gov. Adm. & Defense) [constant prices (million Sf) in 1998]	891	984	1,036	1,024	1,063	1,081	1,065	1,094	1,081	1,225	1,285	NA

Note: Average Annual Increase Ratio
① Peak demand: 1,038 (from 1987 to 1998)
② GDP: 1,039 (from 1987 to 1997)
Source: EBS and CBB

As the above table shows, the average increase rate of the peak demand for the EPAR system for the 12 year period from 1987 to 1998 was 1.038 (approximately 1.04) which was almost identical to the GDP growth ratio of 1.039 (approximately 1.04) from 1987 to 1997.

In general, the annual increase rate of the power demand is in proportion to the GDP growth rate, supporting the trend in Suriname. Accordingly, the annual increase rate used for the power demand forecast for the Project is set at 4%.

(b) Present Load in Project Area

Although the EBS does not possess clear records of the historical changes of the peak demand in the Project Area, it does have records of the peak load of each feeder at substations involved in the Project and operation records of the peak demand by independent power stations. Using these records, the estimated present load in the Project Area is shown in Table 2-3-2.

Table 2-3-2 Present Load in Project Area (1999)

District	Substation/Power Station	Load (kW)	Load (kVA)
Commewijne	Substation A (feeder for Meerzorg)	2,700.0	2,749.6
	Canawapibo Power Station	154.0	192.5
	Alliance Power Station	205.0	256.3
	Total	3,059.0	3,198.3
Saramacca	Substation E (feeder for Uitkijk)	1,186.6	1,396.0
	Lareco Power Station	114.0	142.5
	Total	1,300.6	1,538.5

Notes: 1. The data on kW and kVA for Substation A and Substation E is based on the operation records of the EBS.
2. The data on power stations is based on operation records (kW) for 1998 and kVA is calculated on the basis of pf = 0.8 (estimate).

Source: EBS

(c) Estimated Load for Waiting Consumers in Project Area

The EBS still has consumers awaiting connection with the EPAR system in the Project Area despite their expressed wish for connection and has estimated the load required to meet this demand. Failure to serve these consumers so far can be attributed to the following.

- The distribution line capacity is too small.
- The distance to reach these consumers is prohibitively long vis-a-vis the construction of a new distribution line.
- Distribution transformers cannot be installed because of the financial situation.

Table 2-3-3 and Table 2-3-4 show the waiting consumer list for the Commewijne District and Saramacca District respectively as of 1997. These tables also show the estimated load demands for 1998 and 1999, calculated on the basis of the annual demand increase rate of 4% as described in (a) above. The figures include the load for new consumers to be served by the newly extended 12.6 kV distribution line under the Project although their areas are currently unelectrified.

The estimated load demand of waiting consumers in the Commewijne District in 1999 is approximately 2,830 kVA (1,920 kVA for consumers awaiting connection with existing distribution lines and 910 kVA awaiting connection with new distribution lines) while the corresponding load in the Saramacca District is approximately 3,780 kVA (1,360 kVA for consumers awaiting connecting with existing distribution lines and 2,420 kVA awaiting connection with new distribution lines).

Table 2-3-3 Load List of Waiting Consumers in Commewijne District

(Unit: kVA)

Lines	Area No.	Area	1997	1998	1999
		Annual Increase Rate	-	1.04	1.04
Existing Lines	1	Tamanredjo-Welbedacht	554.0	576.2	599.2
	2	Oost-West Verbinng	30.0	31.2	32.4
	3	Meerzorg	25.0	26.0	27.0
	4	Tamanredjo	25.0	26.0	27.0
	5	Pandit Titakdariweg	25.4	26.4	27.5
	6	Marienburgoroj	6.0	6.2	6.5
	7	Alkmar	5.0	5.2	5.4
	8	New Amsterdam-Zoelen	24.0	25.0	26.0
	9	Comm. Thurkoweg (Commercial)	830.0	863.2	897.7
	10	Canawapibo	246.0	255.8	266.1
	Total (Existing Lines)		1,770.4	1,841.3	1,914.9
New Lines	11	Tamanredjo-Meerzorg	843.1	876.8	911.9
	Total (New Lines)		843.1	876.8	911.9
Grand Total			2,613.5	2,718.0	2,826.8

Note: Calculated using EBS data for 1997.

Table 2-3-4 Load List of Waiting Consumers in Saramacca District

(Unit: kVA)

Lines	Area No.	Area	1997	1998	1999
		Annual Increase Rate	-	1.04	1.04
Existing Lines	1	Catharine Area (Commercial)	415.0	431.6	448.9
	2	La Proveyance (Commercial)	149.0	155.0	161.2
	3	Josi Area (Commercial)	55.0	57.2	59.5
	4	Tambaredjo (Commercial)	332.0	345.3	359.1
	5	Dam Malang	1.0	1.0	1.0
	6	Vankweg	31.0	32.2	33.5
	7	Saramaccaweg	29.0	30.2	31.4
	8	Groningen	55.0	57.2	59.5
	9	Kochweg	25.0	26.0	27.0
	10	Kampong Baroe	29.0	30.2	31.4
	11	Saramacca 3 Sprong	137.3	142.8	148.5
	Total (Existing Lines)		1,258.3	1,308.6	1,361.0
New Lines	12	Santa Maria (Commercial)	974.0	1,013.0	1,053.5
	13	Paloeloeweg	300.0	312.0	324.5
	14	Wayamboweg	750.0	780.0	811.2
	15	Damboentong	100.0	104.0	108.2
	16	Tigerkreek West	55.7	57.9	60.2
	17	Calcutta	70.3	73.1	76.0
	Total (New Lines)		2,237.6	2,327.1	2,420.1
Grand Total			3,496.0	3,635.8	3,781.2

Note: Calculated using EBS data for 1997.

(d) Power Demand Forecast for Project Area

Table 2-3-5 shows the power demand forecast results upto the year 2010 based on the annual increase rate of the power demand, the existing peak demand as of 1999 and the demand forecast for waiting consumers, including new consumers, discussed in (a), (b) and (c) respectively.

According to Table 2-3-5, the peak demand in 2006, the target year of the Project, will be approximately 7.9 MVA for the Commewijne District and approximately 7 MVA for the Saramacca District.

Table 2-3-5 Power Demand Forecast for Project Area

(Unit: kVA)

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Annual Increase Ratio	-	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04
Commewijne District												
Existing Demand	3,198	3,326	3,459	3,597	3,741	3,891	4,046	4,208	4,377	4,552	4,734	4,923
Waiting Consumers	2,825	2,939	3,057	3,179	3,308	3,439	3,576	3,719	3,868	4,023	4,184	4,351
Total Demand	6,025	6,266	6,516	6,777	7,048	7,330	7,623	7,928	8,245	8,575	8,918	9,275
Saramacca District												
Existing Demand	1,539	1,600	1,664	1,731	1,800	1,672	1,947	2,025	2,106	2,190	2,277	2,368
Waiting Consumers	3,781	3,932	4,090	4,253	4,424	4,600	4,784	4,976	5,382	5,382	5,597	5,821
Total Demand	5,320	5,533	5,754	5,984	6,223	6,472	6,731	7,000	7,572	7,572	7,875	8,189

Note: The target year of the Project is 2006.

2) Capacity and Required Number of Pole-Mounted Transformers

It will be necessary to install distribution pole-mounted transformers along the existing distribution lines for waiting consumers and along the new distribution lines to be constructed under the Project Area with a view to stepping down the 12.6 kV main distribution voltage to a lower distribution voltage (220 - 127 V) to serve consumers.

The capacity and number of such pole-mounted transformers to be procured under the Project are basically determined to meet the peak demand in the target year of 2006. However, in view of the requirements of Japan's grant aid scheme, pole-mounted transformers serving commercial and industrial consumers and those serving areas with a small load vis-a-vis consumers awaiting extension of the existing distribution lines are omitted from the scope of the Project as these should be procured by the self-reliant efforts of the Surinamese side.

In regard to the selection of pole-mounted transformers, the three phase four wire system will be employed for the secondary side of the transformer to reduce the voltage drop on the low voltage distribution lines and also to meet a relatively large load.

In regard to the transformer capacity, 50 kVA which is the standard transformer capacity at this time in Suriname will, in principle, be selected while 100 kVA will be selected for areas with a high demand. The required number of transformers is calculated based on the capacity of each distribution line. Table 2-3-6 and Table 2-3-7

show the required number and capacity of pole-mounted transformers for civil use in the Commewijne District and Saramacca District respectively. The pole-mounted transformers to be procured under the Project are those in brackets in these tables, totalling 66 units (50 kVA) and 12 units (100 kVA) (total: 78 units).

Table 2-3-6 Required Number of Pole-Mounted Transformers for Civil Use in Commewijne District

Lines	Area No.	Area	Demand in 2006 (kVA)	Required No. of TRF		Remarks
				50 kVA	100 kVA	
Existing Lines	1	Tamanredjo-Welbedacht	788.6	16 (16)	0	Along trunk road
	2	Oost-West Verbinng	42.7	1	0	
	3	Meerzorg	35.6	1	0	
	4	Tamanredjo	35.6	1	0	
	5	Pandit Tilakdariweg	36.2	1	0	
	6	Marienburgoroj	8.5	0	0	Included in No.5
	7	Alkmar	7.1	0	0	Included in No.5
	8	New Amsterdam-Zoelen	34.2	1	0	
	9	Comm. Thurkoweg (Commercial)	1,181.2	NA	NA	
	10	Canawepibo	350.0	7 (7)	0	Along trunk road
	Total (Existing Lines)		2,519.8	28 (23)	0	
New Lines	11	Tamanredjo-Meerzorg	1,200.0	0	12(12)	
	Total (New Lines)		1,200.0	0	12 (12)	
Grand Total			3,719.8	28 (23)	12 (12)	

Notes:
1. The demand in the year 2006 above is calculated in accordance with the waiting consumer list and annual increase ratio (1.04).
2. NA: transformers for commercial consumers are not considered in the required number of transformers.
3. Figures in brackets indicate the number of transformers to be procured under the Project.

Table 2-3-7 Required Number of Pole-Mounted Transformers for Civil Use in Saramacca District

Lines	Area No.	Area	Demand in 2006 (kVA)	Required No. of TRF		Remarks
				50 kVA	100 kVA	
Existing Lines	1	Catharine Area (Commercial)	590.7	NA	NA	
	2	La Proveyance (Commercial)	212.1	NA	NA	
	3	Josi Area (Commercial)	78.3	NA	NA	
	4	Tambaredjo (Commercial)	472.5	NA	NA	
	5	Dam Malang	1.4	0	0	Included in No. 11
	6	Vankweg	44.1	1	0	
	7	Saramaccaweg	41.3	1	0	
	8	Groningen	78.3	2 (2)	0	District Seat
	9	Kochweg	35.6	1	0	
	10	Kampong Baroe	41.3	1	0	
	11	Saramacca 3 Sprong	195.5	4 (4)	0	Dense residential area
	Total (Existing Lines)		1,791.0	10 (16)	0	
New Lines	12	Sarah Maria (Commercial)	1,386.3	NA	NA	
	13	Paloeloeweg	427.0	9 (9)	0	
	14	Wayamboweg	1,050.0	21 (21)	0	
	15	Damboentong	142.3	3 (3)	0	
	16	Tigerkreek West	79.2	2 (2)	0	
	17	Calcutta	100.0	2 (2)	0	
	Total (New Lines)		3,184.8	37 (37)	0	
Grand Total			4,975.8	47 (43)	0	

Note: see Table 2-3-6

(2) General Plan

Having examined the preconditions described in (1) above, the following conditions are set to determine the scale and specifications of the facilities, equipment and materials for the Project.

1) Climatic Conditions

(a) Temperature

- Annual mean daily temperature : 26.0°C
- Annual mean monthly minimum temperature : 21.6°C
- Annual mean monthly maximum temperature : 33.7°C

- Extreme minimum temperature : 18.2°C
- Extreme maximum temperature : 36.8°C

(b) Relative Humidity

- Maximum relative humidity : 90.0%

(c) Wind

- Maximum wind velocity (gust) : 28.0 m/sec
- Average wind velocity : 3.0 - 5.0 m/sec
- Hurricanes : none
- Wind direction : dominated by northeasterly trade wind except for July, August and November when a southeasterly wind prevails

(d) Altitude : approx. 5.0 m above sea-level

(e) Wet and Dry Seasons

- Major wet season : May to August
- Major dry season : August to December
- Minor wet season : December to February
- Minor dry season : February to May

(f) Rainfall

- Mean monthly rainfall : 170 - 180 mm
- Monthly rainfall in major wet season : 200 - 300 mm

(g) Earthquakes : no earthquakes are recorded in Suriname

(h) Thunderstorms : 25 times/year on average

2) Soil Survey Findings on Bearing Capacity

A soil survey was conducted by the local soil investigation company at the two planned construction sites for the new substations in May, 1999 and the determined bearing capacity is listed below.

- La Paix Substation Site : 20.0 tons/m^2 (see attached Boring Test Report)
- Sidodadiweg Substation Site : 6.0 ~ 8.0 tons/m^2 (see attached Boring Test Report)

Based on the above findings, the soil investigation company proposed the same type of foundations for both sites as described below.

- Transformer foundations : spread foundations with the foundation bed 1 m below the ground level
- Control room foundations : continuous footings with the foundation bed 1.5 m below the ground level

3) Electrical System

(a) Transmission voltage : 33 kV
- three phase three wire (rated voltage)

(b) Distribution voltage : 12.6 kV
- three phase three wire (rated voltage)
220 - 127 V
- three phase four wire

(c) Frequency : 60 Hz

(d) Earthing system : 33 kV transmission line
- effective earthing
12.6 kV distribution line
- neutral earthing (direct earth)

(e) Basic insulation level (BIL) : 33 kV transmission line
- BIL 170 kV
12.6 kV distribution line
- BIL 95 kV

(f) Line capacity : 33 kV transmission line
- 10 MVA/line
12.6 kV distribution line
- 3 MVA/line

4) Use of Existing Facilities

The following existing facilities will be used as part of the Project.

(a) La Paix Substation Construction Work

- Transformer foundations
- Control room
- Gate and perimeter fence

(b) 33 kV Transmission Line Construction Work

Existing 33 kV transmission line (one of two lines linking existing Substation D with existing Substation E for a distance of some 10.5 km)

5) Applicable Codes/Standards and Units

Such international standards as IEC and ISO are referred to for the design of the main functions of the equipment and materials to be procured under the Project. Meanwhile, the following Japanese standards are applied as the manufacturing standards for the equipment and materials. The International System of Units (SI) is used for the units.

(a) IEC : applied to the main functions of electrical goods in general

(b) ISO : applied to evaluate the performance of industrial products in general

(c) JIS : applied to industrial products in general

(d) JEC : applied to electrical goods in general

(e) JEM : as above

(f) JEAC : as above

(g) JCS : applied to electrical wires and cable

(h) Technical standards for electrical facilities in Japan :

applied to electrical work in general

(i) Other related Japanese and international standards :

applied to industrial products in general

(3) Outline of Basic Design

The outline of the basic design for the Project is shown in Table 2-3-8 based on the basic design concept described in 2.3.1.

Table 2-3-8 Outline of Basic Plan

Item	Quantity
[Procurement and Installation Plan for Substation Construction Work]	
1. New La Paix Substation	
(1) Main transformer (33/12.6 kV; 10 MVA; with OLTC)	1
(2) 33 kV outdoor switchgear panels (including transformer primary panel)	3
(3) 12.6 kV outdoor switchgear panels (including transformer secondary panel)	7
(4) DC supply system (outdoor cubicle-type)	1
(5) SCADA interface cubicle (outdoor-type)	1
(6) Indoor remote control and protection panels	5
(7) Auxiliary materials for above equipment (cables and conduit pipes, etc.)	one lot
(8) Outdoor lighting system	one lot
(9) Necessary civil and building works	one lot
2. New Sidodadiweg Substation	
(1) Main transformer (33/12.6 kV; 10 MVA; with OLTC)	1
(2) 33 kV outdoor switchgear panels (including transformer primary panel)	3
(3) 12.6 kV outdoor switchgear panels (including transformer secondary panel)	7
(4) DC supply system (outdoor cubicle-type)	1
(5) SCADA interface cubicle (outdoor-type)	1
(6) Indoor remote control and protection panels	5
(7) Auxiliary materials for above equipment (cables and conduit pipes, etc.)	one lot
(8) Outdoor lighting system	one lot
(9) Necessary civil and building works	one lot
3. Existing Substation B (Expansion)	
(1) 33 kV indoor switchgear panel	1
(2) DC supply system	1
(3) Indoor remote control and protection panel	1
(4) Auxiliary materials for above equipment (cables and conduit pipes, etc.)	one lot
4. Existing Substation D (Expansion)	
(1) 33 kV indoor switchgear panel	1
(2) DC supply system	1
(3) Indoor remote control and protection panel	1
(4) Auxiliary materials for above equipment (cables and conduit pipes, etc.)	one lot
5. Spare Parts and Maintenance Tools for above Substations	one lot
[Procurement Plan for Transmission and Distribution Lines]	
1. Materials for 33 kV Transmission Line	
(1) 33 kV overhead transmission conductors (ACSR)	127.0 km
(2) Overhead grounding wires	54.5 km
(3) 33 kV lightning arresters (single phase with surge counter)	33 pcs
(4) Suspension insulators (common use with 12.6 kV lines)	3,123 pcs
(5) Pin insulators	1,326 pcs
(6) Steel poles (15 m)	80 sets
(7) Pole fitting materials (for steel and wooden poles)	one set
(8) Cables for Suriname River Bridge(triplex 95 mm^2)	1,760 m
(9) Cables for Saramacca Bridge section (single core 95 mm^2 tape-armoured)	1,080 m
(10) Underground cables (between existing Substation B and Suriname River Bridge; single core 95 mm^2 tape-armoured)	4,200 m
(11) Substation connection cables (triplex cable 95 mm^2)	210 m
(12) Equipment and materials for installation of above cables	one lot

(cont.)

Item	Quantity
[Procurement Plan for Transmission and Distribution Lines]	
2. Materials for 12.6 kV Distribution Line	
(1) Pole-mounted transformers (50 kVA)	66 sets
(2) Pole-mounted transformers (100 kVA)	12 sets
(3) 12.6 kV overhead distribution conductors (ACSR)	192.8 km
(4) 12.6 kV lightning arresters (single phase)	231 pcs
(5) Open fuse cutouts (for distribution pole-mounted transformers)	165 pcs
(6) Open fuse cutouts (for 12.6 kV distribution line)	126 pcs
(7) Pin insulators	3,586 pcs
(8) Polefitting materials (for wooden poles)	one lot
(9) Underwater cables (to cross Commewijne River; three core 70 mm^2)	1,300 m
(10) Underground cables for Saramacca Bridge section (single core 70 mm^2 tape-armoured)	2,160 m
(11) Substation connection cables (triplex 70 mm^2)	390 m
(12) Equipment and materials for installation of above cables including those for underwater cables	one lot

(4) Substation Construction Plan

The substation construction work to be conducted by the Japanese side under the Project consists of the construction of the new La Paix Substation in the Commewijne District and the new Sidodadiweg Substation in the Saramacca District and the expansion work of the switchgear panels, etc. at existing Substation B and Substation D in Paramaribo. The equipment and materials to be used for the substation construction work will be selected on the basis of the following issues.

1) Basic Issues

In regard to the selection of the equipment and materials required for the construction (expansion) of substations, metal-enclosed switchgear panels will be selected for all four sites in order to shorten the installation period, taking ease of operation, maintenance and equipment safety after the completion of the work into consideration.

2) Capacities of Main Transformers

The capacities of the main transformers to be installed at the La Paix Substation and Sidodadiweg Substation will be based on the rated capacity listed by the IEC standard, taking the estimated peak demand in the target year of 2006 [7,928 kVA for the Commewijne District and 7,000 kVA for the Saramacca District as described in 2.3.2-(1)-1)] and efficient transformer operation (approximately 80% of the rated capacity) into consideration. The planned capacities of the transformers to be installed at these substations are described below.

(a) La Paix Substation

Peak demand (7,928 kVA) ÷ 0.8 = 9,910 kVA

Based on the rated capacity listed by the IEC standard, a transformer capacity of 10 MVA which is the nearest capacity above 9,910 kVA on the IEC list is selected.

(b) Sidodadiweg Substation

Peak demand (7,000 kVA) ÷ 0.8 = 8,750 kVA

Based on the rated capacity listed by the IEC, a transformer capacity of 10 MVA which is the nearest capacity above 8,750 kVA on the IEC list is selected.

3) Equipment Layout Plan

(a) La Paix Substation

The La Paix Substation will be constructed at Tamanredjo which is the second largest city in the Commewijne District. The EBS secured the substation site some seven years ago and has so far completed not only the site leveling work, gate and boundary fence but has also completed the structure work for the control room building and main transformer. Consequently, the use of the control room building and the existing foundations for main transformer for the Project is planned and the 33 kV outdoor switchgear panels and 12.6 kV outdoor switchgear panels will be installed around the main transformer. The remote control and protection panel will be installed in the control room building (see 2.3.2-(6) - Basic Design Drawing MS-01).

(b) Sidodadiweg Substation

The Sidodadiweg Substation will be located some 39 km west of the centre of Paramaribo, facing the trunk road (East-West Road) linking Suriname with neighbouring Guyana and near the three-way junction leading to Groningen (the District Seat), Coronie and Paramaribo. The diamond-shape site has a size of 40 m x 35 m and was acquired by the EBS in May, 1995 from the Government of Suriname for the Project. Consequently, the site is currently empty land with no existing facilities and it will be necessary for the work to start with site leveling work, including the replacement of soft soil and banking.

As the area along the road is some 40 cm lower than the road surface, making it vulnerable to flooding by rainwater, it is planned to install the substation equipment as far as possible from the road. While the 33 kV outdoor switchgear panels and 12.6 kV outdoor switchgear panels will be placed around the main transformer, the remote control and protection panel will be installed inside the control room building to be constructed under the Project (see 2.3.2-(6) - Basic Design Drawing NS-01).

(c) Existing Substation B

Existing Substation B is located at the junction between Martin Luther King Road and Saramacca Canal, some 4 km west of the centre of Paramaribo, and is the central substation of the EPAR system which comprises the transmission and distribution grid in Paramaribo and its surrounding area. One 33 kV switchgear panel to feed power to the La Paix Substation and a related DC supply system as well as a remote control and protection panel will be installed at this substation under the Project. Although the existing building has sufficient space for the DC supply system and the remote control and protection panel, the existing switchgear panel room is too small to accommodate the new switchgear panel, making it necessary for the EBS to expand the switchgear panel room (see 2.3.2-(6) - Basic Design Drawing BS-01).

(d) Existing Substation D

Existing Substation D is located some 6 km from the centre of Paramaribo along the East-West Road and is responsible for power distribution to consumers in the northwestern part of Paramaribo as well as for the transmission of 33 kV power to existing Substation E. One 33 kV switchgear panel to feed power to the Sidodadiweg Substation and a related DC supply system as well as a remote control and protection panel will be installed at this substation under the Project. The existing building has sufficient space for the installation of the new 33 kV switchgear panel at the side of the existing panel while the control room has enough space to accommodate both the DC supply system and the remote control and protection panel. However, the dimensions of the door of the switchgear room are too small to bring in the new switchgear panel, making it necessary for the EBS to replace it with a larger door (see 2.3.2-(6) - Basic Design Drawing DS-01).

4) Connection with SCADA System

The EBS plans to connect the existing SCADA system and the new substations to be constructed under the Project for remote control operation from the central control room at the Paramaribo Power Station. The following work will, therefore, be conducted at the new substations to enable the exchange of signals between the SCADA system and the new substations.

(a) La Paix Substation and Sidodadiweg Substation

As these substations will be newly constructed, a SCADA interface panel will be installed at the side of the 12.6 kV switchgear panel to allow the exchange of signals required for SCADA operation by the interface panels.

(b) Existing Substations B and D

A terminal board will be installed inside the remote control and protection panel to be procured under the Project to allow the exchange of the necessary signals with the existing SCADA interface panel.

5) Construction Plan for Each Substation

The details of the construction plan for each substation to be constructed/expanded under the Project are shown in Tables 2-3-9 through 2-3-12.

- La Paix Substation (New) : Table 2-3-9
- Sidodadiweg Substation (New) : Table 2-3-10
- Existing Substation B (Expansion) : Table 2-3-11
- Existing Substation D (Expansion) : Table 2-3-12

Table 2-3-9 Details of La Paix Substation Construction Plan

Item/Equipment	Specifications/Quantity
1. Construction of Facilities on Premises	
(1) Building services in control building	one lot (lighting, power outlets, air-conditioning, plumbing, fire extinguishers, etc.)
(2) Outdoor lighting	one lot
(3) Cable pits and rainwater drainage	one lot
(4) Foundations for switchgear and others	one lot
(5) Pit cover for existing transformer foundation	one lot
2. Procurement and Installation of Main Transformer	
(1) Type	Outdoor-type; oil-immersed self-cooling; OLTC
(2) Rated capacity/voltage	10 MVA, 33/12.6 kV, three phase
(3) Applicable standards	IEC
(4) Quantity	1
3. Procurement and Installation of 33 kV Switchgear Panel	
(1) Type	Outdoor use metal enclosed-type; air insulation
(2) Applicable standards	IEC/JIS/JEM
(3) Quantity	33 kV incoming panels: 2 33 kV transformer primary panel: 1
(4) Circuit breaker	Vacuum circuit breaker (36 kV, 630 A, 25 kA)
4. Procurement and Installation of 12.6 kV Switchgear Panel	
(1) Type	Outdoor use metal enclosed-type; air insulation
(2) Applicable standards	IEC/JIS/JEM
(3) Quantity	12.6 kV switchgear panels: 5 12.6 kV transformer secondary panel: 1 DC supply system: 1 12.6 kV house transformer panel: 1 SCADA interface panel: 1
(4) Circuit breaker	Vacuum circuit breaker (15 kV, 630 A, 12.5 kA)
5. Procurement and Installation of Remote Control and Protection Panels	
(1) Type	Indoor use metal enclosed-type; air insulated
(2) Applicable standards	IEC/JIS/JEM
(3) Quantity	33 kV remote control and protection panels: 2 12.6 kV remote control and protection panels: 3
6. Procurement and Installation of 33 kV Power Cables	
(1) Type	19/33 kV XLPE insulation; PVC sheath; copper conductor cable
(2) Applicable standards	IEC502
(3) Size	CVT 95 mm^2 (three core)
(4) Quantity	20 m
(5) Accessories	One lot of terminal treatment materials, etc.
7. Procurement and Installation of 12.6 kV Power Cables	
(1) Type	8.7/15 kV XLPE insulation; PVC sheath; copper conductor cable
(2) Applicable standards	IEC502
(3) Size	CV 240 mm^2 (single core)
(4) Quantity	60 m (20 m/phase x three phase)
(5) Accessories	One lot of terminal treatment materials, etc.
8. Procurement and Installation of Low Voltage Power and Control Cables, etc.	
(1) Low voltage cables	600 V XLPE insulation; PVC sheath; copper conductor cable
(2) Control cables	600 V XLPE insulation; PVC sheath; copper cable conductor
(3) Quantity	one lot
(4) Miscellaneous materials for cabling work	one lot (including grounding work materials)

Table 2-3-10 Details of Sidodadiweg Substation Construction Plan

Item/Equipment	Specifications/Quantity
1. Construction of Facilities on Premises	
(1) Construction of control building	
(2) Building services for control building	One lot (lighting, power outlets, air-conditioning, plumbing fire extinguishers, etc.)
(3) Outdoor lighting	One lot
(4) Foundations for transformer, switchgear panels, etc.	One lot
(5) Cable pits and rainwater drainage	One lot
2. Procurement and Installation of Main Transformer	
(1) Type	Outdoor-type; oil-immersed self-cooling; OLTC
(2) Rated capacity/voltage	10 MVA, 33/12.6 kV, three phase
(3) Applicable standards	IEC
(4) Quantity	1
3. Procurement and Installation of 33 kV Switchgear Panel	
(1) Type	Outdoor use metal enclosed-type; air insulation
(2) Applicable standards	IEC/JIS/JEM
(3) Quantity	33 kV incoming panels: 2 33 kV transformer primary panel: 1
(4) Circuit breaker	Vacuum circuit breaker (36 kV, 630 A, 25 kA)
4. Procurement and Installation of 12.6 kV Switchgear Panel	
(1) Type	Outdoor use metal enclosed-type; air insulation
(2) Applicable standards	IEC/JIS/JEM
(3) Quantity	12.6 kV switchgear panels: 5 12.6 kV transformer secondary panel: 1 DC supply system: 1 12.6 kV house transformer panel: 1 SCADA interface panel: 1
(4) Circuit breaker	Vacuum circuit breaker (15 kV, 630 A, 12.5 kA)
5. Procurement and Installation of Remote Control and Protection Panels	
(1) Type	Indoor use metal enclosed-type; air insulated
(2) Applicable standards	IEC/JIS/JEM
(3) Quantity	33 kV remote control and protection panels: 2 12.6 kV remote control and protection panels: 3
6. Procurement and Installation of 33 kV Power Cables	
(1) Type	19/33 kV XLPE insulation; PVC sheath; copper conductor cable
(2) Applicable standards	IEC502
(3) Size	CVT 95 mm^2 (three core)
(4) Quantity	20 m
(5) Accessories	One lot of terminal treatment materials, etc.
7. Procurement and Installation of 12.6 kV Power Cables	
(1) Type	8.7/15 kV XLPE insulation; PVC sheath; copper conductor cable
(2) Applicable standards	IEC502
(3) Size	CV 240 mm^2 (single core)
(4) Quantity	60 m (20 m/phase x three phase)
(5) Accessories	One lot of terminal treatment materials, etc.
8. Procurement and Installation of Low Voltage Power and Control Cables, etc.	
(1) Low voltage cables	600 V XLPE insulation; PVC sheath; copper conductor cable
(2) Control cables	600 V XLPE insulation; PVC sheath; copper cable conductor
(3) Quantity	one lot
(4) Miscellaneous materials for cabling work	one lot (including grounding work materials)

Table 2-3-11 Details of Existing Substation B Expansion Plan

Item/Equipment	Specifications/Quantity
1. Procurement and Installation of 33 kV Switchgear Panel	
(1) Type	Indoor use metal enclosed-type; air insulation
(2) Applicable standards	IEC/JIS/JEM
(3) Quantity	33 kV incoming panel: 1
(4) Circuit breaker	Vacuum circuit breaker (36 kV, 630 A, 26 kA)
(5) Isolator	Motor operated (3P-36 kV, 600 A)
2. Procurement and Installation of Remote Control and Protection Panel	
(1) Type	Indoor use metal enclosed-type; air insulation
(2) Applicable Standards	IEC/JIS/JEM
(3) Quantity	1
3. Procurement and Installation of DC Supply System	
(1) Type	Indoor use metal enclosed and independent-type
(2) Battery	NiCd alkaline-type
(3) Rated capacity/voltage	10 AH/DC 110 V
(4) Accessories	One lot
4. Procurement and Installation of Low Voltage Power and Control Cables, etc.	
(1) Low voltage cables	600 V XLPE insulation; PVC sheath; copper conductor cable
(2) Control cables	600 V XLPE insulation; PVC sheath; copper conductor cable
(3) Miscellaneous materials for cabling work	one lot (including grounding work materials)

Table 2-3-12 Details of Existing Substation D Expansion Plan

Item/Equipment	Specifications/Quantity
1. Procurement and Installation of 33 kV Switchgear Panel	
(1) Type	Indoor use metal enclosed-type; air insulation
(2) Applicable standards	IEC/JIS/JEM
(3) Quantity	33 kV incoming panel: 1
(4) Circuit breaker	Vacuum circuit breaker (36 kV, 630 A, 26 kA)
(5) Isolator	Motor operated (3P-36 kV, 600 A)
2. Procurement and Installation of Remote Control and Protection Panel	
(1) Type	Indoor use metal enclosed-type; air insulation
(2) Applicable Standards	IEC/JIS/JEM
(3) Quantity	1
3. Procurement and Installation of DC Supply System	
(1) Type	Indoor use metal enclosed and independent-type
(2) Battery	NiCd alkaline-type
(3) Rated capacity/voltage	10 AH/DC 110 V
(4) Accessories	One lot
4. Procurement and Installation of Low Voltage Power and Control Cables, etc.	
(1) Low voltage cables	600 V XLPE insulation; PVC sheath; copper conductor cable
(2) Control cables	600 V XLPE insulation; PVC sheath; copper conductor cable
(3) Miscellaneous materials for cabling work	one lot (including grounding work materials)

(5) Equipment Procurement Plan for 33 kV Transmission Line and 12.6 kV Distribution Line

The points described below must be carefully noted in regard to the procurement of equipment and materials for the 33 kV transmission line and 12.6 kV distribution line under the Project.

1) Basic Issues

(a) Easy and Safety of Maintenance

The specifications of the equipment and materials to be selected for the Project must not exceed the levels of existing transmission and distribution equipment with which EBS engineers are familiar in order to ensure easy and safe maintenance.

(b) Economy

In order to ensure an economical design which meets the requirements of Japan's grant aid scheme, the specifications of the equipment and materials should be standardized based on international standards as much as possible. The variety of equipment should be minimised to increase the interchangeability of equipment.

(c) Exchangeability with EBS Equipment

The specifications of the equipment and materials to be procured by the Japanese side should be compatible as much as possible with existing equipment and materials in the possession of or use by the EBS in view of uniform management.

2) Basic Construction Plan for Transmission and Distribution Lines

(a) Route Selection

The routes of the transmission and distribution lines have been jointly decided with EBS engineers for each district following desk work, field reconnaissance and confirmation of tentative routes prepared based on survey maps, existing transmission and distribution route maps and topographical maps, all of which were obtained from the EBS. The basic routes selected are shown in 2.3.2-(6) - Basic Design Drawings GG-02 and GG-03.

(b) Types of Electric Poles

Of the equipment and materials to be used under the Project, wooden poles are the only item available locally. As Suriname is endowed with tropical rain forests, a sufficient quantity of raw wood called Bruin Heart is locally available for the

production of wooden poles. While wooden poles of upto 11 m in length are treated for insect control and are preserved, tar is simply applied to the terminal section of any wooden pole of a longer length due to the absence of insect control and preservation facilities for long logs in Suriname. This means that as the 11 m long wooden poles for the 12.6 kV distribution line are treated for insect control and are preserved, they have sufficient strength and life expectancy. Meanwhile, the 15 m long wooden poles for the 33 kV transmission line are inadequate in terms of their strength and life expectancy because of the lack of proper treatment. Consequently, the following poles subject to strong tensile force among the poles for the 33 kV transmission line will be made of steel and will be procured in Japan.

① Dead end poles constantly subject to tensile force

② Angle poles (15°C or more) constantly subject to tensile force

③ Inter-connecting poles subject to strong tensile force at the time of construction work

Privately-owned electric pole processing factories in Suriname are generally of a small-scale and the EBS controls the number of factories where it places its orders depending on the scale of the planned procurement. As the procurement of a large number of wooden poles (approximetely 1,370 poles) will be necessary for the transmission and distribution lines to be constructed under the Project, the EBS should make the necessary budgetary appropriation as soon as possible to ensure the prompt delivery of poles by the factories to which orders are placed. The scope of the wooden pole procurement to be conducted by the EBS will include such miscellaneous materials as kicking block, number plates, warning signs, etc.

All equipment and materials other than wooden poles which are required for the construction of the new 33 kV transmission line and new 12.6 kV distribution line under the Project will be included in the scope of procurement for the Japanese side.

(c) Types of Bare Conductors for Overhead Transmission and Distribution Lines

ACSR (Aluminum Conductor Steel Reinforced) will be used as the bare conductors for the transmission and distribution lines to be constructed under the

Project to ensure compatibility with the standard EBS specifications and also to avoid any maintenance complications due to the use of different conductors.

(d) Installation of Pole-Mounted Transformers

Pole-mounted transformers will be installed to step down from 12.6 kV to 220 - 127 V for distribution to consumers. The transformer details are already described in 2.3.2-(1)-2).

(e) Protection from Lightning

33 kV and 12.6 kV arresters will be installed at the dead ends of the relevant transmission and distribution lines and pole-mounted transformer installation points to protect the substation equipment and pole-mounted transformers from lightning damage. Also, overhead ground wires will be installed above the 33 kV transmission line.

(f) Installation of Open Fuse Cutouts

In accordance with EBS standard, open fuse cutouts will be installed every 2 km and at the branching points of the distribution lines and also at the primary side (12.6 kV side) of each pole-mounted transformer for the maintenance and inspection of the distribution lines.

(g) Specifications for Suriname River Crossing Cable at Suriname Bridge

33 kV triplex cable will be installed on cable hangers which will be installed beside the maintenance footpath for the Suriname Bridge. These hangers should be provided by the Surinamese side.

(h) 33 kV Underground Cable (Between Existing Substation B and Suriname River Bridge)

As there are many existing distribution lines along the planned 33 kV transmission route from existing Substation B to the Suriname River Bridge, little space remains for a new overhead line. Moreover, should an overhead line be employed, there will be many crossing points with existing lines, suggesting a high level of risk vis-a-vis the construction work. Consequently, underground cable will be used for this section.

The 33 kV cable in question will be XLPE insulated single core cable with tape armor in view of easy workability and the prevention of external damage after installation and conduits will be employed at road crossing sections.

(i) Underwater Cable Specifications

The underwater cable to be used to cross Commewijne River will be "XLPE insulated 3 core cable with single layer galvanized steel (6mm dia with bitumen compound) armor underwater cable" to ensure sufficient resistance to tensile force at the time of cable installation work and to avoid damage due to the anchors of vessels, dumped materials, etc. At river bank sections, the cable will be laid inside cast iron protective pipe (20 m each for each side) in view of further protection.

(j) Cable Specifications for Saramacca Bridge Section

The Saramacca Bridge which crosses some 210 m of Saramacca River lies between existing Substation D and the Sidodadiweg Substation to be constructed under the Project. As this bridge is made of steel with sufficient strength to support large vehicles, the planned 33 kV transmission line and 12.6 kV distribution line under the Project will be placed in a cable tray to be attached to the piers of the bridge.

The 33 kV cable and 12.6 kV cable in question will be XLPE insulated single core cable with tape armor in view of easy workability and the prevention of external damage after laying.

(k) Cables for Substation Feeder Lines

The specifications of the cable to connect the 33 kV switchgear panel and 33 kV overhead transmission line on the premises of the new substations to be constructed under the Project will be the same as those of the cable to be used between the main transformer and the 33 kV switchgear panel at these substations in order to ensure exchangeability and easy workability as well as procurement. This cable will be XLPE insulated three core cable and protected by protective piping.

3) Quantities of Equipment and Materials Required for the Project

(a) Bare Conductor for Overhead Transmission and Distribution Lines

The quantities of the conductors required for the overhead transmission and distribution lines are calculated by multiplying the total length of these lines on the drawings by 1.13 which represents the margin. (The conductor length for the down sections from the overhead grounding wires are considered to be part of the polefitting materials.)

The margin used (13%) is based on figures commonly used in Japan and is the total of 3% for wire dip, 3% for work surplus and 7% for supplementary quantity.

The resulting procurement quantities of overhead transmission and distribution conductors and overhead grounding wires for the Project are shown in Table 2-3-13.

Table 2-3-13 Procurement Quantity of Conductors for Overhead Transmission and Distribution Lines and Grounding Wires

(Unit: km)

Item	Commewijne District	Saramacca District	Total
1. 33 kV Transmission Line	56.0	71.7	127.7
2. 12.6 kV Distribution Line	38.8	154.0	192.8
3. Overhead Grounding Wire	18.7	35.8	54.5

(b) Pole-Mounted Transformers

The total number of pole-mounted transformers to be procured under the Project is 78 as determined by the selection process described in 2.3.2-(1)-2) and is broken down as shown in Table 2-3-14.

Table 2-3-14 Procurement Quantity of Pole-Mounted Transformers

(Unit: set)

Item	Commewijne District		Saramacca District		Total	
Transformer Capacity	50 kVA	100 kVA	50 kVA	100 kVA	50 kVA	100 kVA
For Existing Distribution Lines	23	-	6	-	29	-
For New Distribution Lines	-	12	37	-	37	12
Total	23	12	43	-	66	12

(c) Arresters

Arresters will be installed to protect the pole-mounted transformers and high voltage cables. The number of installation places is, therefore, 88 places (55 for pole-mounted transformers, 11 places for 33 kV cable and 22 places for 12.6 kV cable) and the procurement quantities are 33 pcs for 33 kV (11 places x three phase) and 231 pcs for 12.6 kV (77 places x three phase).

(d) Open Fuse Cutout

Open fuse cutout switches will be installed at 2 km intervals along the distribution lines and at each branching point for line inspection and maintenance purposes. They will also be installed at the primary side (12.6 kV side) of each pole-mounted transformer to protect the transformer and also for the opening of a circuit at the time of inspection and maintenance. The procurement quantity of open fuse cutout switches is shown in Table 2-3-15.

Table 2-3-15 Procurement Quantity of Open Fuse Cutout

(Unit: pcs)

Purpose of Use	Commewijne District	Saramacca District	Total
Maintenance of Distribution Lines	18	108	126
Protection of Pole-Mounted Transformers	42	123	165
Total	60	231	291

Note: The above quantities include work spares (10%).

(e) Insulators and Pole-fitting Materials

In addition to the materials listed above, work-related materials also include insulators and pole-fitting materials. As the required quantities of these items for the Project are detailed in Basic Design Drawings PL1 through PL4 (Material Lists by Electric Pole Type), the quantities given in these drawings must be procured. In principle, the poles will be erected at an interval of some 100 m for the 33 kV transmission line (pole length 15m) and at an interval of some 80 m for the 12.6 kV distribution line (pole length 11m and 15m) in accordance with the relevant EBS standards. As individual erection sites may have special requirements depending on the type of pole (angle pole and branching pole), careful determination of the exact locations will be necessary to finalise the procurement quantity. Insulators, pole-fitting materials and other work-related

materials will include 10% or at least one set equivalent for work supply in addition to the design quantities in consideration of damage, etc. during the work.

Based on the above considerations, the procurement quantities of insulators and electric poles by type are shown in Table 2-3-16 and Table 2-3-17 respectively.

Table 2-3-16 Procurement Quantity of Insulators

(Unit: piece)

Type of Insulator	Commewijne District	Saramacca District	Total
Suspension Insulator (For 33 kV and 12.6 kV)	984	2,139	3,127
33 kV Pin Insulator	545	781	1,326
12.6 kV Pin Insulator	513	3,073	3,586

Note: The above quantities include work spares (10%).

(f) Electric Poles

The quantity of steel poles to be procured by the Japanese side and the wooden poles to be procured by the Surinamese side for the Project are shown in Table 3-3-17.

Table 3-3-17 Quantity of Electric Poles

Procuring Side	Type of Pole	Commewijne	Saramacca	Total
Japan	33 kV Steel Poles (15 m)	38	50	88
Suriname	33 kV Wooden Poles (15 m)	150	222	372
	12 kV Wooden Poles (15 m)	2	34	36
	12 kV Wooden Poles (11 m)	44	828	872
	Total	234	1,134	1,368

Table 2-3-18 Purpose of Use and Procurement Quantity by Pole Type

(Unit: poles)

Pole Type	Material	Purpose of Use	Pole Length (m)	Commewijne	Saramacca	Total
DM3	Wood	33 kV Intermediate Pole	15	44	82	126
SM3	Steel	33 kV Light Angle Pole	15	12	10	22
HM3	Steel	33 kV Heavy Angle Pole	15	2	2	4
BM3	Steel	33 kV Section Pole	15	3	13	16
OM3	Steel	33 kV Terminal Pole	15	2	2	4
DMC	Wood	33 kV and 12.6 kV Combination Intermediate Pole	15	106	140	246
SMC	Steel	33 kV and 12.6 kV Combination Light Angle Pole	15	5	19	24
HMC	Steel	33 kV and 12.6 kV Combination Heavy Angle Pole	15	3	-	3
BMC	Steel	33 kV and 12.6 kV Combination Section Pole	15	9	-	9
OMC	Steel	33 kV and 12.6 kV Combination Terminal Pole	15	2	4	6
YM1	Wood	12.6 kV T-off Pole	11	14	24	38
DM1	Wood	12.6 kV Intermediate Pole	11	3	632	635
SM1	Wood	12.6 kV Light Angle Pole	11	-	51	51
HM1	Wood	12.6 kV Heavy Angle Pole	11	2	23	25
BM1	Wood	12.6 kV Section Pole	11	-	18	18
OM1	Wood	12.6 kV Single Terminal Pole	11	5	3	8
LM1	Wood	12.6 kV Open Fuse Cutout Pole	11	6	36	42
TM1	Wood	12.6 kV Transformer Pole	11	14	41	55
DM1D	Wood	12.6 kV Dual Intermediate Pole	15	-	26	26
SM1D	Wood	12.6 kV Dual Light Angle Pole	15	2	2	4
HM1D	Wood	12.6 kV Dual Heavy Angle Pole	15	-	2	2
OM1D	Wood	12.6 kV Dual Terminal Pole	15	-	4	4

Note: The above quantities include work spares (10%).

(g) Suriname River Crossing Cable at Suriname bridge

The following quantity of Suriname River crossing cable at the Suriname Bridge is required in view of the bridge length, distance to the connection point with the overhead transmission line and work margin (10%)

33 kV triplex cable (95 mm^2): 1,760 m

(h) Underground Cable (From Existing Substation B to Suriname River Bridge)

Underground cable of 1,600 m in length for each phase, including work supply (approximately 10%) will be procured for the some 1,450 m section between the

new 33 kV switchgear panel at existing Substation B and the connection point with the 33 kV cable at the Suriname River Bridge. The total procurement quantity is calculated below.

33 kV XLPE insulated single core with tape armor cable (95 mm^2): 4,800 m (1,600 m x three phase)

(i) Underwater Cable

The procurement quantities of the 12.6 kV underwater cable to cross Commewijne River are shown in Table 2-3-19, taking into consideration the width and water depth of each river, the side drift of the cable at the time of installation, the distance between the river bank and the cable connection point and work margin (20%).

Table 2-3-19 Procurement Quantity of Underwater Cable

Item	Specifications	Quantity
12.6 kV underwater cable to cross Commewijne River	8.7/15 kV XLPE steel wire sheathed 66 mm underwater cable (three core 70 mm^2)	1,300 m
Accessories for the above	Cable end treatment materials; cast iron cable protection pipe (sprite pipe)	one lot

Note: The sprit pipe will cover 40 m (20 m x both banks) of the 12.6 kV cable.

The equipment and materials listed in Table 2-3-20 will be procured for the Project in connection with the underwater cable installation work. Similarly, the Surinamese side will procure the equipment and materials listed in Table 2-3-21. The Surinamese side will conduct the work using the relevant equipment and materials.

Table 2-3-20 Equipment and Materials for Underwater Cable Installation Work (Japanese Portion)

No	Descriptions	Specification/Purpose	Q'ty	Unit
1.	**On the Barge**			
(1)	Sheave	R3m, L1m×W1.5m	1	set
(2)	Drum Jack	40 tons	1	set
(3)	Drum Break	Iron belt breaking system equipment, lever block type	1	set
(4)	Cable Guide Pipe	Steel pipe	1	set
(5)	Dynamic Break	Lever braking system equipment, lever block type	1	set
(6)	Hauling Machine	Caterpillar type, 1 ton, 15kW	1	set
(7)	AC Generator	75kVA, Diesel, Potable type, for winch, etc.	1	set
(8)	Winch	5 ton, 30kW, double drum, winding wire length 500m	1	set
(9)	Wire Rope	Dia. 20mm, with spare wire	1000	m
(10)	Grease	100g/can	10	can
(11)	Cable Length Counter	For measurement of cable length	1	set
2.	**On the Ground**			
(1)	Tube buoy	ϕ 1000mm, every 2 m at landing portion of 250 m length including spare	150	pcs
(2)	Cable Roller	W225×L305mm, every 3 m at landing portion of 400m length including spare	100	sets
(3)	Air Compressor	For tube buoy, 10HP, 7kg/cm^2, Tank Volume 200 l	1	set
(4)	Winch	Engine type, 1 ton	1	set
(5)	Anchor Wire	For winch above, logs will be used as anchor	30	m
(6)	Swivel	For preventing wire twisting	2	pcs
3.	**Equipment For Surveying of embedded parts before Installation**			
(1)	Buoy	ϕ 300mm, every 100m including spare	18	pcs
(2)	Rope for buoy	Nylon type, 10mm	160	m
(3)	Metal Detector	For embedded parts	1	set

Table 2-3-21 Equipment and Materials for Underwater Cable Installation Work (Suriname Side)

No	Descriptions	Specification/Purpose	Q'ty	Unit
1.	**Boat and Vehicle**			
(1)	Barge	Approx. L 20m x W 8m, with spats	1	unit
(2)	Tug Boat	1000HP or 1500HP	4	unit
(3)	Small working boat with outboard engine	For pulling the floating cable	5	unit
(4)	Diver's boat	For diver	1	unit
(5)	Crane	For rigging, approx. 45ton	1	unit
(6)	Crane	For loading cable drum, approx. 100ton	1	unit
(7)	Boat for caution	For watching the traffic on the river	1	unit
(8)	Diving equipment	Compressor, air tank, chamber, etc.	5	set
(9)	Lorry	For transporting the equipment	1	unit
2.	**Rigging Equipment**			
(1)	Container for equipment	For keeping the tool, air compressor	1	pcs
(2)	Fairleads	For laying up the barge	4	set
(3)	Trailing cable	4 cores, 22mm^2	100	m
(4)	Switching board	For distribution of power supply	1	set
(5)	Anchor	For laying up the barge, 1 ton	3	pcs
(6)	Anchor	For laying up the barge, 3 ton	2	pcs
3.	**Cabling Laying Equipment**			
(1)	Wire	For pulling the cables at land portion	250	m
(2)	Hawser	For pulling the floating cables	100	m
(3)	Nylon Sling	For pulling the floating cables	5	pcs
(4)	Rope	Nylon, dia. 24mm(approx.), for floating cables	200	m
(5)	Rope	Nylon, dia. 10mm(approx.), for tube bouy	600	m
(6)	Surveying equipment		1	set
(7)	General tool	Cutter pillar, knife, gasoline torch, etc.	1	set
4.	**Equipment for Cable Cutting and Jointing**			
(1)	Electric Wire with reel		1	set
(2)	Rotary Band Saw	Stainless blade	1	pc
(3)	Stainless Band	Metal fitting (100sets) with band (30m x 2)	1	lot
(4)	Waterproofing Cap	ϕ 36mm, PVC	15	pcs
(5)	Tape	NP-S (polyethylene) Tape and FB-W (rubber) Tape	Each 10	rolls
(6)	Iron Wire		25	m
(7)	Joint Equipment	Compressing machine	1	set
5.	**Equipment for Survey of embedded parts before Installation**			
(1)	Measure Tape	Approx. 50m	1	pc
(2)	Measure Tape	Approx. 200m	1	pc

(j) Cable for Saramacca Bridge Section

The following quantity of XLPE insulated single core with tape armor cable will be procured, including that for work supply (10%), for the section between the overhead distribution points near both banks of the Saramacca Bridge (Table 2-3-22).

Table 2-3-22 Procurement Quantity of Cable for Saramacca Bridge Section

Type	Specifications	Quantity
33 kV transmission cable	33 kV XLPE insulated single core with tape armor cable (95 mm^2)	1,080 m (360 m/phase x three phase)
12.6 kV distribution cable	12.6 kV XLPE insulated single core with tape armor cable (70 mm^2)	2,160 m (360 m/phase x three phase x two lines)

(k) Cables for Substation Feeder Lines

The cables listed in Table 2-3-23 will be procured to cover the distance between the 33 kV switchgear panel and the connection point with the 33 kV overhead transmission line and the distance between the 12.6 kV switchgear panel and the connection point of the 12.6 kV overhead distribution line, including work supply (10%), for each substation.

Table 2-3-23 Procurement Quantity of Cable for Substation Connection

Item	Commewijne District	Saramacca District		Total
	La Paix SS	Sidodadiweg SS	Existing SS-D	
33 kV triplex cable (95 mm^2)	50 m	90 m	70 m	210 m
12.6 kV triplex cable (70 mm^2)	170 m	220 m	-	390 m

(6) Basic Design Drawings

The Basic Design Drawings for the Project are listed below.

1) General Drawings

Drawing No.	Title	Scale	Remarks
GG-01	Electric Power Network (EPAR System) Diagram	-	
GG-02	Electric Power Network in Commewijne District	1:160,000	
GG-03	Electric Power Network in Saramacca District	1:160,000	

2) La Paix Substation

Drawing No.	Title	Scale	Remarks
MS-01	Equipment Layout	1:200	Including control room layout
MS-02	Single-Line Diagram	-	
MS-03	Outline of 33 kV Outdoor Type Switchgear Panel	1:50	
MS-04	Outline of 12.6 kV Outdoor Type Switchgear Panel	1:50	
MS-05	Outline of Indoor Type Control and Protection Panel	1:30	

3) Sidodadiweg Substation

Drawing No.	Title	Scale	Remarks
NS-01	Equipment Layout	1:250	Including control room layout
NS-02	Single-Line Diagram	-	
NS-03	Outline of 33 kV Outdoor Type Switchgear Panel	1:50	
NS-04	Outline of 12.6 kV Outdoor Type Switchgear Panel	1:50	
NS-05	Outline of Indoor Type Control and Protection Panel	1:30	

4) Existing Substation B

Drawing No.	Title	Scale	Remarks
BS-01	Equipment Layout in the Existing Switchgear Building	1:100	
BS-02	Single-Line Diagram of 33 kV Switchgear Panel	-	
BS-03	Outline of 33 kV Indoor Type Switchgear and Control and Protection Panel	1:30, 1:40	

5) Existing Substation D

Drawing No.	Title	Scale	Remarks
DS-01	General Layout	1:300	Between switchgear panel and No. 1 Pole
DS-02	Equipment Layout in the Existing Switchgear Building	1:100	Inside existing building
DS-03	Single-Line Diagram of 33 kV Switchgear Panel	-	
DS-04	Outline of 33 kV Indoor Type Switchgear and Control and Protection Panel	1:30, 1:40	

6) Assembly Drawing for 33 kV Transmission Line and 12.6 kV Distribution Line

Drawing No.	Title	Scale	Remarks
PL-1	Materials List for 33 kV Single Transmission Line	-	
DM3	33 kV Intermediate Pole	-	
SM3	33 kV Light Angle Pole	-	
HM3	33 kV Heavy Angle Pole	-	
BM3	33 kV Section Pole	-	
OM3	33 kV Terminal Pole	-	
PL-2	Material List for 33kV and 12.6kV Combination Line	-	
DMC	33 kV and 12.6 kV Combination Intermediate Pole	-	
SMC	33 kV and 12.6 kV Combination Light Angle Pole	-	
HMC	33 kV and 12.6 kV Combination Heavy Angle Pole	-	
BMC	33kV and 12.6kV Combination Section Pole	-	
OMC	33 kV and 12.6 kV Combination Terminal Pole	-	
PL-3	Material List for 12.6kV Single Distribution Line	-	
YM1	12.6 kV T-off pole	-	
DM1	12.6 kV Intermediate Pole	-	
SM1	12.6 kV Light Angle Pole	-	
HM1	12.6 kV Heavy Angle Pole	-	
BM1	12.6 kV Section Pole	-	
OM1	12.6 kV Terminal Pole	-	
LM1	12.6 kV Open Fuse Cutout Pole	-	
TM1	12.6 kV Line Distribution Transformer Pole	-	
PL-4	Material List for 12.6 kV Dual Distribution Line	-	
DM1D	12.6 kV Dual Intermediate Pole	-	
SM1D	12.6 kV Dual Light Angle Pole	-	
HM1D	12.6 kV Dual Heavy Angle Pole	-	
OM1D	12.6 kV Dual Terminal Pole	-	

7) Cabling at Suriname River Bridge Section

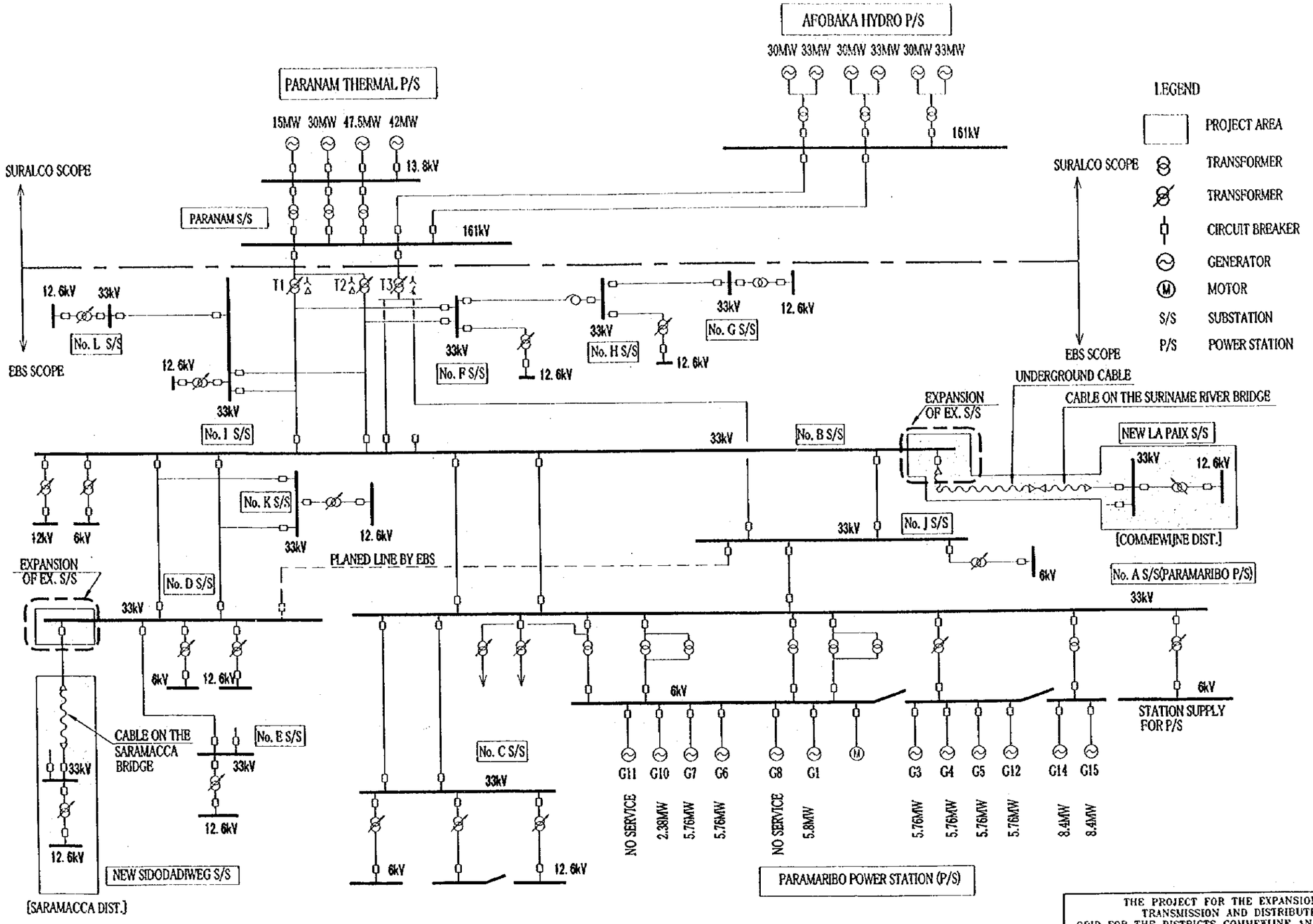
Drawing No.	Title	Scale	Remakes
ALT-CD3-01	33kV Cable Route Plan	-	

8) Underwater Cabling

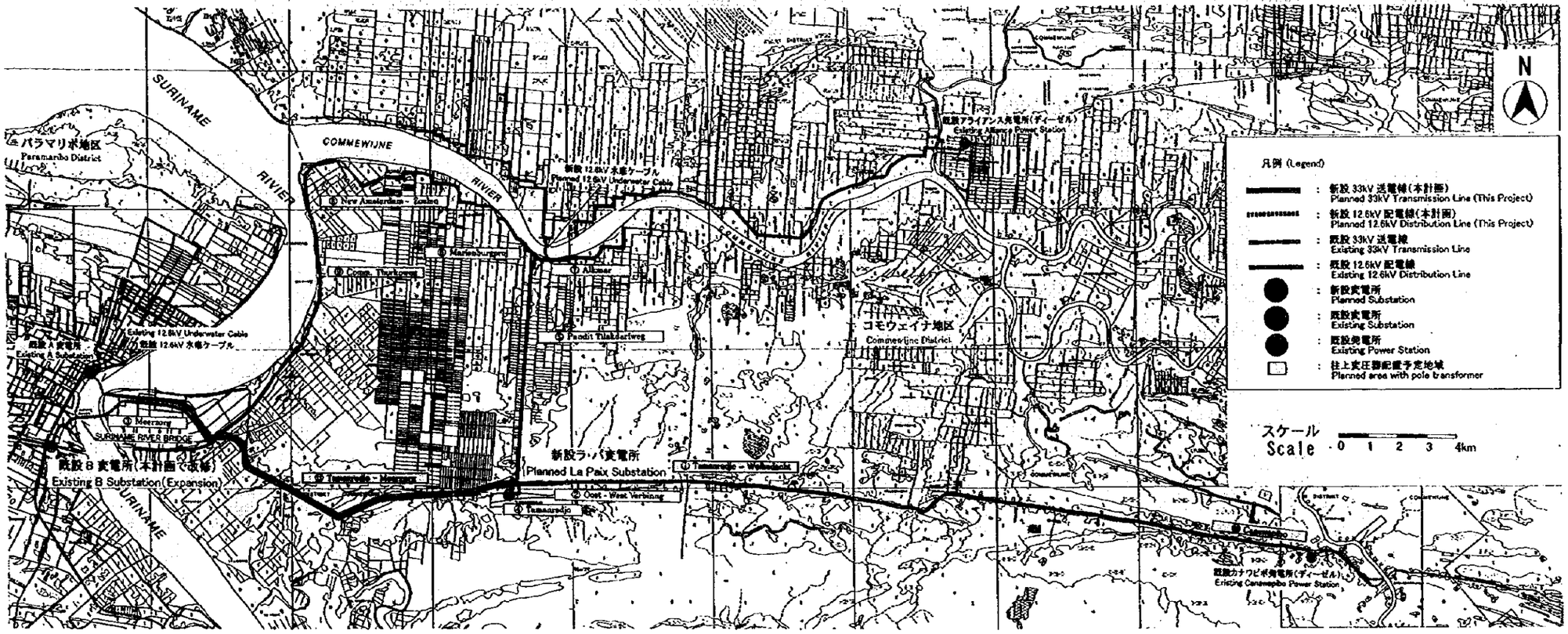
Drawing No.	Title	Scale	Remarks
CD1-52	12.6 kV Underwater Cable Plan in Commewijne River	-	

9) Cabling at Saramacca Bridge Section

Drawing No.	Title	Scale	Remarks
SD3-60	Cabling Plan on Saramacca Bridge	-	

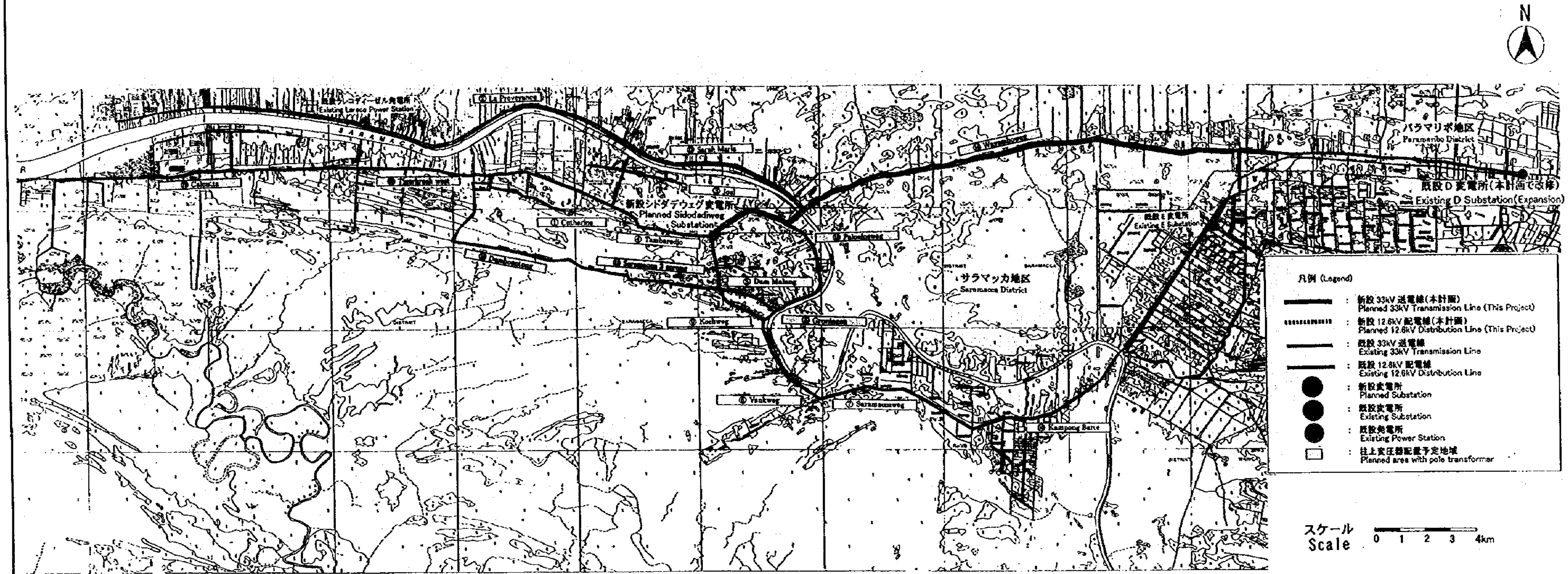


THE PROJECT FOR THE EXPANSION OF TRANSMISSION AND DISTRIBUTION GRID FOR THE DISTRICTS COMMEWIJNE AND SARAMACCA				SCALE —
EPARシステム電力系統図 ELECTRIC POWER NETWORK (EPAR SYSTEM) DIAGRAM				DWG No. GG-01
DATE	DESIGNED	CHECHED	APPROVED	REVISION
10 Aug. '99				
yec YACHIYO ENGINEERING CO., LTD TOKYO JAPAN				

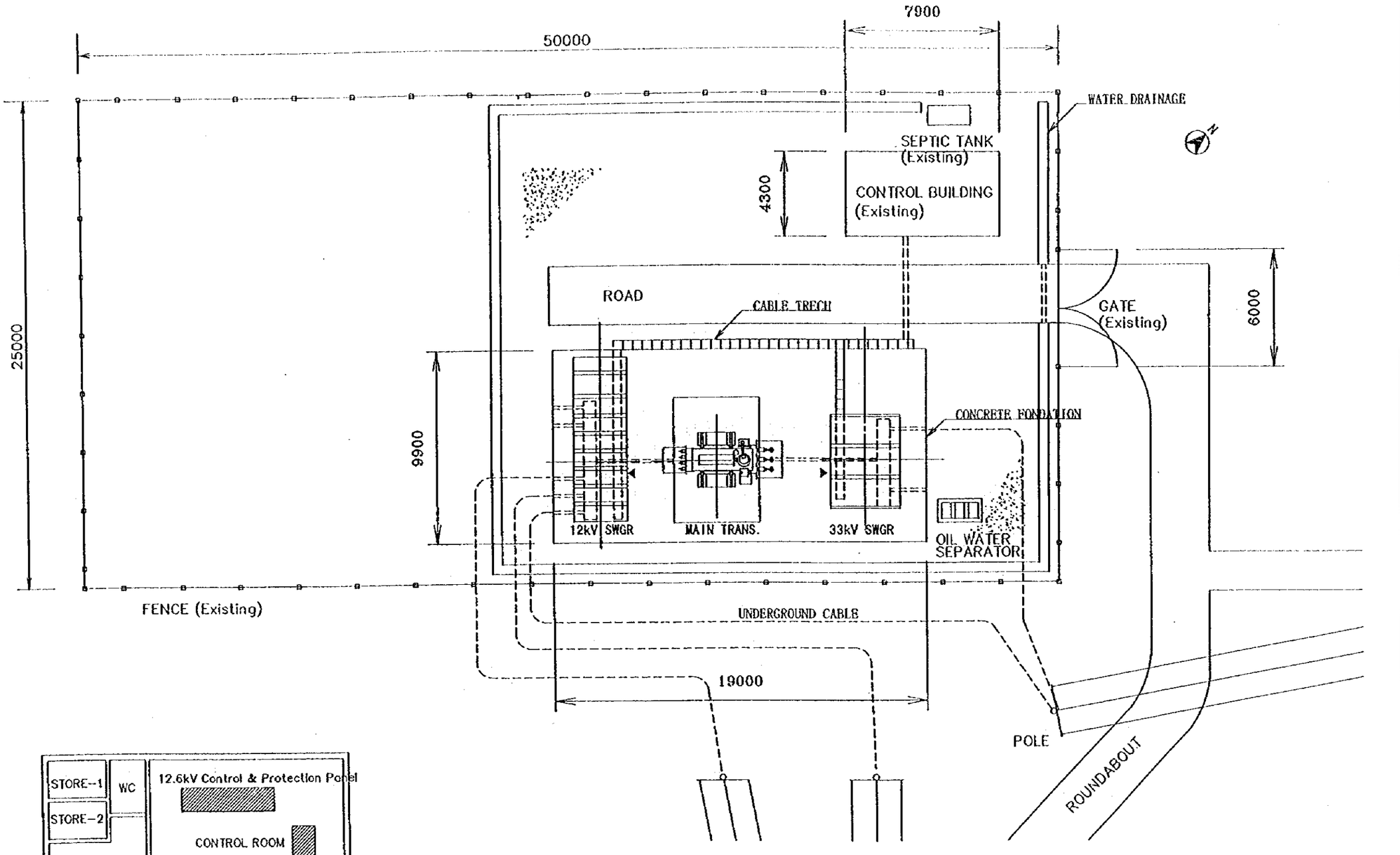


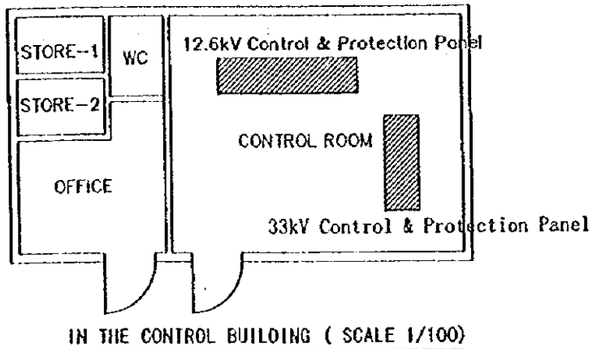
THE PROJECT FOR THE EXPANSION OF TRANSMISSION AND DISTRIBUTION GRID FOR THE DISTRICTS COMMEWIJNE AND SARAMACCA				SCALE 1/160,000
コモウェイナ地区送配電網図 ELECTRIC POWER NETWORK IN COMMEWIJNE DISTRICT				DWG No. GG-02
DATE	DESIGNED	CHECHED	APPROVED	REVISION
24 July, 99				

YACHIYO ENGINEERING CO., LTD
TOKYO JAPAN



THE PROJECT FOR THE EXPANSION OF TRANSMISSION AND DISTRIBUTION GRID FOR THE DISTRICTS COMMEWIJNE AND SARAMACCA				SCALE
				1/160,000
サラマッカ地区送配電網図				DWG No.
ELECTRIC POWER NETWORK IN SARAMACCA DISTRICT				GG-03
DATE	DESIGNED	CHECHED	APPROVED	REVISION
24 July '99	Onuo	m.k	[signature]	
YEC	YACHIYO ENGINEERING CO., LTD TOKYO JAPAN			

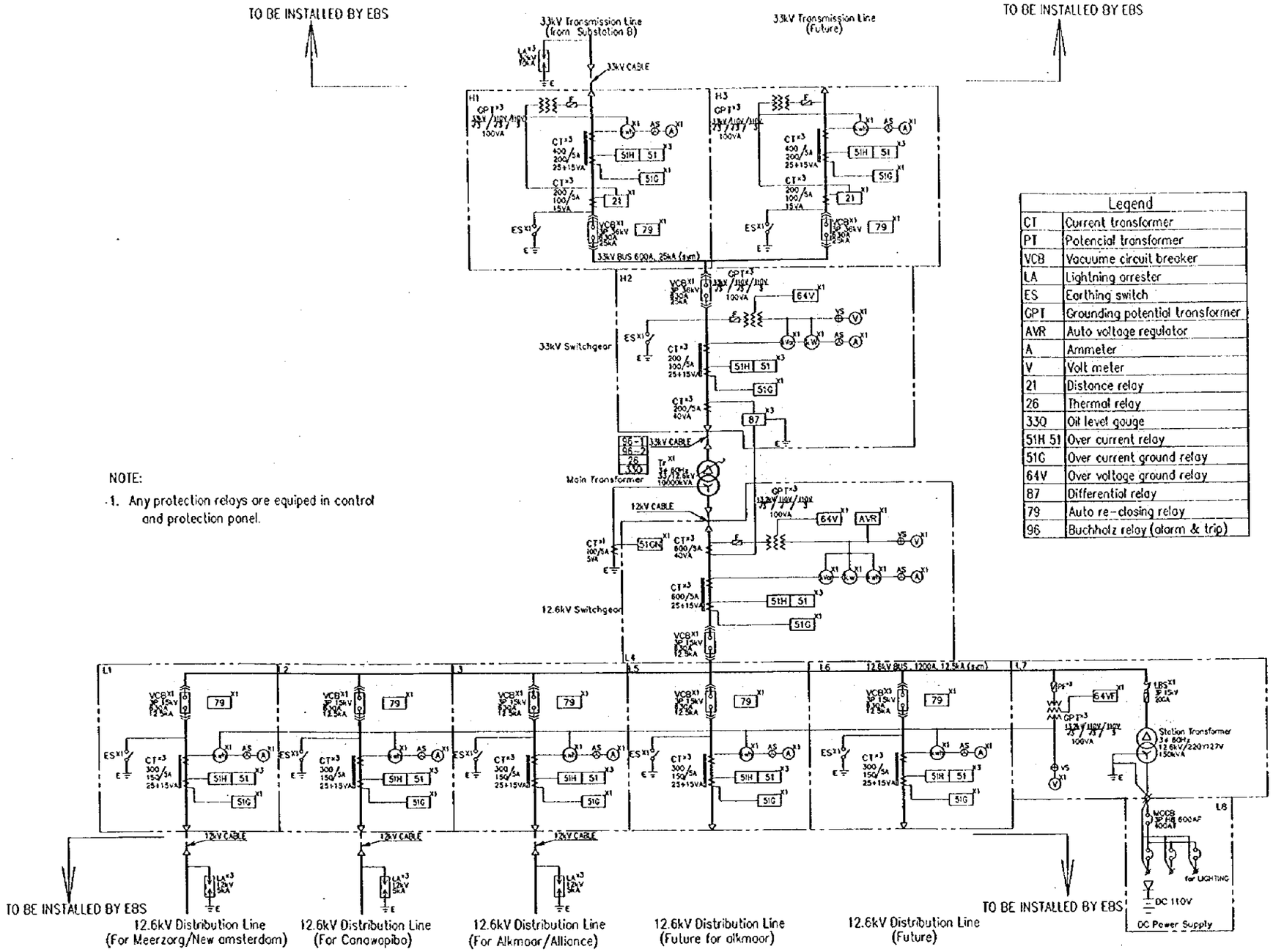




IN THE CONTROL BUILOING (SCALE 1/100)

THE PROJECT FOR THE EXPANSION OF TRANSMISSION AND DISTRIBUTION GRID FOR THE DISTRICTS COMMEWIJNE AND SARAMACCA				SCALE 1/200
機器配置図 【ラパ変電所】 EQUIPMENT LAYOUT 【 LA PAIX SUBSTATION 】				DWG No. MS-01
DATE	DESIGNED	CHECHED	APPROVED	REVISION
10 Aug.,'99				

YACHIYO ENGINEERING CO., LTD TOKYO JAPAN



NOTE:

1. Any protection relays are equiped in control and protection panel.

Legend	
CT	Current transformer
PT	Potencial transformer
VCB	Vacuume circuit breaker
LA	Lightning arrester
ES	Earthing switch
GPT	Grounding potential transformer
AVR	Auto voltage regulator
A	Ammeter
V	Volt meter
21	Distance relay
26	Thermal relay
33Q	Oil level gauge
51H 51	Over current relay
51G	Over current ground relay
64V	Over voltage ground relay
87	Differential relay
79	Auto re-closing relay
96	Buchholz relay (alarm & trip)

THE PROJECT FOR THE EXPANSION OF TRANSMISSION AND DISTRIBUTION GRID FOR THE DISTRICTS COMMEWIJNE AND SARAMACCA				SCALE ---
単線結線図 [ラパ変電所] SINGLE LINE DIAGRAM [LA PAIX SUBSTATION]				DWG No. MS-02
DATE	DESIGNED	CHECHED	APPROVED	REVISION
10 Aug., '99				

YACHIYO ENGINEERING CO., LTD TOKYO JAPAN