THE FEDERAL REPUBLIC OF NIGERIA
FEDERAL MINISTRY OF POWER AND STEEL

No.

BASIC DESIGN STUDY REPORT
ON
THE PROJECT FOR
RURAL ELECTRIFICATION IN
CROSS RIVER AND AKWA IBOM STATES
IN
THE FEDERAL REPUBLIC OF NIGERIA

MARCH 2006

JAPAN INTERNATIONAL COOPERATION AGENCY

YACHIYO ENGINEERING CO., LTD.

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PREFACE

In response to a request from the Federal Government of Nigeria, the Government of Japan decided to conduct a basic design study on the Project for Rural Electrification in Cross River and Akwa Ibom States and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Nigeria a study team from September 27 to November 4, 2005.

The team held discussions with the officials concerned of the Government of Nigeria, 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 Nigeria 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 Nigeria for their close cooperation extended to the teams.

March, 2006

Seiji Kojima
Vice-President
Japan International Cooperation Agency

LETTER OF TRANSMITTAL

March, 2006

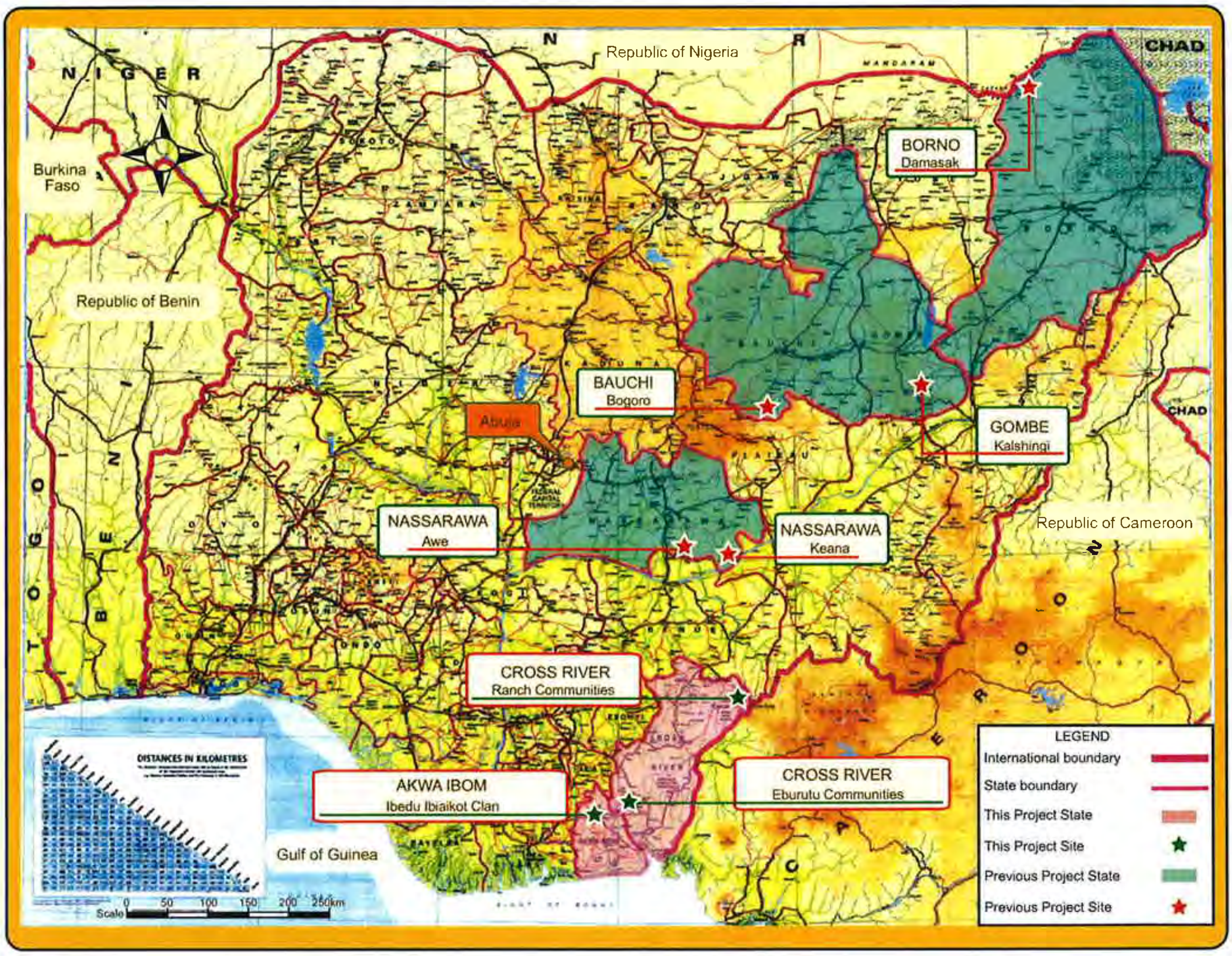
We are pleased to submit to you the basic design study report on the Project for Rural Electrification in Cross River and Akwa Ibom States in the Federal Republic of Nigeria.

This study was conducted by Yachiyo Engineering Co., Ltd., under a contract to JICA, during the period from September, 2005 to March, 2006. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Nigeria and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

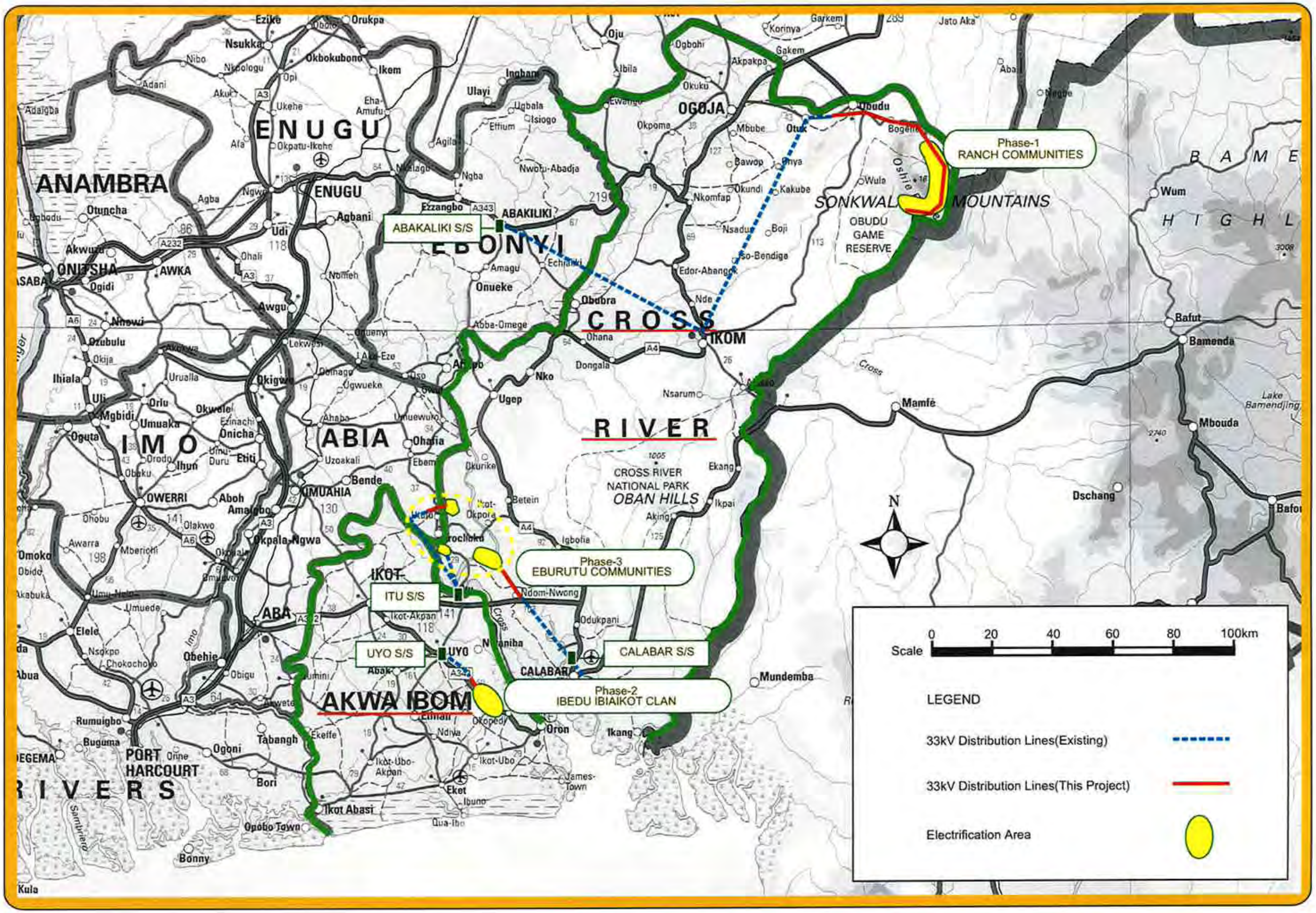
Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,

Masatsugu Komiya
Project Manager,
Basic design study team on the Project for Rural Electrification in Cross River and Akwa Ibom States in the Federal Republic of Nigeria
Yachiyo Engineering Co., Ltd.



FEDERAL REPUBLIC OF NIGERIA AND PROJECT SITES



PROJECT SITE

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ABBREVIATIONS

BPE	Bureau of Public Enterprises
CDF	Comprehensive Development Framework
E/N	Exchange of Notes
FMPS	Federal Ministry of Power and Steel
GDP	Gross Domestic Product
IEC	International Electrotechnical Commission
IPP	Independent Power Producer
ISO	International Organization for Standards
JCS	Japanese Electrical Wire and Cable Maker's Association Standards
JEAC	Japan Electric Association Code
JEC	Japanese Electrotechnical Committee
JEM	Standards of Japan Electrical Manufacturer’s Association
JICA	Japan International Cooperation Agency
JIS	Japanese Industrial Standards
LGA	Local Government Area
LGHQ	Local Government Headquarter
PHCN	Power Holding Company of Nigeria
NEPA	National Electric Power Authority
NESCO	National Electricity Supply Corporation (Nigeria) Limited
NPC	National Planning Commission
O&M	Operation and Maintenance
OJT	On the Job Training
OLTC	On-Load Tap Changer
PRSP	Poverty Reduction Strategy Paper
REB	Rural Electrification Board

SUMMARY

SUMMARY

The Federal Republic of Nigeria (hereinafter referred to as "Nigeria" is situated in the western part of the African Continent. It has a population of some 132.8 million (2002 estimate of the World Bank), a national land area of some 924,000 km^2 (approximately 2.5 times larger than Japan) and a GNI per capita of US$ 350 (2003 estimate of the World Bank).

Following its independence from Great Britain, while Nigeria has experienced a series of civil wars and military coup d'états, the discovery of petroleum resources in the southern part of the country led to a temporary period of economic development. However, the over-dependence on petroleum and lax economic management have resulted in a chronic deficit of government finance and a huge amount of accumulated debts, damaging agriculture and other traditional industries and causing serious problems regarding the development and operation of such important elements of infrastructure as power supply.

The Government of Nigeria formulated the National Economic Empowerment Development Strategy (NEEDS) in 2004. The NEEDS sets out the targets for increased power supply facilities as well as reduced transmission and distribution losses for the promotion of agriculture and the food processing industry together with the improvement of educational and medical facilities for the development of rural areas, anticipating an acceleration of rural development through electrification projects. Meanwhile, the National Energy Policy adopts the targets of completing the electrification of all state capitals, areas with a LGHQ (local government headquarters: total of 774) and important towns and villages nationwide by 2010 and of securing a stable power supply for 75% of the people by 2020.

All power generation, transmission and distribution facilities in Nigeria used to be operated and maintained by the National Electric Power Authority (NEPA) under the supervision of the Federal Ministry of Power and Steel (FMPS). The financial difficulties faced by then dictatorial military government due to international economic sanctions and arbitrary low level of the electricity tariff have contributed to the funding shortage of the NEPA. The resulting lack of fresh investment in generating facilities and the insufficient maintenance over a long period of time have accelerated the malfunctioning and deterioration of equipment and facilities. At present, although the rated generating capacity is more than 5,000 MW, half of the generating units are incapable of performing constant operation. The insufficient maintenance of the transmission and distribution facilities causes frequent large-scale power cuts. As of October, 2005, Nigeria has three hydroelectric power stations and seven thermal power stations with a total installed capacity of 5,762 MW. However, the available capacity has dropped to 3,477 MW, 60% of the rated capacity, falling short of the estimated national power demand of some 4,200 MW. In May, 2005, the Government of Nigeria divided NEPA into different

companies, each responsible for power generation, transmission and distribution, as part of the reform of the electricity sector and established a Power Holding Company of Nigeria (PHCN).

Rural electrification has been in progress based on the National Rural Electrification Programme (NREP) under the supervision of FMPS with a target national electrification rate of 60% by 2010. However, the development of the distribution network in rural areas has been slow due to funding difficulties in the power sector as mentioned earlier and the approximate electrification rate as of 2005 is 60% in urban areas and 20% in rural areas with a national average of 40%. The subject areas for electrification under the NREP are unelectrified areas where a LGHQ is located as well as important towns and villages from the viewpoint of local development. As of October, 2005, 661 LGHQ areas, i.e. 85% of the 774 LGHQ areas, are electrified. Of the remaining 113 LGHQ areas, an electrification plan is in progress in 56 areas. For the remaining 57 areas, the promotion of electrification is assumed to be feasible based on self-help efforts even though allocation of the government budget has been delayed. In contrast, the electrification of important towns and villages has been much slower due to the funding shortage, forcing local residents in unelectrified areas to rely on kerosene lamps, firewood and portable generators, etc. and hampering the development of agriculture and fisheries to support the local economy and the provision of such administrative/public services as education and health care.

In consideration of the current situation, the Government of Nigeria has selected three areas in Cross River State and Akwa Ibom States based on the five criteria listed below and has made a request to the Government of Japan for a grant aid electrification project for these areas.

① Area with a high population density

② Difficult terrain for installation of distribution system, requiring assistance by experts

③ Agricultural area where an increase of the agricultural harvest and the promotion of employment are expected as a result of rural electrification

④ Tourist area where electrification will promote the local economy and contribute to the earning of foreign currency

⑤ Area where security conditions are well ensured

In response to this request, the Government of Japan decided to conduct a basic design study and the Japan International Cooperation Agency (JICA) dispatched the Basic Design Study Team to Nigeria from 27th September to 4th November, 2005 to (i) confirm the contents of the request and to discuss the contents of the Project with related counterparts in Nigeria, (ii) to survey the proposed project sites and (iii) to gather relevant information. On its return to Japan, the Study Team examined the necessity, socioeconomic effects and relevance of the Project based on the field survey findings and compiled the basic design for the optimal project and its implementation plan into the Outline of the Basic

Design. The JICA then dispatched the same Study Team to Nigeria from 27th February to 10th March, 2006 to explain the contents of the Outline of the Basic Design.

The goal of the Project is to stimulate the development of local economies through improved power supply in the project sites based on the NREP and the purpose of the Project is to supply stable power to those towns/villages, which are important for local development as these play a central role in administrative and public services, in the three project sites to achieve improvement of the living conditions for local residents, the stable operation of public facilities and the vitalisation of socioeconomic activities. The basic concepts of the Project are the procurement and installation of 33 kV distribution equipment and materials and the construction of booster stations (including installation of a capacitor station) to achieve the said purpose. Meanwhile, the Nigerian side is expected to procure and install LV distribution equipment and materials.

The basic plan for the Project based on the results of the field survey and discussions with the Nigerian side are outlined in the following table.

Outline of the Basic Plan for the Project

Project Area	Ranch Communities, Cross River State	Ibedu Ibiaikot Clan, Akwa Ibom State	Eburutu Communities, Cross River State
Plan for Procurement and Installation of Equipment and Materials	Procurement and installation of the following 33 kV distribution equipment, etc. and booster station equipment (1) Booster station (voltage regulating facilities) New 33 kV booster station (5 MVA) x 1 (2) Capacitor station (reactive power compensation) New 33 kV capacitor station (3 MVar) x 1 (3) 33 kV distribution line From the new booster station to Anape: approx. 59 km (4) 33 kV/415-240 V distribution transformers 1) 200 kVA x 6 2) 300 kVA x 5 3) 500 kVA x 4	Procurement and installation of the following 33 kV distribution equipment, etc. and booster station equipment (1) Booster station (voltage regulating facilities) New 33 kV booster station (3 MVA) x 1 (2) 33 kV distribution line From the connection point with the existing 33 kV distribution line to Ibedu: approx. 20 k m (3) 33 kV/415 – 200 V distribution transformers 1) 200 kVA x 7 2) 300 kVA x 2	Procurement and installation of the following distribution equipment, etc. (1) 33 kV distribution line From the connection point with the existing 33 kV distribution line to the target towns/villages for electrification: approx. 85 km (2) 33 kV/415 – 240 V distribution transformers 1) 200 kVA x 8 2) 300 kVA x 15 3) 500 kVA x 5
Plan for Procurement and Installation of Equipment and Materials	Procurement of the following distribution equipment, etc. for 13 towns/villages (1) Spare parts and maintenance tools for the 33 kV distribution line and booster station: one set	Procurement of the following distribution equipment, etc. for 14 towns/villages (1) Spare parts and maintenance tools for the 33 kV distribution line and booster station: one set (2) 33 kV/415 – 240 V distribution transformers 1) 200 kVA x 3 2) 500 kVA x 1	Procurement of the following distribution equipment, etc. for 27 towns/villages (1) Spare parts and maintenance tools for the 33 kV distribution line: one set

If the Project is to be implemented under Japan's grant aid scheme, the cost of the Project is estimated to be approximately ¥ 2,634 million (Japanese portion of approximately ¥ 2,228 million and Nigerian portion of approximately ¥ 406 million). The main undertakings by the Nigerian side will be the construction of temporary roads (levelling, road widening and bush clearing) and the procurement and installation of the LV distribution equipment and materials. The project period, including the detailed design period, will be some 14 months for Phase I involving Ranch Communities in Cross River State, some 13.5 months for Phase II involving Ibedu Ibiaikot Clan in Akwa Ibom State and some 15.5 months for Phase III involving Eburutu Communities in Cross River State.

After the completion of the Project, the new facilities and equipment will be operated and maintained by the PHCN. As the PHCN assigns engineers as operation and maintenance personnel for its facilities after training at its own training institute, the PHCN engineers are inferred to possess basic operation and maintenance skills. Given the fact that the specifications of the distribution equipment to be procured and installed under the Project are not expected to exceed those of similar equipment procured under past grant aid projects, the PHCN is believed to possess sufficient capability to install, operate and maintain the new equipment, etc. as required for the implementation of the Project. Moreover, the Japanese substation and distribution equipment procured under past grant aid projects has been well maintained, so it is a reasonable assumption that the new equipment, etc. will be properly maintained after completion of the Project.

The beneficiaries of the Project will be some 175,000 people living in the project sites for electrification under the Project, i.e. local residents of Ranch Communities and Eburutu Communities in Cross River State and Ibedu Ibiaikot Clan in Akwa Ibom State. As the implementation of the Project is expected to produce many positive effects for vitalisation of the Nigerian economy, improvement of the living conditions for local residents and the stable operation of social welfare and other public facilities, the provision of grant aid for the Project is highly relevant for the purpose of Japan's grant aid scheme. The Nigerian side has sufficient manpower and funds to operate and maintain the new facilities installed under the Project and no special problems are foreseen regarding the implementation of the Project.

It will be necessary for the Nigerian side to complete the following major tasks to ensure the realisation and continuation of the positive effects of the Project.

(1) In Eburutu Communities in Cross River State, 1) the work to install an additional transformer (30 MVA x 1 unit) at the Itu 132/33 kV Substation which is the feeder point to the newly extended 33 kV distribution line to the project area, 2) the work to construct temporary roads at sections where vehicle passage is currently impossible (ground levelling, road widening and bush clearing, etc.), and 3) the Ibiono Idoro Project as well as the Edem Urua Project, which are rural

electrification projects by FMPS, must be completed prior to the commencement of the construction work by the Japanese side.

(2) The work to procure and install the 415 V LV distribution equipment and materials must be promptly conducted by Nigerian side in the three project sites for electrification.

(3) Distribution transformer to meet the estimated power demand up to five years after their commissioning will be procured under the Project. However, it will be necessary for Nigerian side to review the power demand from time to time to determine the actual increase of such demand after commissioning, to prepare a plan for the installation of additional transformers after the completion of the Project and to secure the necessary budget for the procurement of new equipment.

(4) It will be necessary for the Nigerian side to construct a new PHCN service center (in Ranch Communities in Cross River State) to operate and maintain the new distribution systems and to provide a user service by the time of the Project's completion. This office should commence operation at the same time as the commissioning of the planned facilities under the Project in view of the establishment of an appropriate operation and maintenance system.

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2. Survey Schedule
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4. Minutes of Discussions
5. Revised List of Target Villages in Eburutu Communities

CHAPTER 1

BACKGROUND OF THE PROJECT

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BACKGROUND OF THE PROJECT

The first step of the power industry in Nigeria was marked by the commencement of power supply by a thermal power station in Lagos in 1898. The Nigeria Power Authority was established in 1950, followed by the establishment of the Nigeria Dam Authority in 1962. These two authorities were amalgamated in 1972 to establish the National Electric Power Authority (NEPA) which has since been responsible for the operation and maintenance of power generation, transmission and distribution facilities throughout the country. The economic sanctions imposed by industrialised countries in 1993 on then dictatorial military government have caused a serious funding shortage in Nigeria. Moreover, the arbitrary low level of the electricity tariff has contributed to a funding shortage of NEPA. The resulting lack of fresh investment in generating facilities and the insufficient maintenance over a long period of time have accelerated the malfunctioning and deterioration of equipment and facilities. As of October, 2005, Nigeria has three hydroelectric power stations and seven thermal power stations with a total rated generating capacity of 5,762 MW. However, the available capacity has dropped to 3,477 MW, 60% of the rated capacity, falling short of the estimated national power demand of some 4,200 MW. The insufficient maintenance of the transmission and distribution facilities causes frequent large-scale power cuts. In May, 2005, the Government of Nigeria divided NEPA into different companies, each responsible for power generation, transmission and distribution, as part of the reform of the electricity sector and established a Power Holding Company of Nigeria (PHCN).

The development of the power distribution network in rural areas has been slow. In 2005, the electrification rate in urban and rural areas was 60% and 20% respectively with a national average of 40%. The second Obasanjo Administration inaugurated in 2003 has identified the improvement of the living conditions in rural areas as an important target among its national policies. In particular, the government considers the improvement of the rural electrification rate to be a high priority and has been earnestly promoting the Rural Electrification Programme. This Programme which is led by the Federal Ministry of Power and Steel (FMPS) is being implemented with the technical assistance by PHCN and is developing new power supply networks through links with the national transmission and distribution grid, the maintenance of which is easier than that of independent power generation sources using diesel power generators, and which has an established electricity charge collection system.

This Programme gives the priority of electrification to non-electrified areas where a local government headquarters (LGHQ) is located as well as important towns and villages from the viewpoint of local development. Among 774 areas where a LGHQ is located, 661 or 85% of the total have been electrified as of October, 2005. While an electrification plan is in progress for 56 of the remaining 113 areas, no electrification plan exists for 57 areas due to a lack of funding. According to FMPS, electrification of the remaining LGHQ areas can be achieved based on the self-help efforts by Nigeria but the electrification of important towns and villages has made little progress, making the electrification of these towns and villages as well as LGHQ areas an urgent necessity. The areas selected for electrification under the Project are such important towns and villages which have been selected by the Nigerian side taking the background described below into consideration.

① When the LGHQ area electrification rate is compared by geopolitical zone, the south-south zone where the project sites are located is the second lowest after the north-east zone which was partially electrified under a previous cooperation project, illustrating the high level of urgency of the latest request.

② Cross River State and Akwa Ibom State, both of which are targeted areas of the Project, have many important towns which are subject to the planned electrification in 2005 in the South-South Zone.

In consideration of the current situation, the Government of Nigeria has selected three areas in Cross River State and Akwa Ibom States based on the five criteria listed below and has made a request to the Government of Japan for a grant aid electrification project for these areas.

① Area with a high population density

② Difficult terrain for installation of distribution system, requiring assistance by experts

③ Agricultural area where an increase of the agricultural harvest and the promotion of employment are expected to result from electrification

④ Tourist area where electrification will promote the local economy and contribute to the earning of foreign currency

⑤ Area where security conditions are well ensured

The contents of the Nigerian request which were confirmed during the field survey for the Basic Design Study are listed below, consisting of the extension of 33 kV distribution lines to the project sites, construction of booster stations (including reactive power compensation) and construction of 33/11 kV substations.

[Contents of the Request]

Procurement and installation of the following substation/distribution equipment required for the electrification of the project areas

① Ranch Communities in Cross River State

- Booster station (voltage regulating facility) x 1
- 33/11 kV distribution substation x 1
- 33 kV/LV and 11 kV/LV distribution transformers x 17
- 33 kV distribution lines (48 km), 11 kV distribution lines (30 km)
- Auto reclosers and load break switches

② Ibedu Ibiaikot Clan in Akwa Ibom State

- Booster station (voltage regulating facility) x 1
- 33 kV/LV distribution transformers x 15
- 33 kV distribution lines (52 km)
- Auto reclosers and load break switches

③ Eburutu Communities in Cross River State

- Booster station (voltage regulating facility) x 1
- 33 kV/LV distribution transformers x 28
- 33 kV distribution lines (106 km)
- Auto reclosers and load break switches

One of the project sites of the original request was Eburutu Clan in Cross River State. A clan is a sub-group of a community and it has been confirmed that the official name of the area is Eburutu Communities.

It has also been confirmed that the target towns/villages for electrification in the above area require changing and the FMPS has submitted a revised list of the target towns/villages as shown in Appendix 5. The principal changes are described below.

① Eseku I and II/Ikot Osu/Yoki

Although these villages were included in the original request, the field survey has established that these villages do not belong to Eburutu Communities. Therefore, they are excluded from the scope of the Project.

② Ikot Udia

Although this village was included in the original request, it has now been deserted and there are no local inhabitants. Therefore, this village is excluded from the scope of the Project.

③ Atan Onoyom

Although this village was not included in the original request, this is a central town of Eburutu Communities with a much larger population (10,000) than many other towns/villages in Eburutu Communities. The electrification of its public facilities and commercial facilities will make it a core town for the development of the local economy in the future. A 33 kV distribution line has already been extended from neighbouring Iboho Ito town and the work to be conducted by the Japanese side will be restricted to the installation of distribution transformers. It is, therefore, appropriate to include this town in the scope of the Project.

CHAPTER 2

CONTENTS OF THE PROJECT

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2.1 Basic Concept of the Project

2.1.1 Goal and Purpose of the Project

In Nigeria, Federal Ministry of Power and Steel (FMPS) is implementing the National Rural Electrification Programme (NREP) as part of the policy to “promote the development of infrastructure to benefit the whole nation” which is a priority of the National Development Plan. Under this Programme, work is in progress to electrify areas with a local government headquarters (LGHQ) as well as important towns and villages by means of connecting these areas to the national grid. In the case of LGHQs, 661 or 85% of the total have been electrified so far. In contrast, the electrification of important towns and villages has been much slower due to the funding shortage, forcing local residents in unelectrified areas to rely on kerosene lamps, firewood and portable generators, etc. and hampering the provision of such administrative/public services as education and health care.

The goal of the Project is to stimulate the development of local economies through improved power supply in the project sites based on the NREP and the purpose of the Project is to supply stable power to those towns/villages, which are important for local development as these play a central role in administrative and public services, in the three project sites to achieve improvement of the living conditions for local residents, the stable operation of public facilities and the vitalisation of socioeconomic activities.

2.1.2 Basic Concept of the Project

The basic concept of the Project is the development of new distribution lines, which constitute part of important socioeconomic infrastructure, by means of procuring and installing 33 kV distribution equipment and materials and also the construction of booster stations (including reactive power compensation). Meanwhile, the Nigerian side is expected to procure and install LV distribution equipment and materials.

The main components of the Project are the procurement and installation of the following distribution equipment and materials required for the electrification of the project sites.

① Ranch Communities in Cross River State

- Booster station (voltage regulating facility) x 1

- Capacitor station x 1
- 33 kV/LV distribution transformers x 15
- 33 kV distribution lines (approx. 59 km)

② Ibedu Ibiaikot Clan in Akwa Ibom State

- Booster station (voltage regulating facility) x 1
- 33 kV/LV distribution transformers x 9 (including installation)
- 33 kV/LV distribution transformers x 4 (procurement only)
- 33 kV distribution lines (approx. 20 km)

③ Eburutu Communities in Cross River State

- 33 kV/LV distribution transformers x 28
- 33 kV distribution lines (approx. 85 km)

2.2 Basic Design of Requested Japanese Assistance

2.2.1 Design Policies

(1) Basic Policies

The scope of the Japanese assistance under the Project is the construction of booster stations (voltage regulating facilities) and the procurement and installation of 33 kV distribution equipment and materials, all of which are required to supply power to the three project sites in Cross River State and Akwa Ibom State.

The capacity of the equipment to be procured under the Project will be planned based on the estimated power demand in the project sites. In the case of booster stations and distribution equipment and materials, their capacities will be able to sustain the estimated power demand five years after the commencement of their service.

(2) Natural Conditions

1) Temperature

The temperature in the project areas is high throughout the year as it constantly remains at a level of some 30°C – 40°C. As the planned booster stations under the Project consist of outdoor-type high voltage panels, careful attention is required in regard to their structure so that the temperature inside the panels remains within the design temperature range for the equipment to ensure normal operation by preventing a temperature rise due to the hotter outside air temperature and direct sunlight. Given the fact that the average elevation of the mountain top areas of Ranch Communities in Cross River State is as high as 1,580 m, the large temperature gap between the day-time and the night-time will be taken into consideration for the construction of the distribution lines in these areas.

2) Humidity and Rainfall

The maximum humidity in the project sites exceeds 90%. The maximum humidity and maximum monthly rainfall are both especially high at Eburutu Communities in Cross River State at 94% and 800 mm (July) respectively. The introduction of a space heater for sealed distribution panels will be considered to prevent condensation due to temperature fluctuation. Rainwater drainage will be introduced on the booster station premises so that standing rainwater will not disrupt the operation and maintenance of the voltage regulating equipment.

3) Lightning Damage

The project sites have a high level of thunderstorm occurrence (IKL) of more than 65 days/year (Ranch Communities) and 30 days/year (other areas). Suitable lightning arresters, etc. will be installed to prevent any damage to the booster stations, etc. by a direct lightning hit or induced lightning via a distribution line.

(3) Environmental and Social Considerations

An environmental impact assessment (EIA) is conducted in Nigeria in accordance with the EIA Act No. 86 (Decree No. 86 of 1992) and the relevant guidelines introduced in 1995.

Based on the said guidelines, development projects are classified in the following three categories.

Category I : Project requiring a full-scale EIA

Category II : Project requiring a partial EIA, mainly featuring environmental impact alleviation measures and an environmental plan. A full-scale EIA is required, however, if the project site is near an area requiring special environmental and social considerations.

Category III : Project producing “essentially positive impacts” on the environment and the Ministry of the Environment prepares an EIS (Environmental Impact Statement)

In regard to development projects in the power sector, the guidelines classify them into different categories based on the contents of such projects.

Category I : a. Construction of a steam power plant with an output of 10 MW or larger
b. Construction of a hydroelectric power plant which meets one of the following criteria
(i) Dam head of 15 m or larger and a site area of 40 ha or larger
(ii) Reservoir area of 400 ha or larger
c. Construction of a combined cycle power plant
d. Nuclear power station

Category II : Small-scale transmission line (no definition of the scale in question)

When the PHCN implements a transmission line construction project, it usually conducts a full-scale EIA in the case when the voltage involved is 132 kV or higher. The PHCN does not conduct an EIA in other cases. The above criteria were originally believed to apply to determine any need for environmental and social considerations for the Project. At the meeting with the Federal Ministry of the Environment (FMoE) on 28th September, 2005, however, the FMoE expressed its intention of "conducting an environmental review for even small-scale distribution projects in accordance with the same procedure applicable to projects in general". Accordingly, it was decided to follow the following procedure.

1) Registration of the Project by the FMPS with the FMoE (registration fee: N 10,000). As part of this registration, submission of the IC/R to provide information on the Project (registration completed on 29th September, 2005)

2) Based on the submitted project information, review of the possible environmental impacts of the Project by the FMoE who informs the review results to the FMPS.

The FMPS is expected to be informed of the review results by the end of February, 2006, confirming that the Project will have little impact on the environment. It will, therefore, be confirmed that a full-scale EIA or a partial EIA is unnecessary for the Project.

The field survey conducted in the project sites confirmed that the planned construction sites for the booster stations, a capacitor station and 33 kV distribution lines are owned either by the federal government or by the state government and that no relocation of local residents due to project-related work will be necessary.

Meanwhile, the FMPS independently prepared the Environmental Management Plan regarding the construction work and the operation and maintenance of the new facilities after the completion of the Project and provided this plan to the FMoE and the Study Team. This plan widely covers the impacts of the work on residents, fauna and flora, the environment around the construction sites and the socioeconomy in the project sites. The minimisation of any environmental impacts of the Project is entirely feasible by abiding by the recommendations of this plan.

For the selection of equipment and preparation of the work plan for the Project, the following environmental regulations, etc. in Nigeria will be observed.

- S.I.8 National Environmental Protection (Effluent Limitation) Regulations, 1991
- S.I.9 National Environmental Protection (Pollution Abatement in Industries and Facilities Generating Waste) Regulations, 1991
- Guidelines and Standards for Environmental Pollution Control in Nigeria, 1991

(4) Local Construction Industry

Because of the recent relocation of the capital from Lagos in 1991, a large amount of construction work, including the construction of office buildings, is in progress in Abuja. As a result, several foreign general construction companies have established local offices in the city, resulting in a reasonable state of the local construction industry. Meanwhile, in Lagos which is Nigeria's economic centre, foreign construction companies have been establishing subsidiaries in the city. In rural areas, such as the project areas, however, the construction work conditions are much worse, including the slow development of infrastructure. Consequently, proper attention must be paid to the method of transporting the construction equipment and materials from Abuja or nearby cities and also to the available cities for the site offices at the time of formulating the work implementation plan.

(5) Use of Local Construction Companies, Equipment and Materials

1) Use of Local Construction Companies

Subsidiaries of foreign general construction companies and electrical installation companies are located in Abuja and Lagos. The recruitment/procurement of workers, transport vehicles and construction equipment, etc. is relatively easy and it should be possible to use local companies for the construction of the planned distribution lines and the foundations for the booster stations as subcontractors.

In the case of the equipment installation work for the new booster stations, the use of local companies for other than the recruitment of workers will be difficult because of the little experience of local companies and also because of the necessity for highly skilled engineers for the installation work and equipment adjustment and testing after installation.

Consequently, Japanese engineers should be dispatched to Nigeria to conduct quality control, technical guidance and schedule control.

2) Procurement of Local Equipment and Materials

In Nigeria, the local procurement of aggregates, cement and reinforcing bars, etc. for the foundation work and such distribution materials as overhead wires and concrete poles is possible. These local materials are, in fact, often used for work similar to that planned under the Project. The use of local equipment and materials will, therefore, be planned as much as possible for the formulation of the work implementation plan. However, in the case of the main distribution equipment required for the Project (which are used for the booster stations and distribution transformers), Nigeria relies on imported products as no local products are available. Accordingly, this equipment will be imported from Japan.

(6) Operation and Maintenance Capability of Project Implementation Body

The PHCN has so far been directly conducting the operation and maintenance of the transmission and distribution grids throughout the country, including the 330 kV extra-high voltage transmission lines. The operation and maintenance conditions of the substations and transmission lines of the extra-high voltage (330 kV) and high voltage (132 kV) trunk transmission systems are generally adequate and the current operating situation of the various facilities is fairly good.

In contrast, the maintenance situation of such terminal facilities for end user areas as the 33 kV distribution and substation facilities and 11 kV distribution facilities is less than favourable because of the shortage of spare parts and general deterioration which have not been properly addressed due to the impoverished economic situation of Nigeria for many years. In view of the possibility that PHCN engineers and technicians may lack sufficient technical knowledge of the latest distribution equipment, Japanese engineers will provide OJT on the operation and maintenance of the new booster station equipment during the work period together with the supply of the necessary spare parts, testing instruments, maintenance tools and operation/maintenance manuals. Recommendations will also be made in regard to the operation and maintenance system following the commencement of the service of the new equipment so that the newly installed facilities are operated in an effective and efficient manner.

(7) Scope of Facilities and Equipment and Their Grades

In consideration of the conditions described above, the following principles are adopted for the scope of procurement and installation of equipment and materials under the Project and for their technical grades.

1) Scope of Facilities and Equipment

The target year of the Project is five years after completion of the Project. The minimum but necessary configuration of equipment and specifications will be selected for the procurement and installation of equipment for the 33 kV distribution lines, 33 kV/415–240 V distribution transformers and booster stations to enable a stable supply of electricity for local residents in rural areas where agriculture, a leading industry in Nigeria, is conducted. A stable supply of electricity will also benefit such social welfare facilities as clinics and schools and local tourism through which they are trying to facilitate local economic development making the best use of the cool climate in the mountainous areas.

2) Grades

For the design of the 33 kV distribution lines, 33 kV/415 – 240 V distribution transformers and booster station equipment to be installed or procured under the Project, special attention will be paid not to exceed the technical capability of the PHCN which will be responsible for the operation and maintenance of the new facilities/equipment after completion of the Project. As the 415 V distribution equipment and materials will be procured and installed by the Nigerian side, items which are compatible with the technical capability of the Nigerian side will be selected.

Moreover, to ensure an economical design, a small number of standard products of which the specifications comply with international standards will be selected as much as possible to achieve the minimum but necessary configuration and specifications and to allow the compatibility of equipment.

(8) Implementation Schedule

As the Project will be implemented in accordance with the grant aid scheme by the Government of Japan, the installation work must be completed within a single fiscal year. The schedule should ensure coordination between the work by the Japanese side and the work by the Nigerian side and should also take the routes, methods and periods for inland transportation and the relevant administrative procedures, etc. into consideration to ensure the completion of the work in the planned period and the achievement of the expected effects of electrification.

2.2.2 Basic Plan (Equipment Plan)

(1) Preconditions

1) Electricity Demand Forecast for Project Areas

The electricity demand in the project areas in the target year, i.e. five years after the commencement of the electricity supply service, is forecast in the following manner based on the estimated electricity demand at present.

(a) Calculation of Population Size and Number of Households

The latest population statistics for Nigeria are those based on the national census conducted in 1991. More recent population statistics for the country or the project areas are unavailable. The number of target electricity consumers under the Project has been estimated by classifying the potential consumers in each project area, estimated through interviews at LGHQs, a questionnaire survey and field investigation, into such categories as general households, stores and public facilities (government offices, primary schools, secondary schools, clinics, hospitals, churches, mosques and bore halls).

(b) Annual Increase Rate of Maximum Demand

It appears reasonable to estimate the annual increase rate of the maximum demand in the project areas after the commencement of the power supply service based on the actual results of rural electrification projects in Nigeria. The NREP of the FMPS adopts an annual peak demand increase rate of 10% for the first five years and 5% for the next five years as standard values for the design of electricity supply facilities. These standard values have been employed by Japanese grant aid projects in the pasts.

The peak demand increase rate can be considered to consist of three elements: ① the rate of new subscriptions to the power supply system by consumers after commencement of the Project, ② the population increase rate in each project site, and ③ the electricity demand increase per basic consumption unit mainly due to the increased income level after electrification. In the immediate aftermath of electrification, elements ① and ② are expected to increase the maximum electricity demand. After several years, elements ② and ③ are expected to increase the maximum electricity demand. For these reasons, the demand increase rates adopted by the NREP appear to be appropriate for the Project.

Based on the above, the following estimated average annual increase rates of the electricity demand are adopted for the Project.

- Up to commencement of electricity supply (by population growth) : 5%
- Up to fifth year after commencement of electricity supply (by population growth and power demand growth) : 10%

(c) Basic Consumption Units for Estimation of Electricity Demand

The basic consumption units for estimation of the electricity demand are listed below. These units have been adopted for previous rural electrification projects of the PHCN. As similar units are used for rural electrification projects in Ghana and other West African countries, they are deemed to be appropriate for the Project.

- Unit electricity demand
  - General household : 300 W/ consumer
  - Commerce : 450 W/ consumer
  - Public facility : 3.5 kW/ consumer
- Power factor : 0.85
- Demand factor : 50%

(The demand factor means the ratio of the maximum demand of the load actually used to the total installed capacity.)

(d) Estimation of Electricity Demand in Target Year

The target year of the Project will be the fifth year after commencement of using equipment and materials under the Project and the estimated electricity demand in the project sites based on the electricity demand increase rate and other conditions described above is shown in Tables 2-1 through 2-3. The total maximum electricity demand of the three project sites in the target year is estimated to be some 10 MW as shown in the said tables. As this figure represents approximately 0.3% of the generation output as of 2005, the impact of the Project on the nationwide electricity supply and demand structure is believed to be extremely small.

Table 2-1 Power Demand Forecast for Ranch Communities in Cross River State

(Unit: kW)

Population Growth → Power Demand Growth →

Code	Name of towns	Population	No. of Household	Public and Commercial Facilities				2005	2006 (+5%)	2007 (+5%)	2008 (+10%)	2009 (+10%)	2010 (+10%)	2011 (+10%)	2012 (+10%)
				Clinic	School	Shop	Restaurant			Commencement of operation					Target Year
CR-01	Utanga (Utanga Clan)	7,000	700	5	5	29	16	265	279	292	322	354	389	428	471
CR-02	Amana I	7,000	700	2	6	11	8	247	259	272	299	329	362	398	438
CR-03	Belinge I (Becheve Clan)	1,900	150	2	5	7	2	74	77	81	89	98	108	119	131
CR-04	Belinge II (Becheve Clan)	1,600	150	1	1	1	1	53	56	58	64	71	78	85	94
CR-05	Ugbakoko (Becheve Clan)	5,000	300	1	2	3		102	107	112	124	136	149	164	181
CR-06	Old Ikwette (Bottom Hill)	4,000	400		1	5		126	132	139	153	168	185	203	223
CR-07	Kigol	200	40			2		13	14	14	16	17	19	21	23
CR-08	Apah-Ajile	200	50			1		15	16	17	19	21	23	25	27
CR-09	Ranch Resort	840	140	1	2	20	10	66	69	73	80	88	97	107	117
CR-10	Okwamu	500	20				1	6	7	7	8	9	9	10	11
CR-11	Keji-Oku	150	40					12	13	13	15	16	18	19	21
CR-12	Okpazange	250	50					15	16	17	18	20	22	24	27
CR-13	Anape	800	200	1	1	4		69	72	76	83	92	101	111	122
Total		29,440	2,940	13	23	83	38	1,062	1,116	1,171	1,288	1,417	1,559	1,715	1,886

Basic Parameters

Growth Ratio (%) before commencement	**1.05**
Growth Ratio (%) after commencement	**1.1**

Maximum Demand per customer (kW)	
Domestic (Household)	**0.3**
Clinic	**3.5**
School	**3.5**
Shop	**0.45**
Restaurant	**0.45**

Table 2-2 Power Demand Forecast for Ibedu Ibiaikot Clan in Akwa Ibom State

(Unit: kW)

Population Growth → Power Demand Growth →

Code	Name of towns	Population	No. of Household	Public and Commercial Facilities				2005	2006 (+5%)	2007 (+5%)	2008 (+5%)	2009 (+10%)	2010 (+10%)	2011 (+10%)	2012 (+10%)	2013 (+10%)
				Clinic	School	Shop	Restaurant				Commencement of operation					Target Year
AI-01	Ikot Otu	2,500	167		5	50	4	92	96	101	106	117	129	142	156	171
AI-02	Ibakang	1,900	127	1	3	9	3	58	60	63	67	73	s81	89	97	107
AI-03	Ikot Nkpene	1,500	100	1	3	10	3	50	52	55	58	63	70	77	84	93
AI-04	Okoro Atai	2,200	147		4	10	3	64	67	71	74	81	90	99	108	119
AI-05	Okoro Nsit	1,800	120		3	10	4	53	55	58	61	67	74	81	89	98
AI-06	Idifa	1,500	100		2	8	3	42	44	46	49	53	59	65	71	78
AI-07	Ikot Abiaenye	1,000	67	1	7	15	5	57	60	63	66	73	80	88	97	106
AI-08	Idikpa	1,500	100	1	9	42	6	87	91	95	100	110	121	133	147	161
AI-09	Ibedu	2,000	133	1	7	6	7	74	77	81	85	94	103	114	125	137
AI-10	Ndisiak	2,000	133		3	4	2	53	56	59	61	68	74	82	90	99
AI-11	Ikot Ukpong	2,000	133	1	5	4	2	64	67	70	74	81	89	98	108	119
AI-12	Ikot Ekpot/Ikot Ntuen	3,800	253	1	10	7	7	121	127	133	140	154	169	186	205	225
AI-13	Adia	2,500	167	2	5	11	6	82	86	91	95	105	115	127	139	153
AI-14	Unyehe	1,800	120	0	6	15	3	65	68	72	75	83	91	100	110	121
Total		28,000	1,867	9	72	201	58	960	1,008	1,059	1,111	1,223	1,345	1,479	1,627	1,790

Basic Parameters

Growth Ratio (%) before commencement	**1.05**
Growth Ratio (%) after commencement	**1.1**

Maximum Demand per customer (kW)	
Domestic (Household)	**0.3**
Clinic	**3.5**
School	**3.5**
Shop	**0.45**
Restaurant	**0.45**

Table 2-3 Power Demand Forecast for Eburutu Communities in Cross River State

(Unit: kW)

Population Growth → Power Demand Growth →

Code	Name of towns	Population	No. of Household	Public and Commercial Facilities				2005	2006 (+5%)	2007 (+5%)	2008 (+5%)	2009 (+10%)	2010 (+10%)	2011 (+10%)	2012 (+10%)	2013 (+10%)	2014 (+10%)
				Clinic	School	Shop	Restaurant					Commencement of operation					Target Year
CE-1	Obom Itiat	10,000	500	1	3	15	5	173	182	191	200	220	242	267	293	323	355
CE-2	Ikot Efa	3,000	385	2	1	4	3	129	136	142	150	164	181	199	219	241	265
CE-3	Idim Ndom	10,000	500	1	1	4	5	161	169	178	186	205	226	248	273	300	330
CE-4	Atan Eki	6,500	650	3	2	5	3	216	227	238	250	275	303	333	366	403	443
CE-5	Esuk Atan	250	30	0	0	2	1	10	11	11	12	13	14	16	18	19	21
CE-6	Obodio Eki	4,000	400	0	1	10	6	131	137	144	151	166	183	201	222	244	268
CE-7	Obio Nno	10,000	500	1	1	15	10	168	177	185	195	214	236	259	285	314	345
CE-8	Ekpene Ibiabong Eki	5,000	500	1	3	6	4	169	177	186	195	215	236	260	286	314	346
CE-9	Ikot Ekpo Anwafiong	150	25			1		8	8	9	9	10	11	12	13	15	16
CE-10	Isong Inyang	3,000	300	1	2	30	10	119	124	131	137	151	166	183	201	221	243
CE-11	Atan Onoyom	10,000	1,000	1	3	12	2	320	336	353	371	408	449	494	543	597	657
CE-12	Iboho Ito	2,000	200		1	12		69	72	76	80	88	97	106	117	128	141
CE-13	Idere	2,000	250		1	6		81	85	90	94	103	114	125	138	151	167
CE-14	Odioho Ito	1,000	150					45	47	50	52	57	63	69	76	84	92
CE-15	Enen Ito	600	70	1	1	4	3	31	33	34	36	40	44	48	53	58	64
CE-16	Ekim Ito	600	80					24	25	26	28	31	34	37	41	45	49
CE-17	Utambara Ito	500	75	2	3	5	1	43	45	47	49	54	60	66	72	80	88
CE-18	Akpabio Ito	400	40		1			16	16	17	18	20	22	24	26	29	32
CE-19	Obot Esu	1,500	200			1		60	63	67	70	77	85	93	102	113	124
CE-20	Mbiabong Ito I	5,000	500		1	3	1	155	163	171	180	198	218	239	263	290	318
CE-21	Mbiabong Ito II	3,000	300			2	1	91	96	101	106	116	128	141	155	170	187
CE-22	Okpo	3,000	300	0	1	1	0	94	99	104	109	120	132	145	159	175	193
CE-23	Asang Eniong	3,000	350	1	2	8	7	122	128	135	142	156	171	188	207	228	251
CE-24	Ntanobu Ukpe	10,000	550	2	3	20	7	195	204	215	225	248	273	300	330	363	399
CE-25	Obot Akpabio	4,000	400	2	3	3	5	141	148	156	163	180	198	217	239	263	289
CE-26	Mbiabong Ukwa	7,000	700	3	3	20	7	243	255	268	281	310	341	375	412	453	499
CE-27	Ukwa Ibom	12,000	1,000	5	7	100	10	392	411	432	453	499	548	603	664	730	803
Total		117,500	9,955	27	44	289	91	3,406	3,576	3,755	3,943	4,337	4,771	5,248	5,773	6,350	6,985

Basic Parameters

Growth Ratio (%) before commencement	**1.05**
Growth Ratio (%) after commencement	**1.1**

Maximum Demand per customer (kW)	
Domestic (Household)	**0.3**
Clinic	**3.5**
School	**3.5**
Shop	**0.45**
Restaurant	**0.45**

2) Electric System Plan

(a) Selection of Appropriate Distribution Voltage

The original request proposed the construction of a 33/11 kV distribution substation in the hill bottom area of Ranch Communities in Cross River State to extend the 11 kV distribution lines over a distance of some 5 km to the mountain top area. In general, an 11 kV distribution system has technical and economic advantages over a 33 kV distribution system in any of the following situations.

① In the case where the distribution area spreads (or is expected to spread in the future) in the wide area

② In the case where the demand density is high, necessitating the use of more than one distribution line to serve the overall load

③ In the case where protection of the distribution lines from faults is the highest priority (in an important area, etc.)

For the present Project, however, direct extension of the 33 kV distribution line to the mountain top via a booster station along with the installation of distribution transformers (33 kV/LV) at mountain top communities without the construction of a 33/11 kV distribution substation at the hill bottom area is more advantageous because of the following reasons.

① As the distance from the substation to the terminal point of the 33 kV distribution line is as long as some 200 km, a higher voltage class would be desirable in view of voltage drop and distribution loss.

② As the construction cost of an 11 kV distribution line is similar to that of a 33 kV distribution line (the former is some 80% of the latter), the construction cost of a 33/11 kV distribution substation will increase the overall cost of the Project.

③ Even if a substation is constructed at the hill bottom, the electricity demand beyond the substation will be small, making only one feeder distribution line economically viable.

④ The installation of an auto recloser at the hill bottom will enable to reduce the number of customers interrupted by line faults at the last section of the distribution line.

⑤ The Protea Hotel, a major load source at the mountain top, already has its own generating facilities.

Based on the above, a distribution system involving extension of the 33 kV distribution line to the mountain top without the construction of a 33/11 kV distribution substation at the hill bottom area will be planned for the Project.

(b) Connection Method between Existing and New Distribution Lines

The new 33 kV distribution lines to be installed under the Project will be connected to the existing 33 kV distribution system and will stretch to the project sites for electrification. The connection method shown in Table 2-4 will be applied in view of the location of the existing 33 kV distribution line and conditions of access roads to the project sites.

In the case of Ibedu Ibiaikot Clan in Akwa Ibom State, the No. 5 distribution line of the existing Uyo Substation has already been extended to the planned connection point under the Project. However, the lowest recorded feeder voltage from the substation on this particular line is 27 kV, failing to supply sufficient power to the existing loads. Given this situation, the Akwa Ibom State Government plans to extend the No. 3 distribution line from the Uyo Substation for 7 km by June, 2006 to provide the connection point with the new distribution line serving the project site.

In the case of two towns (Obot Akpabio and Ntanobu Ukpe) in Eburutu Communities in Cross River State, the Japanese side will extend the 33 kV distribution line from the terminal at Use Ikot Amama to the target towns after extension of the existing 33 kV distribution line from Oko Ita to Use Ikot Amama under the rural electrification projects (Ibiono Idoro Project and Edem Urua Project) by FMPS.

Table 2-4 Connection Method between New 33 kV Distribution Line and Existing 33 kV Distribution System

Project Site	Connection of New 33 kV Distribution Line
Ranch Communities in Cross River State	Extension from the terminal (road side) of the existing line serving the 33 kV/415-240 V distribution transformer at Bebi Air Strip (Yahe Feeder from Abakaliki Substation) to the new booster station
Ibedu Ibiaikot Clan in Akwa Ibom State	Extension from the terminal of the existing 33 kV distribution line at Ikot Akpasia (No. 3 Feeder from Uyo Substation)
Eburutu Communities in Cross River State	Extension or T-branching from the terminal of the following existing 33 kV distribution lines and installation of distribution transformers (1) No. 1 Feeder from Calabar Substation (2) Arochuku Feeder from Itu Substation (3) Itu Feeder from Itu Substation

(c) Measures to Prevent Excessive Voltage Drop

The power flow analysis results indicate that the voltage drop of the 33 kV distribution line exceeds the voltage regulation (±10%) in Ranch Communities in Cross River State and Ibedu Ibiaikot Clan in Akwa Ibom State, necessitating the introduction of measures to compensate voltage drop.

In Ranch Communities area in Cross River State, extension from the terminal of the existing 33 kV distribution line is planned. A booster (capacity: 5 MVA) will be installed at this connection point to set the voltage regulation by OLTC (on-load tap changer) between +5% and -25% (13 taps) so that the terminal voltage of the distribution line will be maintained within the allowable range. While this booster will be the outdoor type, the 33 kV high voltage panel, LV switchgear and protective device will be placed inside a cubicle for easy operation and maintenance and also in view of safety. Given the long distance of some 260 km from the existing Abakaliki Substation to the terminal of the distribution line in this area, a capacitor station (3 MVar) will be set up at Ranch Resort on the mountain top to compensate for reactive power.

In the case of Ibedu Ibiaikot Clan in Akwa Ibom State, although the distance from the existing Uyo Substation to the project site is not very long, the large existing load forces the primary side voltage at the substation to drop from the reference voltage of 132 kV to 110 kV. To improve the situation, a booster (capacity: 3 MVA) will be installed at the connection point with the existing distribution line and the voltage regulation will be set between +5% and -25% (13 taps). Because of the short distance to the terminal of the existing distribution line, a capacitor to compensate for reactive power will not be required in this area. Table 2-5 shows the power flow analysis results for the project sites. There are no special problems regarding an excessive voltage drop in Eburutu Communities in Cross River State.

Table 2-5 Power Flow Analysis Results for the Project Sites

Area	33 kV Feeder	Voltage Drop (kV) (Voltage Drop Rate Against Rated Voltage)
Ranch Communities in Cross River State	Yahe Feeder	-6.6 (-20%)
Ibedu Ibiaikot Clan in Akwa Ibom State	No. 3 Feeder	-5.6 (-17%)
Eburutu Communities in Cross River State	No. 1 Feeder	-1.3 (-4%)
	Arochuku Feeder	-1.3 (-4%)
	Itu Feeder	-2.0 (-6%)

Note: The PHCN standards set the allowable voltage drop of a 33 kV distribution line at 10%.

(2) Overall Plan

The following conditions are set to determine the scale and specifications of the facilities, equipment and materials for the Project.

1) Climatic and Site Conditions

	Ranch Communities in Cross River State	Ibedu Ibiaikot Clan in Akwa Ibom State	Eburutu Communities in Cross River State
(a) Altitude	1,580 m (mountain top) 450 m (hill bottom)	50 m	60 m
(b) Ambient temperature			
Maximum	38°C	36°C	35°C
Minimum	29°C	28°C	26°C
Mean	33°C	32°C	31°C
(c) Relative humidity Maximum	91%	90%	94%
(d) Maximum monthly rainfall	630 mm	560 mm	800 mm
(e) Mean monthly rainfall	149 mm	192 mm	243 mm
(f) Annual thunderstorm days	65	30	30
(g) Gusts	37 m/s	37 m/s	37 m/s
(h) Dust	To be considered	To be considered	To be considered

2) Electrical system

(a) Distribution voltage : 33 kV, three-phase three-wire (maximum 34.5 kV)
415 – 240 V, three-phase four-wire

(b) Frequency : 50 Hz

(c) Interrupting capacity : 33 kV system – 25 kA (1 sec.)

(d) Earthing system : 33 kV system – effectively earthed system

(e) Earthing resistance : 10Ω or less

(f) Basic insulation level (BIL) : 170 kV, commercial frequency withstand voltage of 70 kV

(g) Creepage distance : 20 mm/kV

(h) Feeder capacity : 33 kV distribution line – 15 MVA

(i) Colour coding : IEC standards (red, yellow, blue, black)

(j) Insulator material and colour : Porcelain, brown

(k) Protection class and plate thickness for switchgear panels : IP 43 or higher, plate thickness ≥ 2.3 mm

(l) Safety factor : 2.0 (electric pole and foundation)
2.5 (overhead conductors and cross-arm)
2.0 (insulator)

(m) Clearance of distribution lines, etc.

① Minimum clearance

(i) Phase to phase (33 kV)	:	1,200 mm
(ii) Phase to phase (LV)	:	200 mm
(iii) Phase to earth	:	300 mm
(iv) 33 kV to LV	:	1,400 mm

② Minimum height

(i) Road crossing	:	6.0 m
(ii) Alongside road	:	6.0 m

③ Distance from pole to road : 10.0 m

3) Applicable Codes/Standards and Units

In regard to the design of the Project, such international standards as IEC and ISO and Japanese standards will be used for the main equipment functions in consideration of compatibility with existing equipment in Nigeria. Regulations applied at PHCN will be used for the electrical installation work, complemented by the relevant Japanese standards. The International System of Units (SI) will be 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 products in general
(e)	JEM	:	as above
(f)	JEAC	:	as above
(g)	JCS	:	applied to electrical wires and cables
(h)	Technical Standards for Electrical Equipment	:	applied to electrical work in general facilities in Japan
(i)	PHCN regulations	:	applied to electrical work in general facilities in Nigeria

(3) Outline of Basic Plan

The outline of the basic plan for the Project based on the basic design concept described in 2.2.1 is shown in Table 2-6.

Table 2-6 Outline of the Basic Plan

Ranch Communities in Cross River State	Ibedu Ibiaikot Clan in Akwa Ibom State	Eburutu Communities in Cross River State
Procurement and Installation of Equipment and Materials		
Procurement and installation of equipment for the 33 kV distribution line and booster station (1) Booster station (voltage regulating facility) New 33 kV booster station (5 MVA) x 1 (2) Capacitor station (reactive power compensation) New 33 kV capacitor station (3 MVar) x 1 (3) 33 kV distribution line From the new booster station to Anape (approx. 59 k m) (4) 33 kV/415 – 240 V distribution transformers 1) 200 kVA x 6 2) 300 kVA x 5 3) 500 kVA x 4	Procurement and installation of equipment for the 33 kV distribution line and booster station (1) Booster station (voltage regulating facility) New 33 kV booster station (3 MVA) x 1 (2) 33 kV distribution line From the connecting point with the existing 33 kV distribution line to Ibedu (approx. 20 km) (3) 33 kV/415 – 240 V distribution transformers 1) 200 kVA x 7 2) 300 kVA x 2	Procurement and installation of equipment for the 33 kV distribution line (1) 33 kV distribution line From the connecting point with the existing 33 kV distribution line to each target town/village (approx. 85 km) (2) 33 kV/415 – 240 V distribution transformers 1) 200 kVA x 8 2) 300 kVA x 15 3) 500 kVA x 5
Procurement Only		
Procurement of the following distribution equipment, etc. for 13 target towns/villages (1) Spare parts and maintenance tools for the 33 kV distribution line and booster station: one set	Procurement of the following distribution equipment, etc. for 14 target towns/villages (1) Spare parts and maintenance tools for the 33 kV distribution line and booster station: one set (2) 33 kV/415 – 240 V distribution transformers 1) 200 kVA x 3 2) 500 kVA x 1	Procurement of the following distribution equipment, etc. for 27 target towns/villages (1) Spare parts and maintenance tools for the 33 kV distribution line: one set

(4) Equipment Plan

1) Booster Station and Capacitor Station Construction Plan

The Japanese side will conduct the construction work under the Project at three sites: booster station site and capacitor station site in Ranch Communities in Cross River State and booster station site in Ibedu Ibiaikot Clan in Akwa Ibom State. The types of equipment and materials to be used for the construction of these facilities will be decided based on the basic issues and equipment outline described below.

a) Basic Issues

In regard to the selection of the equipment and materials required for the installation of booster stations, special attention should be paid to the easy operation and maintenance as well as the safety of the equipment after completion of the installation work. For these reasons and to shorten the installation period, an outdoor-type high voltage panel will be used. The new booster stations will be basically monitored and controlled on site by maintenance staff of the PHCN and outdoor lighting will be provided for adequate monitoring.

The design of the booster, capacitor and high voltage panel will take the climatic conditions of the project areas into consideration. To protect the equipment from lightning, surge arresters will be installed at both the receiving and sending ends of the stations and a lightning rod will be installed on the premises (in Ranch Communities). An overhead grounding wire will not be installed for the 33 kV distribution lines in accordance with the PHCN standards. To ensure the safety of local residents, however, protective fencing will be erected around the booster stations and capacitor station.

b) Outline of Booster Station

① Equipment Capacity

The capacity of the 33/33 kV automatic voltage regulator (booster) to be installed at the new booster stations under the Project will be 5,000 kVA for Ranch Communities and 3,000 kVA for Ibedu Ibiaikot Clan based on the maximum power demand in the target year and consideration of the power factor of the load (0.85).

② Functions

In view of the lowest voltage recorded in the past at the existing distribution substations, the boosters to be installed to compensate for a voltage drop will maintain the voltage within the regulation of 33 kV +5% ~ -25% (2.5% x 13 taps) using OLTCs.

c) Outline of Reactive Power Compensation

① Equipment Capacity

The capacity of the capacitors to be installed at the new booster stations and the capacitor station under the Project will be 3 MVar based on the maximum reactive power to compensate in the target year and in consideration of the power factor of the load (0.85).

② Functions

Capacitors to compensate for reactive power will be installed at Ranch Resort near the terminal of the 33 kV distribution line. As manual operation by a PHCN worker cannot be frequently conducted, the capacitor will be automatically closed or opened from the distribution line using a circuit breaker panel incorporating an under-voltage relay as well as an over-voltage relay.

d) Outline of 33 kV Power Receiving Facilities

① Booster Station for Ranch Communities in Cross River State

The existing 33 kV distribution line will be extended by approximately 86 m from the front gate area of Bebi Airstrip to the booster station site. A cable terminating pole will be erected on the site to supply power to the 33 kV high voltage panel by underground cable.

② Capacitor Station for Ranch Communities in Cross River State

This capacitor station will be constructed at the mountain top end of the new 33 kV distribution line. To protect the equipment from lightning damage, a cable terminating pole will be erected on the capacitor station site to supply power to the 33 kV high voltage panel by underground cable.

③ Booster Station for Ibedu Ibiaikot Clan in Akwa Ibom State

The existing 33 kV distribution line will be extended by approximately 1,800 m and a cable terminating pole will be erected on the booster station site to supply power to the 33 kV high voltage panel via underground cable.

Each cable terminating pole will be equipped with an arrester (10 kA) and a circuit breaker (vacuum circuit breaker, 36 kV, 630 A, 25 KA) and will be installed inside the distribution panel. A station transformer, disconnecting switch, meters and protective relay, etc. will also be installed for the purpose of station power supply, monitoring and system protection and will be placed inside cubicles. The 33 kV distribution feeders will employ an automatic reclosing system so that the circuit breaker is automatically opened and closed in pre-set time even at a minor earth fault to improve the power supply reliability. The distribution panel will consist of 4 – 8 cubicles and each cubicle will house the equipment listed in Table 2-7 through Table 2-9.

Table 2-7 Configuration of Distribution Panel at Booster Station for Ranch Communities in Cross River State

No.	Cubicle Name	Equipment Housed
1	Station panel	Station transformer (25 kVA); AC power supply panel
2	Circuit breaker panel (booster primary side)	Vacuum circuit breaker; instrument current transformer; over-current relay; ground relay
3	Circuit breaker panel (booster secondary side)	Vacuum circuit breaker; instrument current transformer; reclosing relay; earthing switch; over-current relay; ground relay; watt-hour meter; reactive power meter; ammeter; integrating watt-hour meter
4	Disconnecting switch panel	36 kV disconnecting switch; under-voltage relay; over-voltage relay
5	Instrument transformer panel (booster primary side)	Instrument transformer; earthing switch; voltmeter
6	Instrument transformer panel (booster secondary side)	Instrument transformer; voltage regulator relay; under-voltage relay; voltmeter
7	Circuit breaker panel (capacitor primary side)	Vacuum circuit breaker; instrument current transformer; over-current relay; ground relay; ammeter; earthing switch
8	Circuit breaker panel (capacitor primary side)	Vacuum circuit breaker; instrument current transformer; over-current relay; ground relay; ammeter; earthing switch

Table 2-8 Configuration of Distribution Panel at Capacitor Station for Ranch Communities in Cross River State

No.	Cubicle Name	Equipment Housed
1	Station panel	Station transformer (25 kVA); AC power supply panel
2	Instrument transformer panel	Station transformer; earthing switch; voltage regulating relay; under-voltage relay; voltmeter
3	Circuit breaker panel (capacitor primary side)	Vacuum circuit breaker; instrument current transformer; over-current relay; ground relay; ammeter; earthing switch
4	Circuit breaker panel (capacitor primary side)	Vacuum circuit breaker; instrument current transformer; over-current relay; ground relay; ammeter; earthing switch

Table 2-9 Configuration of Distribution Panel at Booster Station for Ibedu Ibiaikot Clan in Akwa Ibom State

No.	Cubicle Name	Equipment Housed
1	Station panel	Station transformer (25 kVA); AC power supply panel
2	Circuit breaker panel (booster primary side)	Vacuum circuit breaker; instrument current transformer; over-current relay; ground relay
3	Circuit breaker panel (booster secondary side)	Vacuum circuit breaker; instrument current transformer; reclosing relay; earthing switch; over-current relay; ground relay; watt-hour meter; reactive power meter; ammeter; integrating watt-hour meter
4	Instrument transformer panel (booster primary side)	Instrument transformer; earthing switch; voltmeter
5	Instrument transformer panel (booster secondary side)	Instrument transformer; voltage regulator relay; under-voltage relay; voltmeter

e) Outline of Auxiliary Systems

The auxiliary systems (outdoor lighting system and others) to be installed at the booster stations and capacitor station which will be constructed under the Project will take the need for energy conservation into full consideration. At the booster stations, an oil separating tank will be installed on the premises as a measure to deal with an insulating oil leakage incident at the time of a booster accident. Moreover, adequate drainage facilities will be installed to protect the environment. Table 2-10 shows the specifications of the high voltage cables connecting the high voltage equipment and distribution panel, etc. at the booster stations and capacitor station.

Table 2-10 Specifications of Station Cables and Cable Connecting to Existing Distribution Line

	Section	Specifications	Remarks
Booster Station	Between the 33 kV cable rising pole and the 33 kV distribution panel	19/33 kV, copper conductor, XLPE insulation, PVC sheath, 120 mm^2 (single core) with armour	To meet a line capacity of 15 MVA or more
	Between the 33 kV distribution panel and the booster (primary side)	As above	As above
	Between the booster (secondary side) and the 33 kV distribution panel	As above	As above
	Between the 33 kV distribution panel (feeder panel) and the 33 kV rising pole	As above	As above
Capacitor Station	Between the 33 kV cable rising pole and the 33 kV distribution panel	19/33 kV, copper conductor, XLPE insulation, PVC sheath, 50 mm^2 (single core) with armour	To meet a reactive power compensation capacity of 3 MVar
	Between the 33 kV distribution panel and the capacitor	As above	As above

Note: XLPE = cross-linked polyethylene insulated, PVC = polyvinyl chloride

2) 33 kV Distribution Line Plan

The procurement and installation of the 33 kV distribution equipment and materials to be conducted by the Japanese side for the Project will be designed based on the basic issues and outline of equipment and materials described below.

a) Basic Issues

The equipment will be designed based on the PHCN standards and the specifications of the equipment to be procured by the Japanese side will ensure compatibility with the existing equipment possessed or in use by PHCN as much as possible in view of the consistent maintenance between the existing and new equipment.

b) Outline of 33 kV Distribution Line Plan

① Route Selection

The route for the new distribution line in each project site has been decided based on the examination results of the pre-prepared distribution route map and the topographical map and the results of the field reconnaissance jointly conducted with PHCN engineers to check for any obstacles, landmarks and unique natural conditions in the area. Particularly in the case of Ranch Communities, given the fact that the new distribution line will be laid from an altitude of some 700 m to 1,550 m through a valley, application of built up steel plate poles (steel poles) is considered. The basic routes are shown on attached drawings RC-D-01, IC-D-01 and EC-D-01.

② Determination of Pole Span

Having considered the size of conductor to be used, the tensile load for the conductor and the pole strength, etc., the standard pole spans used by the PHCN are adopted for pole span design purposes.

- Standard span for 33 kV distribution line : 70 m
- Standard span for 33 kV distribution line in mountain areas : 50 m
- Standard span for sections where combination of 33 kV and LV distribution lines are applied : 45 m
- Standard interval of section poles : every nine spans

③ Type of Overhead Distribution Conductor

Aluminium conductor steel reinforced (ACSR) which is the standard conductor used by PHCN will be applied for the planned overhead distribution lines under the Project and the size will be as follows.

- 33 kV distribution lines: ACSR 150 mm^2 or 100 mm^2 (in consideration of the existing distribution conductor size)

The planned procurement quantity of conductors for the distribution lines is determined by the plane distance measured on the drawings (design quantity) multiplied by a margin rate of 1.13 (3% for conductor dip and 10% for work supply). The planned quantity of conductors for the 33 kV distribution line installation work by the Japanese side is calculated by multiplying the design quantity by a margin rate of 1.03. Accordingly, the quantities of overhead distribution conductors to be procured and installed under the Project are those shown in Table 2-11.

Table 2-11 Required Quantity of Conductors for 33 kV Overhead Distribution Lines

Item	Ranch Communities	Ibedu Ibiaikot Clan	Eburutu Communities	Total
Type of conductor	ACSR 150 mm^2	ACSR 100 mm^2	ACSR 100 m^2	
① Length of distribution line	59 km	20 km	85 km	105 km (ACSR 100 mm^2) 59 km (ACSR 150 mm^2)
② Design quantity (three phase, ① x 3)	178 km	60 km	255 km	315 km (ACSR 100 mm^2) 178 km (ACSR 150 mm^2)
③ Procurement quantity (② x 1.13)	201 km	68 km	288 km	356 km (ACSR 100 mm^2) 201 km (ACSR 150 mm^2)
④ Installation quantity (② x 1.03)	183 km	62 km	262 km	324 km (ACSR 100 mm^2) 183 km (ACSR 150 mm^2)

④ Types and Shapes of Poles

In principle, concrete poles or steel poles will be used. The length of these poles will be either 10.36 m or 12.50 m to match the standard pole length for a 33 kV distribution line.

15.00 m long concrete poles will be used, however, in some sections in Eburutu Communities in Cross River State due to flooding during the rainy season.

A standard value of 20 mm/kV is adopted as the creepage distance of the pin as well as suspension insulators used for the 33 kV distribution lines because the project sites are not classified as salt-polluted areas. Zinc-plated steel arms will be used to position the insulators.

Table 2-12 shows the types, purpose of use and quantities of the poles while Table 2-13 through Table 2-16 show the detailed procurement quantities of the equipment and materials for the 33 kV distribution lines.

⑤ 33 kV/415 – 240 V Distribution Transformers

(i) Selection of Capacity and Quantity

The installation of distribution transformers is necessary for the project sites to step down the voltage from the 33 kV distribution line to the low voltage (415 – 240 V) distributed to each consumer. The precondition for the capacity and quantity of the distribution transformers to be procured under the Project is to satisfy the maximum demand in the target year. The capacity is selected from the PHCN's list of standard transformer capacities while the optimum quantity is determined based on the distribution of the load in the project sites. The distribution transformer should be located as near as possible to such public facilities with a large load as schools and hospitals/clinics to ensure the quality of electricity supply.

In order to maintain the voltage fluctuation for low voltage consumers within ±10%, the distribution transformers to be procured for the Project will have ±2.5% and ±5% taps (switching over at the time of no voltage) on the high voltage side while the low voltage side will use the three-phase four-wire system in view of the efficiency and economy of the distribution line.

The capacity and quantity of the distribution transformers to be procured for the project sites are shown in Table 2-17. The total quantity of distribution transformers to be procured under the Project is 56.

(ii) Installation Method

All of the distribution transformers will be installed on the ground. In accordance with the PHCN standards, the concrete foundation on which a distribution transformer is installed will have a height of 1.5 m. Concrete block walls of 1.4 m in height will be constructed to cover an area of 5 m x 5 m to allow the accommodation of a transformer and a LV distribution panel. The walls will have a lockable gate section.

Table 2-12 Quantity of Poles by Type for 33 kV Distribution Lines

Pole Type	Purpose of Use	Material	Length (m)	No. of Poles per Set	% by Purpose of Use	Ranch Communities			Ibedu Ibiaikot Clan			Eburutu Communities			Total No. of Sets (Poles)
						A Design Qty.	B Work Supply Qty.	Sub-Total A + B	A Design Qty.	B Work Supply Qty.	Sub-Total	A Design Qty.	B Work Supply Qty.	Sub-Total	
< For Standard Distribution Line >															
A	Through pole (0° – 5°)	Concrete	10.36	1	65%	609	30	639	283	14	297	807	40	847	1783 (1783)
B	Angle pole (5° – 15°)	Concrete	10.36	1	13%	122	6	128	57	2	59	163	8	171	358 (358)
C	Angle pole (15° – 60°)	Steel	10.36	2	8%	75	3	78	34	1	35	99	4	103	216 (432)
D	Angle pole (60° – 90°)	Steel	10.36	2	4%	36	1	37	19	0	19	49	2	51	107 (214)
E	Section pole	Steel	10.36	2	10%	93	4	97	44	2	46	127	6	133	276 (552)
F	T-off pole	Steel	10.36	2	Actual Qty.	10	0	10	3	0	3	4	0	4	17 (34)
G	Cable pole	Steel	10.36	2	Actual Qty.	3	0	3	2	0	2	0	0	0	5 (10)
G1	Dead end pole	Steel	10.36	2	Actual Qty.	1	0	1	0	0	0	14	0	14	15 (30)
H	LBS pole	Steel	10.36	2	Actual Qty.	1	0	1	1	0	1	3	0	3	5 (10)
J1	TR pole (dead end)	Steel	10.36	2	Actual Qty.	11	0	11	5	0	5	19	0	19	35 (70)
J2	TR pole (through)	Steel	10.36	2	Actual Qty.	4	0	4	8	0	8	9	0	9	21 (42)
K	Auto recloser pole	Steel	10.36	2	Actual Qty.	1	0	1	0	0	0	1	0	1	2 (4)
< For Distribution Line in Mountain Area >															
AL	Through pole (0° – 5°)	Steel	12.50	1	65%	91	4	95	0	0	0	0	0	0	95 (95)
BL	Angle pole (5° – 15°)	Steel	12.50	1	25%	33	1	34	0	0	0	0	0	0	34 (34)
EL	Section pole	Steel	12.50	2	10%	14	0	14	0	0	0	0	0	0	14 (28)
< For Distribution Line in Flooding Area >															
ALL	Through pole (0° – 5°)	Concrete	15.00	1	65%	0	0	0	0	0	0	103	5	108	108 (108)
BLL	Angle pole (5° – 15°)	Concrete	15.00	1	25%	0	0	0	0	0	0	39	1	40	40 (40)
ELL	Section pole	Concrete	15.00	2	10%	0	0	0	0	0	0	14	0	14	14 (28)

(Remarks) Concrete foundation shall be installed for 10% of Standard Distribution Line (Steel Pole), for all poles of Distribution Line in Mountain Area, and for all poles of Distribution Line in Flooding Area.

Table 2-13 Detailed Quantities of Poles, etc. for 33 kV Distribution Line (Ranch Communities in Cross River State)

Ranch Communities					①	②	③	④	④-2	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫	⑬	⑭	
	Interval:				Bebi Connection Point to	B/S to Utanga	Bagga to Utanga	Utanga to Amana	Amana-1 to 2	Amana to Belinge-1	Belinge-1 to 2	Belinge-2	Belinge-2 to Ugbakoko	Ugbakoko	Ugbakoko to Bottom hill	Bottom Hill Top Hill	CR-8 & 7	CR-10, 11, 12 & 9	CR-13	Total
	Distance (km):		ACSR	150mm2	0.1	18.9	5.9	1.9	1.1	3.8	1.5	0.2	1.8	1.4	3.0	6.9	2.7	3.1	6.9	59.2
	Pole Span (m):				70	70	45	70	45	45	70	45	70	45	70	50	45	45	45	
	No. of Poles by Span:				3	270	133	29	26	86	23	6	27	33	44	139	60	70	155	
(Ratio)		(Pole Type)	(Material)	(Length, m)																
65%	A	0-5°	Concrete	10.36	1	174	82	19	16	55	15	3	17	21	28	0	37	40	101	609
13%	B	5-15°	Concrete	10.36	0	35	17	4	3	11	3	1	4	4	5	0	7	8	20	122
8%	C	15-60°	Steel	10.36	0	22	10	2	2	7	2	0	2	3	3	0	5	5	12	75
4%	D	60-90°	Steel	10.36	0	11	5	1	1	3	1	0	1	1	2	0	2	2	6	36
10%	E	Section	Steel	10.36	0	27	13	3	2	8	2	1	3	3	4	0	6	6	15	93
			(Sub-total of A to E)		**1**	**269**	**127**	**29**	**24**	**84**	**23**	**5**	**27**	**32**	**42**	**0**	**57**	**61**	**154**	**935**
65%	AL	0-5°	Steel	12.5	0	0	0	0	0	0	0	0	0	0	0	91	0	0	0	91
25%	BL	5-15°	Steel	12.5	0	0	0	0	0	0	0	0	0	0	0	33	0	0	0	33
10%	CL	Section	Steel	12.5	0	0	0	0	0	0	0	0	0	0	0	14	0	0	0	14
Fixed	F	T-off	Steel	10.36	0	0	3	0	1	0	0	0	0	0	1	0	1	4	0	10
Fixed	G	Cable	Steel	10.36	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	3
Fixed	G1	Dead end	Steel	10.36	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Fixed	H	LBS	Steel	10.36	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Fixed	J1	TR (Dead End)	Steel	10.36	0	0	3	0	1	0	0	0	0	0	1	0	2	3	1	11
Fixed	J2	TR (Through)	Steel	10.36	0	0	0	0	0	2	0	1	0	1	0	0	0	0	0	4
Fixed	K	Auto Recloser	Steel	10.36	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
			(Sub-total of AL to K)		**2**	**1**	**6**	**0**	**2**	**2**	**0**	**1**	**0**	**1**	**2**	**139**	**3**	**9**	**1**	**169**
	Total No. of Poles:				**3**	**270**	**133**	**29**	**26**	**86**	**23**	**6**	**27**	**33**	**44**	**139**	**60**	**70**	**155**	**1,104**
	Concrete Foundation:				0														155	155
	Connection Materials to the Existing Lines:				1															1

Table 2-14 Detailed Quantities of Poles, etc. for 33 kV Distribution Line (Ibedu Ibiaikot Clan in Akwa Ibom State)

Ibedu Ibiaikot Clan																							
	Interval:				AI-00 to B/S	B/S to AI-01	AI-01 to Corner-01	Corner-01 to Corner-02	Corner-02 to AI-02	AI-02 to AI-03	AI-03 to AI-04	AI-04 to AI-05	AI-05 to AI-06	AI-06 to AI-07	AI-07 to Corner-03	Corner-03 to AI-08	Corner-03 to AI-09	AI-10	AI-11	AI-12	AI-13	Total	Total BQ
	Distance (km):		ACSR	100mm2	1.8	0.7	2.0	3.3	1.1	1.1	1.1	2.5	0.6	1.9	1.3	0.8	1.8					20.0	67.8
	Pole Span (m):				45	45	45	45	45	45	45	45	45	45	45	45	45						
	No. of Poles by Span:				41	17	45	74	25	25	25	56	14	43	29	18	40						
(Ratio)	(Pole Type)		(Material)	(Length, m)																			
65%	A	0-5°	Concrete	10.36	26	9	28	48	14	16	16	36	8	28	18	11	25					283	297
13%	B	5-15°	Concrete	10.36	5	2	6	10	3	3	3	7	2	5	4	2	5					57	59
8%	C	15-60°	Steel	10.36	3	1	4	6	2	2	2	4	1	3	2	1	3					34	35
4%	D	60-90°	Steel	10.36	2	1	2	3	1	1	1	2	0	2	1	1	2					19	19
10%	E	Setion	Steel	10.36	4	2	5	7	2	2	2	6	1	4	3	2	4					44	46
			(Sub-total of A to E)		**40**	**15**	**45**	**74**	**22**	**24**	**24**	**55**	**12**	**42**	**28**	**17**	**39**	**0**	**0**	**0**	**0**	**437**	**456**
Fixed	F	T-off	Steel	10.36	0	0	0	0	1	0	0	0	1	0	1	0	0	0	0	0	0	3	3
Fixed	G	Cable	Steel	10.36	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2
Fixed	G1	Dead end	Steel	10.36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fixed	H	LBS	Steel	10.36	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Fixed	J1	TR (Dead End)	Steel	10.36	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	1	1	5	5
Fixed	J2	TR (Through)	Steel	10.36	0	1	0	0	1	1	1	1	1	0	0	0	0	1	1	0	0	8	8
Fixed	K	Auto Recloser	Steel	10.36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			(Sub-total of F to K)		**1**	**2**	**0**	**0**	**3**	**1**	**1**	**1**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**19**	**19**
	Total No. of Poles:				**41**	**17**	**45**	**74**	**25**	**25**	**25**	**56**	**14**	**43**	**29**	**18**	**40**	**1**	**1**	**1**	**1**	**456**	**475**
	Concrete Foundation:											5			5							10	10
	Connection Materials to the Existing Lines:				1					1								1	1	1	1	6	6

Table 2-15 Detailed Quantities of Poles, etc. for 33 kV Distribution Line (Eburutu Communities in Cross River State (1/2))

Eburutu Communities																			
	Interval:				Ndon Nwong to CE-01	Ndon Nwong to CE-01	CE-01 to CE-02	CE-01 to CE-03	CE-03 to CE-04	CE-04 to CE-05	CE-04 to CE-06	CE-06 to CE-07	T-off to CE-08	CE-09	CE-10	CE-11A	CE-11B	CE-12	T-off to CE-13
	Distance (km):		ACSR	100mm2	13.0	2.0	2.5	2.3	3.2	3.1	3.4	2.0	11.0	0.1	0.1	0.4	0.0	0.1	8.0
	Pole Span (m):				70	45	45	45	45	45	45	45	70	70	70	45	45	70	70
	No. of Poles by Span:				187	46	56	52	72	69	77	46	159	3	3	10	1	2	116
(Ratio)	(Pole Type)		(Material)	(Length, m)															
65%	A	0-5°	Concrete	10.36	118	29	36	33	45	44	48	28	102	1	1	5	0	0	74
13%	B	5-15°	Concrete	10.36	23	6	7	7	9	9	10	6	20	0	0	1	0	0	15
8%	C	15-60°	Steel	10.36	14	4	4	4	6	5	6	4	13	0	0	1	0	0	9
4%	D	60-90°	Steel	10.36	7	2	2	2	3	3	3	2	6	0	0	0	0	0	5
10%	E	Section	Steel	10.36	18	5	6	5	7	7	8	5	16	0	0	1	0	0	11
			(Sub-total of A to E)		180	46	55	51	70	68	75	45	157	1	1	8	0	0	114
65%	ALL	0-5°	Concrete	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25%	BLL	5-15°	Concrete	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10%	CLL	Section	Concrete	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fixed	F	T-off	Steel	10.36	2	0	0	0	1	0	1	0	0	0	0	0	0	0	0
Fixed	G	Cable	Steel	10.36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fixed	G1	Dead end	Steel	10.36	1	0	0	0	0	0	0	0	0	1	1	1	0	1	1
Fixed	H	LBS	Steel	10.36	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Fixed	J1	TR (Dead End)	Steel	10.36	0	0	1	0	0	1	1	1	1	1	1	1	0	1	1
Fixed	J2	TR (Through)	Steel	10.36	2	0	0	1	1	0	0	0	0	0	0	0	1	0	0
Fixed	K	Auto Recloser	Steel	10.36	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			(Sub-total of AL to K)		7	0	1	1	2	1	2	1	2	2	2	2	1	2	2
	Total No. of Poles:				187	46	56	52	72	69	77	46	159	3	3	10	1	2	116
	Concrete Foundation:													3	3				20
	Connection Materials to the Existing Lines:				1	1								1	1	1	1	1	1

Table 2-16 Detailed Quantities of Poles, etc. for 33 kV Distribution Line (Eburutu Communities in Cross River State (2/2))

Eburutu Communities																			
	Interval:				CE-14	CE-15	CE-17	CE-19	CE-20 to CE-21	CE-21	Ikot Ekwere to CE-22	Ikot Uwa to CE-23	Use Ikot Amama to CE-25	CE-25 to CE-24	Ututu to CE-26	CE-26 to CE-27A	CE-27A to CE-27B	Total	Total BQ
	Distance (km):		ACSR	100mm2	0.2	0.3	0.3	0.6	3.0	0.1	3.0	4.0	6.0	4.0	9.0	2.7	0.5	84.9	287.6
	Pole Span (m):				70	70	45	45	45	70	70	70	70	70	70	45	45		
	No. of Poles by Span:				4	6	8	15	67	2	44	59	87	58	130	60	12		
(Ratio)	(Pole Type)		(Material)	(Length, m)															
65%	A	0-5°	Concrete	10.36	2	3	4	8	42	0	0	0	55	0	83	38	8	807	847
13%	B	5-15°	Concrete	10.36	0	1	1	2	9	0	0	0	11	0	17	8	1	163	171
8%	C	15-60°	Steel	10.36	0	0	0	1	5	0	0	0	7	0	10	5	1	99	103
4%	D	60-90°	Steel	10.36	0	0	0	1	3	0	0	0	3	0	5	2	0	49	51
10%	E	Section	Steel	10.36	0	0	1	1	7	0	0	0	9	0	13	6	1	127	133
			(Sub-total of A to E)		**2**	**4**	**6**	**13**	**66**	**0**	**0**	**0**	**85**	**0**	**128**	**59**	**11**	**1,245**	**1,305**
65%	ALL	0-5°	Concrete	15	0	0	0	0	0	0	28	38	0	37	0	0	0	103	108
25%	BLL	5-15°	Concrete	15	0	0	0	0	0	0	10	14	0	15	0	0	0	39	40
10%	CLL	Section	Concrete	15	0	0	0	0	0	0	4	5	0	5	0	0	0	14	14
Fixed	F	T-off	Steel	10.36	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4
Fixed	G	Cable	Steel	10.36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fixed	G1	Dead end	Steel	10.36	1	1	1	1	0	1	1	1	1	0	0	0	0	14	14
Fixed	H	LBS	Steel	10.36	0	0	0	0	0	0	0	0	0	0	1	0	0	3	3
Fixed	J1	TR (Dead End)	Steel	10.36	1	1	1	1	1	0	1	1	0	1	0	0	1	19	19
Fixed	J2	TR (Through)	Steel	10.36	0	0	0	0	0	1	0	0	1	0	1	1	0	9	9
Fixed	K	Auto Recloser	Steel	10.36	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
			(Sub-total of AL to K)		**2**	**2**	**2**	**2**	**1**	**2**	**44**	**59**	**2**	**58**	**2**	**1**	**1**	**206**	**212**
	Total No. of Poles:				**4**	**6**	**8**	**15**	**67**	**2**	**44**	**59**	**87**	**58**	**130**	**60**	**12**	**1,451**	**1,517**
	Concrete Foundation:										44	55	87	58	30	20	20	340	340
	Connection Materials to the Existing Lines:				1	1	1	1		1	1	1	1		1			17	17

Table 2-17 Capacity and Quantity of Distribution Transformers

Area	Site Code	Target Town/Village	Quantity of Distribution Transformers		
			200 kVA	300 kVA	500 kVA
Ranch Communities in Cross River State	CR-01	Utanga (Utanga Clan)		2	1
	CR-02	Amana I		1	1
	CR-03	Belinge I (Becheve Clan)	1		
	CR-04	Belinge II (Becheve Clan)	1		
	CR-05	Ugbakoko (Becheve Clan)		1	
	CR-06	Old Ikwette (Bottom Hill)		1	
	CR-07	Kigol	1		
	CR-08	Apah-Ajile	1		
	CR-09	Ranch Resort			1
	CR-10	Okwamu			1
	CR-11	Keji-Oku	Shared with CR-10 Okwamu		
	CR-12	Okpazange	1		
	CR-13	Anape	1		
	Sub-Total		6	5	4
Ibedu Ibiaikot Clan in Akwa Ibom State	AI-01	Ikot Out		1	
	AI-02	Ibakang	1		
	AI-03	Ikot Nkpene	1		
	AI-04	Okoro Atai		1	
	AI-05	Okoro Nsit	1		
	AI-06	Idifa	1		
	AI-07	Ikot Abiaenye	1		
	AI-08	Idikpa	1		
	AI-09	Ibedu	1		
	AI-10	Ndisiak	1*		
	AI-11	Ikot Ukpong	1*		
	AI-12	Ikot Ekpot/Ikot Ntuen			1*
	AI-13	Adia	1*		
	AI-14	Unyehe	Existing transformer can be used		
	Sub-Total		10	2	1
Eburutu Communities in Cross River State	CE-01	Obom Itiat	1	1	
	CE-02	Ikot Efa		1	
	CE-03	Idim Ndom		1	
	CE-04	Atan Eki		1	
	CE-05	Esuk Atan	1		
	CE-06	Obodio Eki		1	
	CE-07	Obio Nno	1		
	CE-08	Ekpene Ibiabong Eki			1
	CE-09	Ikot Ekpo Anwafiong	1		
	CE-10	Isong Inyang		1	
	CE-11	Atan Onoyom		1	1
	CE-12	Iboho Ito		1	
	CE-13	Idere	1		
	CE-14	Odioho Ito	1		
	CE-15	Enen Ito		1	
	CE-16	Ekim Ito	Shared with CE-15 Enen Ito		
	CE-17	Utambara Ito		1	
	CE-18	Akpabio Ito	Shared with CE-17 Utambara Ito		
	CE-19	Obot Esu		1	
	CE-20	Mbiabon Ito I			1
	CE-21	Mbiabong Ito II	1		
	CE-22	Okpo	1		
	CE-23	Asang Eniong		1	
	CE-24	Ntanobu Ukpe		1	
	CE-25	Obot Akpabio		1	
	CE-26	Mbiabong Ukwa			1
	CE-27	Ukwa Ibom		1	1
	Sub-Total		8	15	5
Total of Each Area			24	22	10
Grand Total of Three Areas			56		

* To be procured by the Japanese side but to be installed by the Nigerian side.

⑥ Installation of Load Break Switches

A load break switch will be installed at each appropriate section of long distribution lines, the connection point with the existing 33 kV distribution line and the branch point to switch the load current on and off. The actual sites for installation are listed below.

(i) 33 kV Distribution Line for Ranch Communities

Between the capacitor station and Ranch Resort on the mountain (hill) top.

(ii) 32 kV Distribution Line for Ibedu Ibiaikot Clan

Between the Ibakang TR pole and the existing distribution line

(iii) 33 kV Distribution Line for Eburutu Communities

Between the branch point in Akwa Ekim and Ekpene Ibiabong Eki
Between the branch point in Akwa Ekim and Obom Itiat
Between the existing Ukwa distribution line and Mbiabong Ukwa

⑦ Installation of Fused Cut-Out Switches

A fused cut-out switch for protection of the transformer from over-loading and short-circuit faults and for maintenance of the transformer will be installed on the high voltage side (33 kV side) of each distribution transformer to be procured for the project sites.

⑧ Installation of Surge Arresters

Surge arresters will be installed on the primary side of each distribution transformer and auto recloser to protect such equipment from lightning damage.

3) Outline of Equipment Specifications

The details of the equipment and materials to be applied for the booster stations, capacitor station and 33 kV distribution lines are listed in Table 2-18 through Table 2-21. Procurement Plan for Testing Equipment and General Maintenance Tools is listed in Table 2-22.

Table 2-18 Booster Station Construction Plan for Ranch Communities

Code	Item/Equipment	Specifications	Quantity
RB-1	Construction of Auxiliary Facilities	(Area: 25 m x 25 m = 625 m^2)	
	(1) Gravel		1 lot
	(2) Rainwater drainage, etc.		1 lot
	(3) Grounding net		1 lot
	(4) Outdoor lighting	(Mercury lamps x 2)	1 lot
	(5) Equipment foundations		1 lot
	(6) Oil separating tank		1 lot
RB-2	Procurement and Installation of 33 kV Automatic Voltage Regulator (Booster)		1
	(1) Applicable standards	IEC	
	(2) Type	Outdoor, oil-filled self-cooling type with OLTCs	
	(3) Number of phases	Three	
	(4) Rated frequency	50 Hz	
	(5) Rated primary voltage	33 kV	
	(6) Rated secondary voltage	33 kV	
	(7) Rated capacity	5 MVA	
	(8) Tap voltage	33 kV + 5% to -25%	
	(9) Number of taps	13	
	(10) Step voltage	2.5%	
RB-3	Procurement and Installation of 33 kV Capacitor and Series Reactor		2
	(1) Type	Outdoor, oil-filled	
	(2) Capacity	1.5 MVar	
RB-3	33 kV Distribution Panel	(see Drawing RC-S-02)	8 cubicles
	(1) Panel		
	1) Type	Outdoor closed metal-type with space heater	
	2) IP level	IP43 or higher	
	(2) Circuit breaker		
	1) Type	Vacuum circuit breaker, draw-out type	
	2) Rating	Three-phase, 36 kV, 630 A, 25 kA	
	(3) Instrument current transformer		
	1) Type	Indoor, resin-molded	
	2) Rating	200 – 100/5 A	
	(4) Instrument voltage transformer		
	1) Type	Indoor, resin-molded	
	2) Rating	3 poles, Primary:33/$\sqrt{3}$kV, Secondary: 110/$\sqrt{3}$V	
	(5) Earthing switch		
	1) Type	Manual operation-type	
	(6) Disconnecting switch		
	1) Type	Manual operation-type	
	2) Rating	3 poles, 36 kV, 600 A	
	(7) Fused cut-out	36 kV	
	(8) 33 kV station transformer		
	1) Type	Indoor oil-filled type	
	2) Rating	Three-phase, 50 Hz, 33 kV/415/240 V, 25 kVA	
	(9) Voltage regulator	10 kVA	
	(10) Instruments and control switches	Ammeter; voltmeter; voltage detector; control switches; fault indicator; real power meter; reactive power meter; watt-hour meter	
	(11) Protective relays	- Over-current relay - Ground relay - Voltage regulating relay - Under-voltage relay - Auto reclosing relay	

Code	Item/Equipment	Specifications	Quantity
RB-4	Procurement and Installation of 33 kV Distribution Cables and Accessories (1) 33 kV power cable 1) Applicable standards 2) Type 3) Size (2) Cable treatment materials 1) Type	 IEC or equivalent standards 19/33 kV, XLPE insulation, copper conductor, PVC sheath, single core cable with armour 120 mm^2 - Outdoor specification, heat shrinkable type (line and capacitor sides) - Indoor specification, heat shrinkable type (transformer and circuit breaker sides)	 450 m (for three-phases) (set for three-phases) 4 sets 8 sets
RB-5	Procurement and Installation of LV Power Cables and Control Cables (1) LV power cables 1) Applicable standards 2) Type (2) Control cables 1) Reference standards 2) Type	 IEC or equivalent standards 600 V/1,000 V XLPE insulation, PVC sheath, copper conductor cable IEC or equivalent standards 600 V PVC insulation, copper conductor with copper tape shield	 1 lot 1 lot
RB-6	Procurement and Installation of Earthing Materials (1) Earthing conductor (2) Earthing pole	 38 and 100 m m^2 bare copper wires or equivalent Copper-covered steel pole with lead terminal, 14 mm (D) x 1,500 mm (L) or equivalent	 1 lot 1 lot

Table 2-19 Capacitor Station Construction Plan for Ranch Communities

Code	Item/Equipment	Specifications	Quantity
RC-1	Construction of Auxiliary Facilities (1) Gravel (2) Grounding net (3) Outdoor lighting (4) Equipment foundations	(Area: 12 m x 25 m (300 m^2)) (Mercury lamps x 2)	 1 lot 1 lot 1 lot 1 lot
RC-2	Procurement and Installation of 33 kV Condenser and Series Reactor (1) Type (2) Capacity	 Outdoor, oil-filled type 1.5 MVar	2
RC-3	33 kV Distribution Panel (1) Panel 1) Type 2) IP level (2) Circuit breaker 1) Type 2) Rating (3) Instrument current transformer 1) Type 2) Rating (4) Instrument voltage transformer 1) Type 2) Rating (5) Earthing switch 1) Type (6) Disconnecting switch 1) Type 2) Rating (7) Fused cut-out	(see Drawing RC-S-02) Outdoor closed metal-type with space heater IP43 or higher Vacuum circuit breaker, draw-out type Three-phase, 36 kV, 630 A, 25 kA Indoor, resin-molded 200 – 100/5 A Indoor, resin-molded 3 poles, Primary:33/$\sqrt{3}$kV, Secondary: 110/$\sqrt{3}$V Manual operation-type Manual operation-type 3 poles, 36 kV, 600 A 36 kV	4 cubicles

Code	Item/Equipment	Specifications	Quantity
	(8) 33 kV station transformer 1) Type 2) Rating (9) Voltage regulator (10) Instruments and control switches (11) Protective relays	 Indoor oil-filled type Three-phase, 50 Hz, 33 kV/415/240 V, 25 kVA 10 kVA Ammeter; voltmeter; voltage detector; control switches; fault indicator - Over-current relay - Ground relay - Over-voltage relay - Under-voltage relay	
RC-4	Procurement and Installation of 33 kV Distribution Cables and Accessories (1) 33 kV power cable 1) Applicable standards 2) Type 3) Size (2) Cable treatment materials 1) Type	 IEC or equivalent standards 19/33 kV, XLPE insulation, copper conductor, PVC sheath, single core cable with armour 50 mm^2 - Outdoor specification, heat shrinkable type (line and capacitor sides) - Indoor specification, heat shrinkable type (circuit breaker side)	 200 m (for three-phases) (set for three phases) 3 sets 3 sets
RC-5	Procurement and Installation of LV Power Cables and Control Cables (1) LV power cables 1) Applicable standards 2) Type (2) Control cables 1) Reference standards 2) Type	 IEC or equivalent standards 600 V/1,000 V XLPE insulation, PVC sheath, copper conductor cable IEC or equivalent standards 600 V PVC insulation, copper conductor with copper tape shield	 1 lot 1 lot
RC-6	Procurement and Installation of Earthing Materials (1) Earthing conductor (2) Earthing pole	 38 and 100 m m^2 bare copper wires or equivalent Copper-covered steel pole with lead terminal, 14 mm (D) x 1,500 mm (L) or equivalent	 1 lot 1 lot

Table 2-20 Booster Station Construction Plan for Ibedu Ibiaikot Clan

Code	Item/Equipment	Specifications	Quantity
IB-1	Construction of Auxiliary Facilities (1) Gravel (2) Rainwater drainage, etc. (3) Grounding net (4) Outdoor lighting (5) Equipment foundations (6) Oil separating tank	(Area: 19 m x 25 m = 475 m^2) (Mercury lamps x 2)	 1 lot 1 lot 1 lot 1 lot 1 lot 1 lot
IB-2	Procurement and Installation of 33 kV Automatic Voltage Regulator (Booster) (1) Applicable standards (2) Type (3) Number of phases (4) Rated frequency (5) Rated primary voltage (6) Rated secondary voltage (7) Rated capacity (8) Tap voltage (9) Number of taps	 IEC Outdoor, oil-filled self-cooling type with OLTCs Three 50 Hz 33 kV 33 kV 3 MVA 33 kV + 5% to -25% 13	1

Code	Item/Equipment	Specifications	Quantity
	(10) Step voltage	2.5%	
IB-3	33 kV Distribution Panel	(see Drawing RC-S-02)	5 cubicles
	(1) Panel		
	1) Type	Outdoor closed metal-type with space heater	
	2) IP level	IP43 or higher	
	(2) Circuit breaker		
	1) Type	Vacuum circuit breaker, draw-out type	
	2) Rating	Three-phase, 36 kV, 630 A, 25 kA	
	(3) Instrument current transformer		
	1) Type	Indoor, resin-mold type	
	2) Rating	200 – 100/5 A	
	(4) Instrument voltage transformer		
	1) Type	Indoor, resin-mold type	
	2) Rating	3 poles, Primary:33/√3kV, Secondary: 110/√3V	
	(5) Earthing switch		
	1) Type	Manual operation-type	
	(6) Disconnecting switch		
	1) Type	Manual operation-type	
	2) Rating	3 poles, 36 kV, 600 A	
	(7) Fused cut-out	36 kV	
	(8) 33 kV station transformer		
	1) Type	Indoor oil-filled type	
	2) Rating	Three-phase, 50 Hz, 33 kV/415/240 V, 25 kVA	
	(9) Voltage regulator (AVR)	10 kVA	
	(10) Instruments and control switches	Ammeter; voltmeter; voltage detector; control switches; fault indicator; real power meter; reactive power meter; watt-hour meter	
	(11) Protective relays	- Over-current relay - Ground relay - Voltage regulating relay - Under-voltage relay - Auto reclosing relay	
IB-4	Procurement and Installation of 33 kV Distribution Cables and Accessories		
	(1) 33 kV power cable		300 m (for three-phases)
	1) Applicable standards	IEC or equivalent standards	
	2) Type	19/33 kV, XLPE insulation, copper conductor, PVC sheath, single core cable with armour	
	3) Size	120 mm^2	(set for three phases)
	(2) Cable treatment materials		
	1) Type	- Outdoor specification, heat shrinkable type (line side)	2 sets
		- Indoor specification, heat shrinkable type (transformer and circuit breaker sides)	6 sets
IB-5	Procurement and Installation of LV Power Cables and Control Cables		
	(1) LV power cables		
	1) Applicable standards	IEC or equivalent standards	1 lot
	2) Type	600 V/1,000 V XLPE insulation, PVC sheath, copper conductor cable	
	(2) Control cables		
	1) Reference standards	IEC or equivalent standards	1 lot
	2) Type	600 V PVC insulation, copper conductor with copper tape shield	
IB-6	Procurement and Installation of Earthing Materials		
	(1) Earthing conductor	38 and 100 mm^2 bare copper wires or equivalent	1 lot
	(2) Earthing pole	Copper-covered steel pole with lead terminal, 14 mm (D) x 1,500 mm (L) or equivalent	1 lot

Table 2-21 33 kV Distribution Line Construction Plan

Code	Item/Equipment	Specifications	Quantity
DL-1	Procurement and Installation of 33 kV Overhead Distribution Poles		See main text (Table 2-12)
	(1) Material	Concrete and steel	
	(2) Length	10.36 m, 12.50 m and 15.00 m	
	(3) Type		
	1) Through pole	Line angle: 0° – 5°	
	2) Light angle pole	Line angle: 5° – 15°	
	3) Medium angle pole	Line angle: 15° – 60°, H-type	
	4) Heavy angle pole	Line angle: 60° – 90°, H-type	
	5) Section pole	H-type, every 9 spans	
	6) T-off pole	H-type	
	7) Cable pole	H-type	
	8) Dead end pole	H-type	
	9) LBS pole	H-type	
	10) TR pole	H-type	
	11) Auto recloser pole	H-type	
DL-2	Procurement and Installation of 33 kV Overhead Distribution Conductors		See main text (Table 2-11)
	(1) Applicable standards	IEC or equivalent standards	
	(2) Type	ACSR	
	(3) Size	100 mm^2 and 150 mm^2	
DL-3	Procurement and Installation of Insulators		
	(1) Pin insulators		
	1) Applicable standards	IEC or equivalent standards	1 lot
	2) Type	Porcelain; colour: brown	
	3) Nominal voltage	33 kV	
	4) BIL	170 kV	
	(2) Suspension insulators		
	1) Applicable standards	IEC or equivalent standards	1 lot
	2) Type	Porcelain; colour: brown	
	3) Nominal voltage	33 kV	
	4) Creepage distance	280 mm/disc	
	5) BIL	105 kV	
DL-4	Procurement and Installation of Pole Fittings		
	(1) Cross arm		1 lot
	1) Material	Soft steel	
	2) Finish	Hot-dip galvanized	
	3) Cross-sectional shape	Main body: angular pipe; arm tie: plate-type	
	(2) Anchor shackle		1 lot
	1) Type	Bolt type	
	2) Material	Steel	
	(3) Ball eye and socket eye		1 lot
	1) Material	Plastic, iron or steel	
	2) Finish	Hot-dip galvanized	
	(4) Anchor clamp		1 lot
	1) Material	Main body: ductile iron Holder: aluminium cast alloy	
	(5) Guy wire		1 lot
	1) Material	Zinc-plated stranded steel cable	
	2) Size	45 mm^2 (2.90 mm x 7) or equivalent	
	(6) Guy insulator		1 lot
	1) Line voltage	33 kV	
	2) Material	Porcelain; colour: brown	
	(7) Guy anchor		1 lot
	1) Material	Steel plate, knock-in type	
	2) Tensile load	10 ton or equivalent	
	(8) Turn buckle		1 lot
	1) Material	Soft steel	

Code	Item/Equipment	Specifications	Quantity
	2) Finish (9) Under-bracing 1) Material 2) Application sites (10) Attached plate	Hot-dip galvanized Wood or concrete Section poles and at poles where the uneven tension of conductors is large Danger plate	 1 lot 1 lot
DL-5	Procurement and Installation of Load Break Switches (1) Applicable standards (2) Type (3) Nominal voltage (4) Rated voltage (5) Charging current for switching	 IEC or equivalent standards Three-phase, 630 A, outdoor and manual operation-type 33 kV 36 kV 10 A or higher	5
DL-6	Procurement and Installation of Arresters (1) Applicable standards (2) Type (3) Nominal voltage (4) Rated voltage	 IEC or equivalent standards Outdoor, gapless-type 33 kV 36 kV 5 kA (for distribution equipment) 10 kA (for booster/capacitor station)	 189 (5 kA) 15 (10 kA) (1 per phase)
DL-7	Procurement and Installation of Fused Cut-Out Switches (1) Applicable standards (2) Type (3) Nominal voltage (4) Rated voltage	 IEC or equivalent standards Outdoor-type; 10 A (200 kVA transformers); 20 A (300 kVA and 500 kVA transformers) 33 kV 36 kV	 168 (1 per phase)
DL-8	Procurement and Installation of Distribution Transformers (1) Applicable standards (2) Type (3) Number of phases (4) Frequency (5) Capacity (6) Rated voltage	 IEC or equivalent standards Oil-filled self-cooling, outdoor-type - three-phase, three-wire (HV primary side) - three-phase, four-wire (LV secondary side) 50 Hz - 200 kVA - 300 kVA - 500 kVA 33 kV/415 – 240 V	See main text (Table 2-13)
DL-9	Procurement and Installation of Disconnecting Switches (1) Type (2) Rating (3) Accessory	 Outdoor, vertical single-break, manual operation-type 33 kV, 600 A, 25 kA Operating rod	5
DL-10	Procurement and Installation of Auto Reclosers (1) Applicable standards (2) Type (3) Rating (4) Accessories	 IEC or equivalent standards Outdoor, vacuum circuit breaker, pole-mounted, horizontal-type Three-phase, 36 kV, 630 A, 12.5 kA VT, mechanical emergency stop device and operating rod, etc.	2
DL-11	Procurement and Installation of Earthing Materials (1) Earthing conductor (2) Earthing pole	 38 mm^2 bare copper wire or equivalent Copper-covered steel pole with lead terminal, 16 mm (D) x 1,500 mm (L) or equivalent	 1 lot 1 lot
DL-12	Procurement and Installation of Overhead Connectors (1) Type (2) Material	 Bolt type Aluminium cast alloy	1 lot

Table 2-22 Procurement Plan for Testing Equipment and General Maintenance Tools

Item	Unit	Ranch Communities in Cross River State	Ibedu Ibiaikot Clan in Akwa Ibom State	Eburutu Communities in Cross River State
1. Testing Equipment/Tools				
(1) Insulation oil tester	piece	1	1	
(2) DC withstand voltage tester	piece	1	1	
(3) Analogue-type tester	piece	1	1	
(4) Phase rotation meter	piece	1	1	1
(5) Voltage detectors (for HV and LV)	piece	1	1	1
(6) Relay testing kit (for single phase use)	set	1	1	
(7) Portable AC volt/amp meter	set	1	1	
(8) Insulation resistance tester (megger) 500 V	set	1	1	1
(9) Insulation resistance tester (megger) 1,000 V	set	1	1	1
(10) Portable earth-resistance meter	set	1	1	1
(11) Digital type multi-meter	set	1	1	1
(12) Clip-on meter	set	1	1	
2. General Maintenance Tools				
(1) Hydraulic compression tool (with dice)	set	2	2	2
(2) Hydraulic compression pliers (14 – 120 mm^2)	set	2	2	2
(3) Cable cutter	set	2	2	2
(4) Wire stripper	set	2	2	2
(5) Portable earthing device	set	2	2	2
(6) Operating rod for fused cut-out switch	piece	2	2	2

2.2.3 Basic Design Drawings

The basic design drawings for the Project are listed below.

(1) 33 kV Distribution Routes and Grid

Drawing No.	Title	Scale
RC-G-01	33 kV Distribution Grid [Ranch Communities in Cross River State]	—
RC-D-01	33 kV Distribution Route (1/2) [Ranch Communities in Cross River State]	—
RC-D-02	33 kV Distribution Route (2/2) [Ranch Communities in Cross River State]	—
IC-G-01	33 kV Distribution Grid [Ibedu Ibiaikot Clan in Akwa Ibom State]	—
IC-D-01	33 kV Distribution Route [Ibedu Ibiaikot Clan in Akwa Ibom State]	—
EC-G-01	33 kV Distribution Grid [Eburutu Communities in Cross River State]	—
EC-G-02	33 kV Distribution Grid [Eburutu Communities in Cross River State]	—
EC-G-03	33 kV Distribution Grid [Eburutu Communities in Cross River State]	—
EC-D-01	Overall 33 kV Distribution Routes [Eburutu Communities in Cross River State]	—

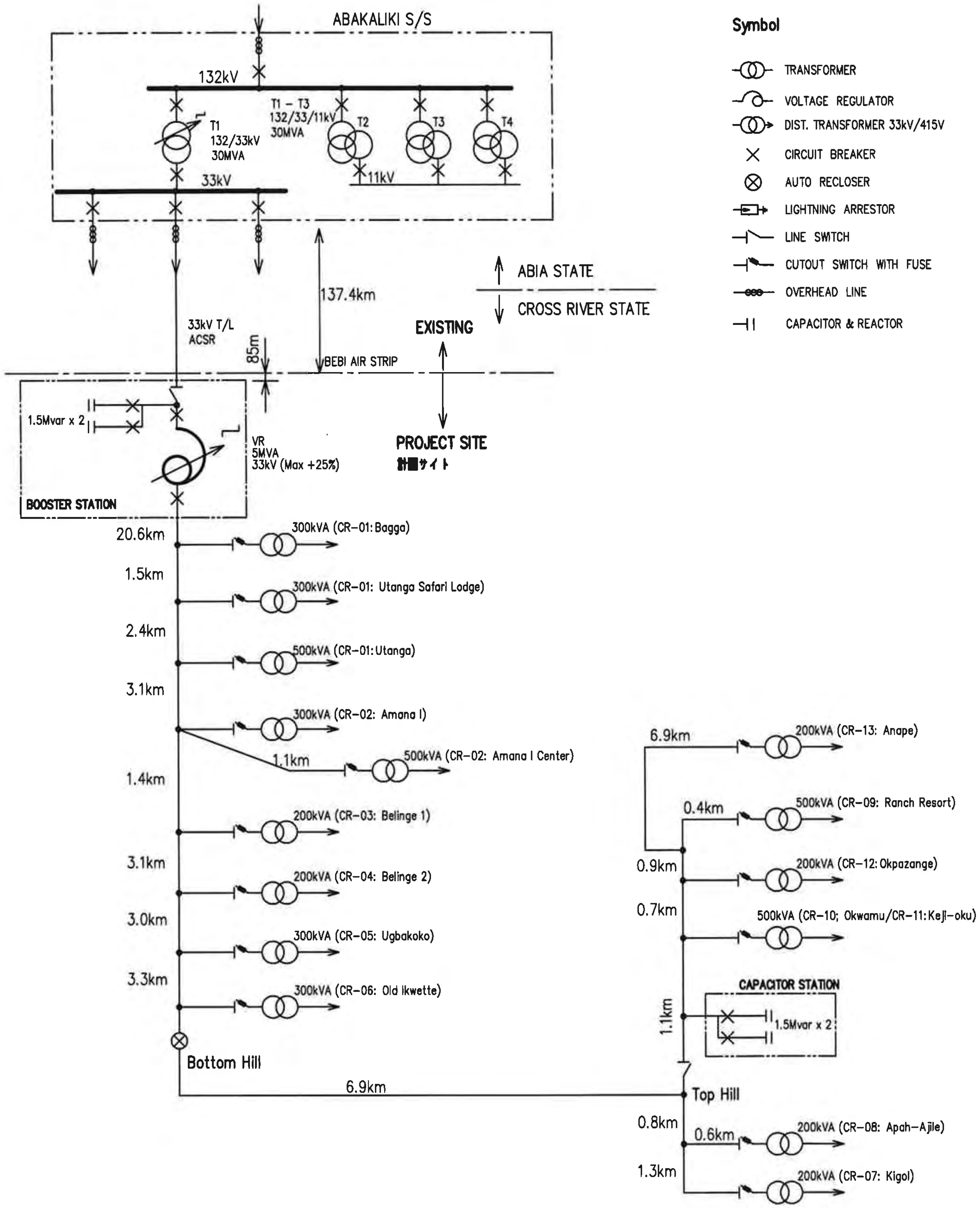
EC-D-02	33 kV Distribution Route (1/3) [Eburutu Communities in Cross River State]	—
EC-D-03	33 kV Distribution Route (2/3) [Eburutu Communities in Cross River State]	—
EC-D-04	33 kV Distribution Route (3/3) [Eburutu Communities in Cross River State]	—

(2) Booster and Capacitor Stations

Drawing No.	Title	Scale
RC-S-03	Single Line Diagramme for Booster Station [Ranch Communities in Cross River State]	—
RC-S-01	Equipment Layout for Booster Station [Ranch Communities in Cross River State]	1/200
RC-S-04	Single Line Diagramme for Capacitor Station [Ranch Communities in Cross River State]	—
RC-S-02	Equipment Layout for Capacitor Station [Ranch Communities in Cross River State]	1/200
IC-S-02	Single Line Diagramme for Booster Station [Ibedu Ibiaikot Clan in Akwa Ibom State]	—
IC-S-01	Equipment Layout for Booster Station [Ibedu Ibiaikot Clan in Akwa Ibom State]	1/200

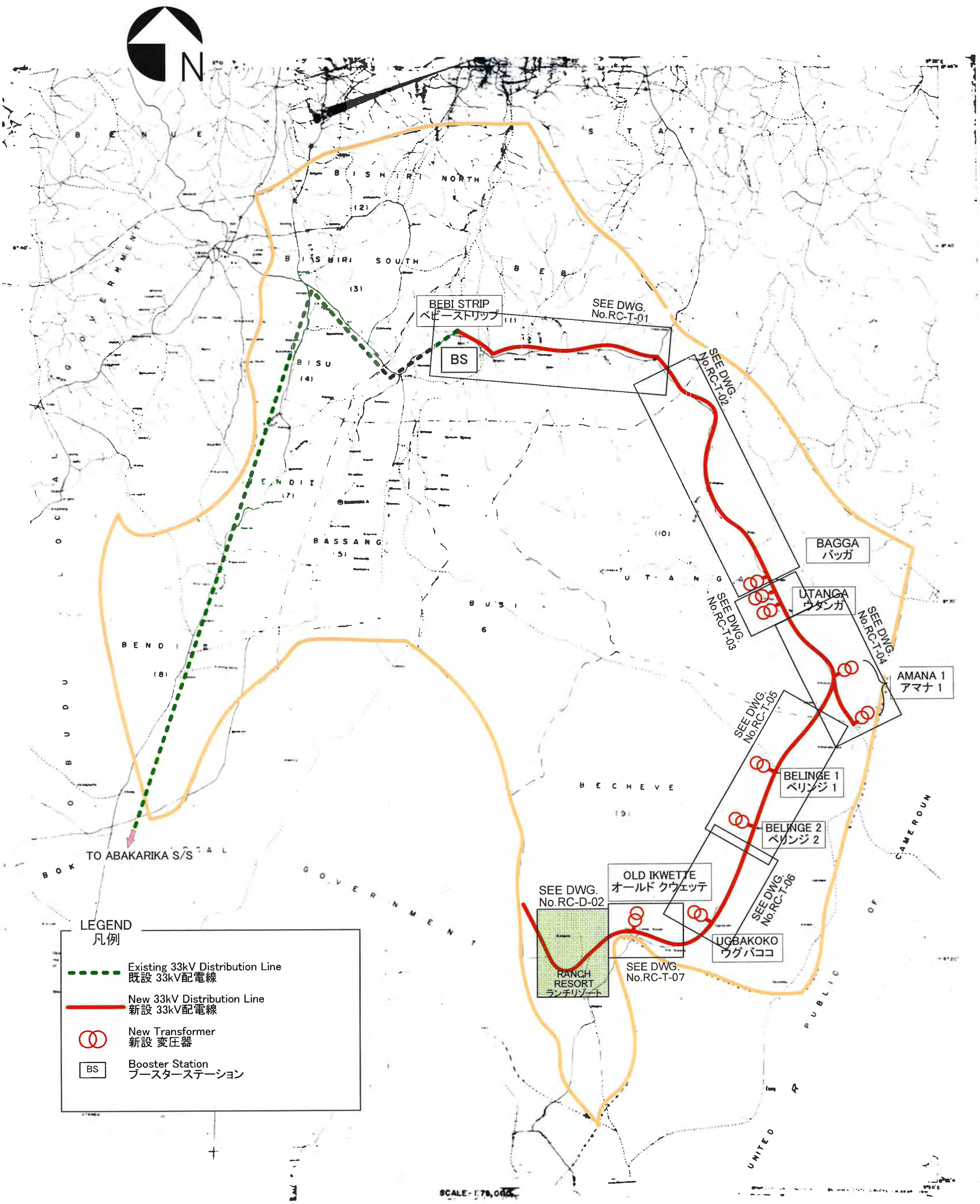
(3) Pole Assembly Drawings for 33 kV Distribution Lines

Drawing No.	Pole Type	Title	Scale
DL-E-01	A	33 kV Through Pole (0° – 5°)	1/70
DL-E-02	B	33 kV Angle Pole (5° – 15°)	1/70
DL-E-03	C	33 kV Angle Pole (15° – 60°)	1/70
DL-E-04	D	33 kV Angle Pole (60° – 90°)	1/80
DL-E-05	E	33 kV Section Pole	1/80
DL-E-06	F	33 kV T-Off Pole	1/80
DL-E-07	G	33 kV Cable Pole	1/80
DL-E-08	G1	33 kV Dead End Pole	1/90
DL-E-09	H	33 kV LBS Pole	1/80
DL-E-10	J1	33 kV TR Pole (Dead End)	1/100
DL-E-11	J2	33 kV TR Pole (Through)	1/95
DL-E-12	K	Auto Recloser Pole	1/95
DL-E-13		Materials for Existing Poles	1/50
DL-E-14	AL	33 kV Through Pole (0° – 5°) (Steel Pole: 12.5 m)	1/70
DL-E-15	BL	33 kV Angle Pole (5° – 15°) (Steel Pole: 12.5 m)	1/70
DL-E-16	EL	33 kV Section Pole (Steel Pole: 12.5 m)	1/80
DL-E-17	ALL	33 kV Through Pole (0° – 5°) (15 m)	1/70
DL-E-18	BLL	33 kV Angle Pole (5° – 15°) (15 m)	1/70
DL-E-19	ELL	33 kV Section Pole (15 m)	1/80



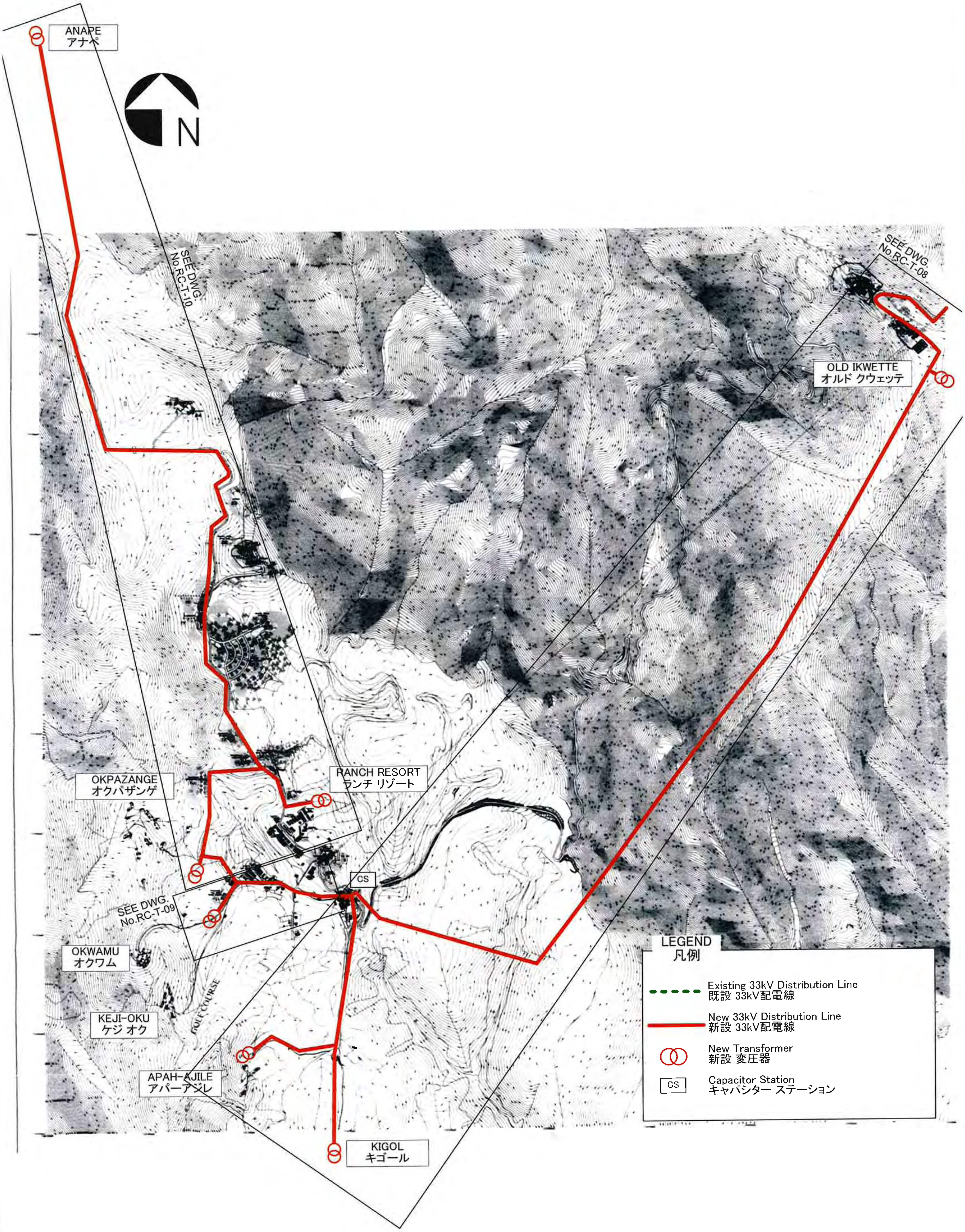
DWG No. RC-G-01: NETWORK DIAGRAM OF RANCH COMMUNITIES (CROSS RIVER STATE)

DWG No. RC-G-01: 33kV 配電系統図 クロス・リバー州ランチコミュニティー地区

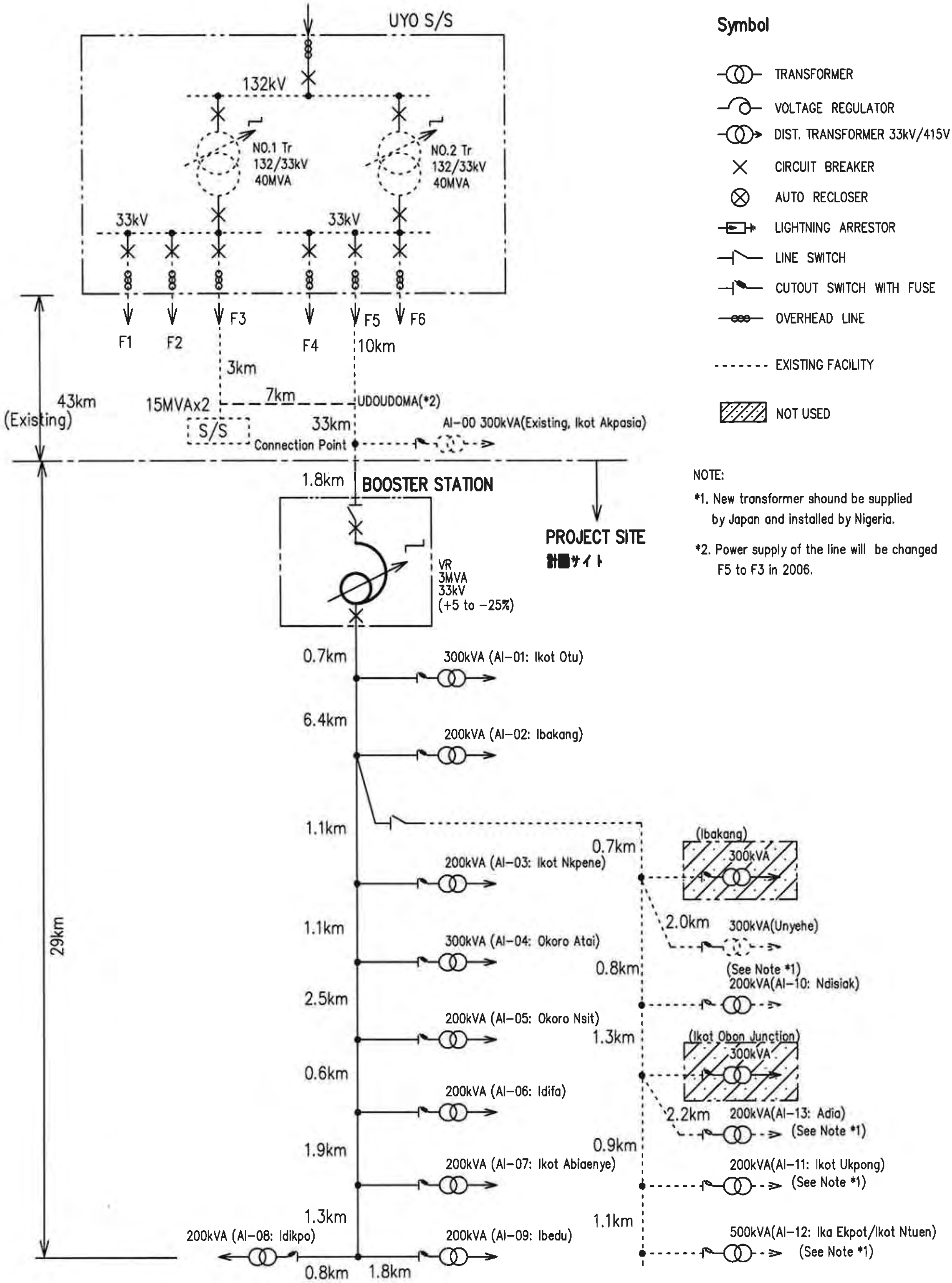


RC-D-01 Route Map of 33kV Distribution Lines(1/2)(Ranch Communities in Cross River State)

RC-D-01 33kV 配電ルート図 (1/2) (クロス・リバー州ランチコミュニティー地区)

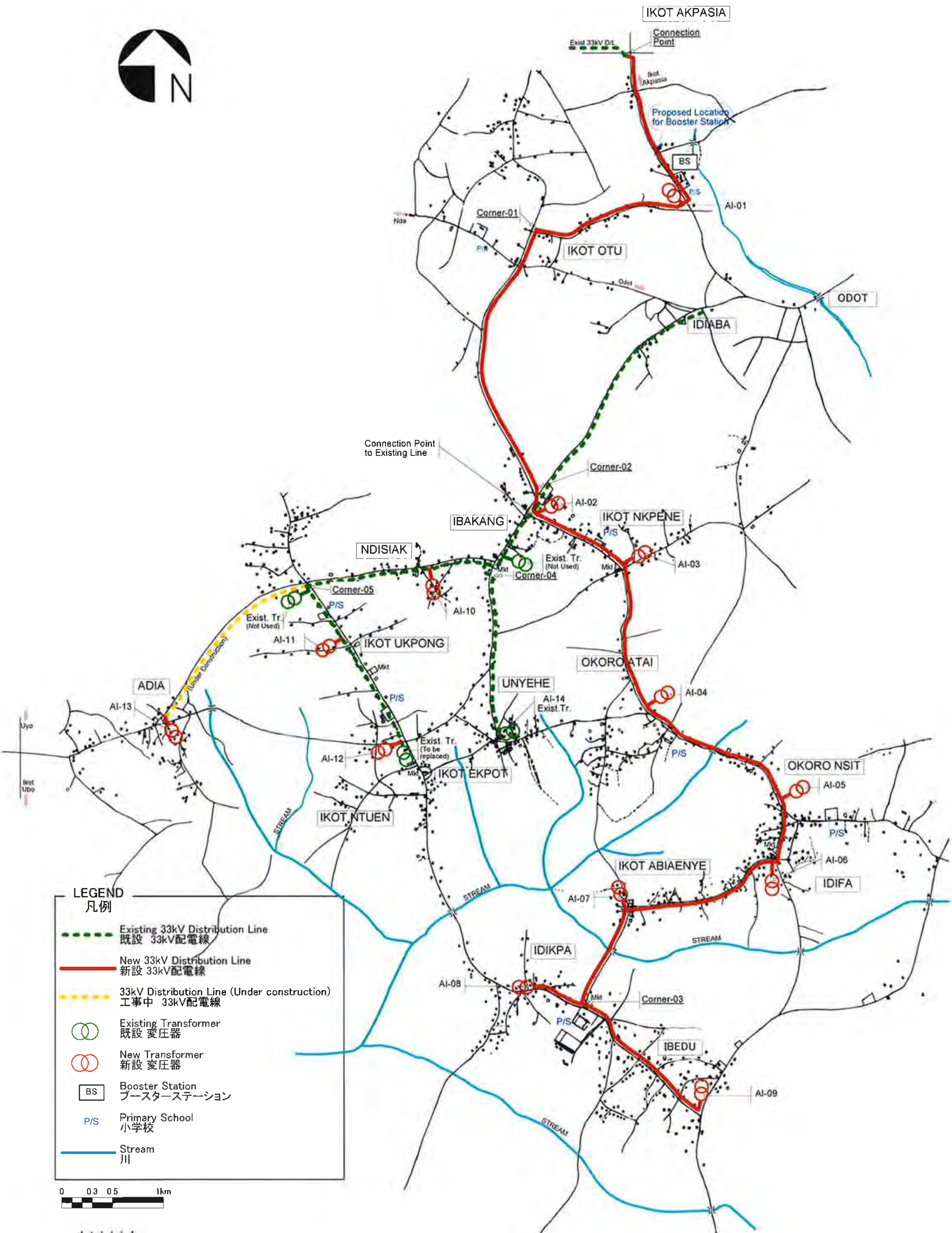


RC-D-02 Route Map of 33kV Distribution Lines(2/2)(Ranch Communities in Cross River State)
RC-D-02 33kV 配電ルート図 (2/2) (クロス・リバー州ランチコミュニティー地区)



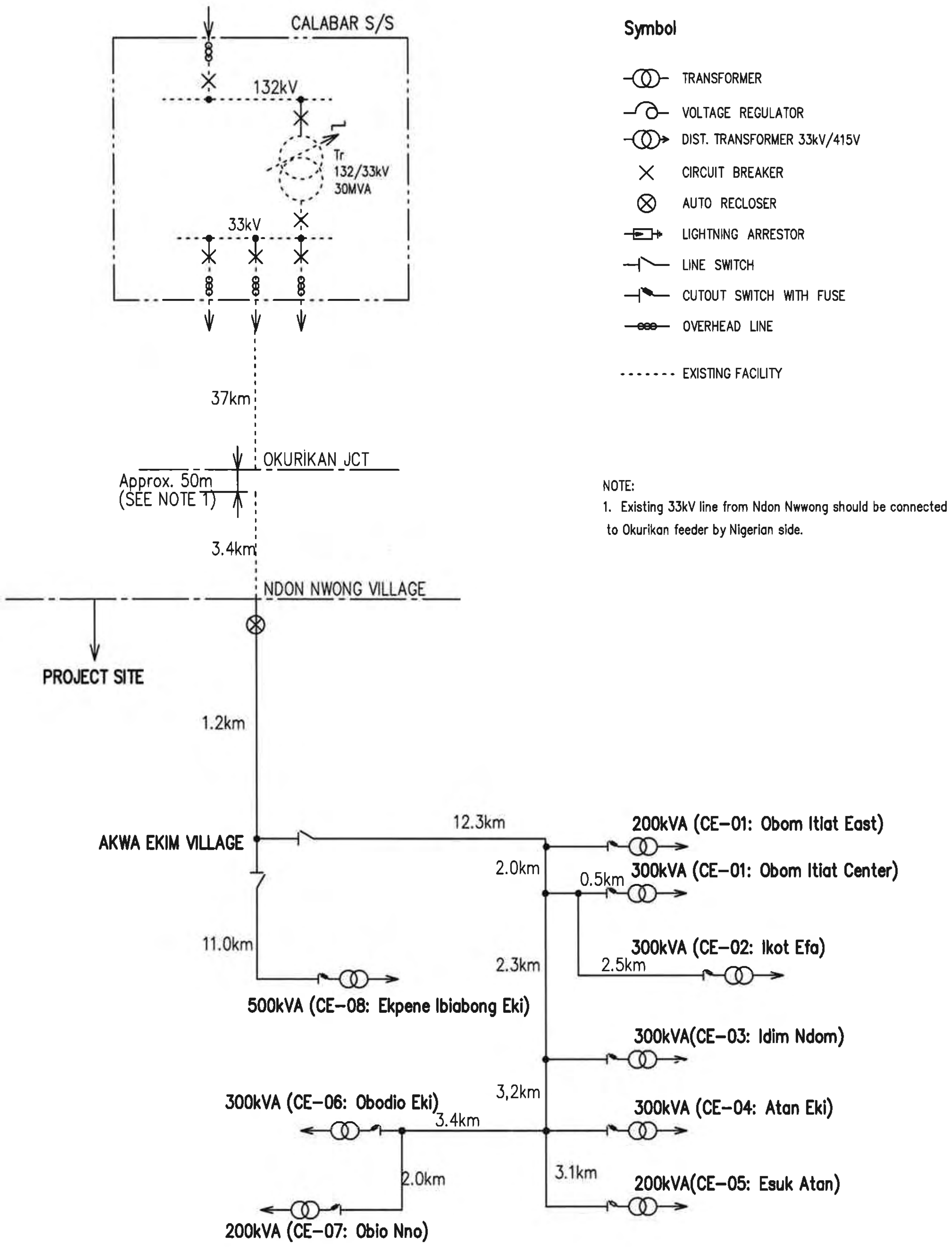
DWG No. IC-G-01: NETWORK DIAGRAM OF IBEDU IBIAIKOT CLAN (AKWA IBOM STATE)

DWG No. IC-G-01: 33kV 配電系統図 アクワ・イボム州イベドゥ・イビアイコット・クラン地区

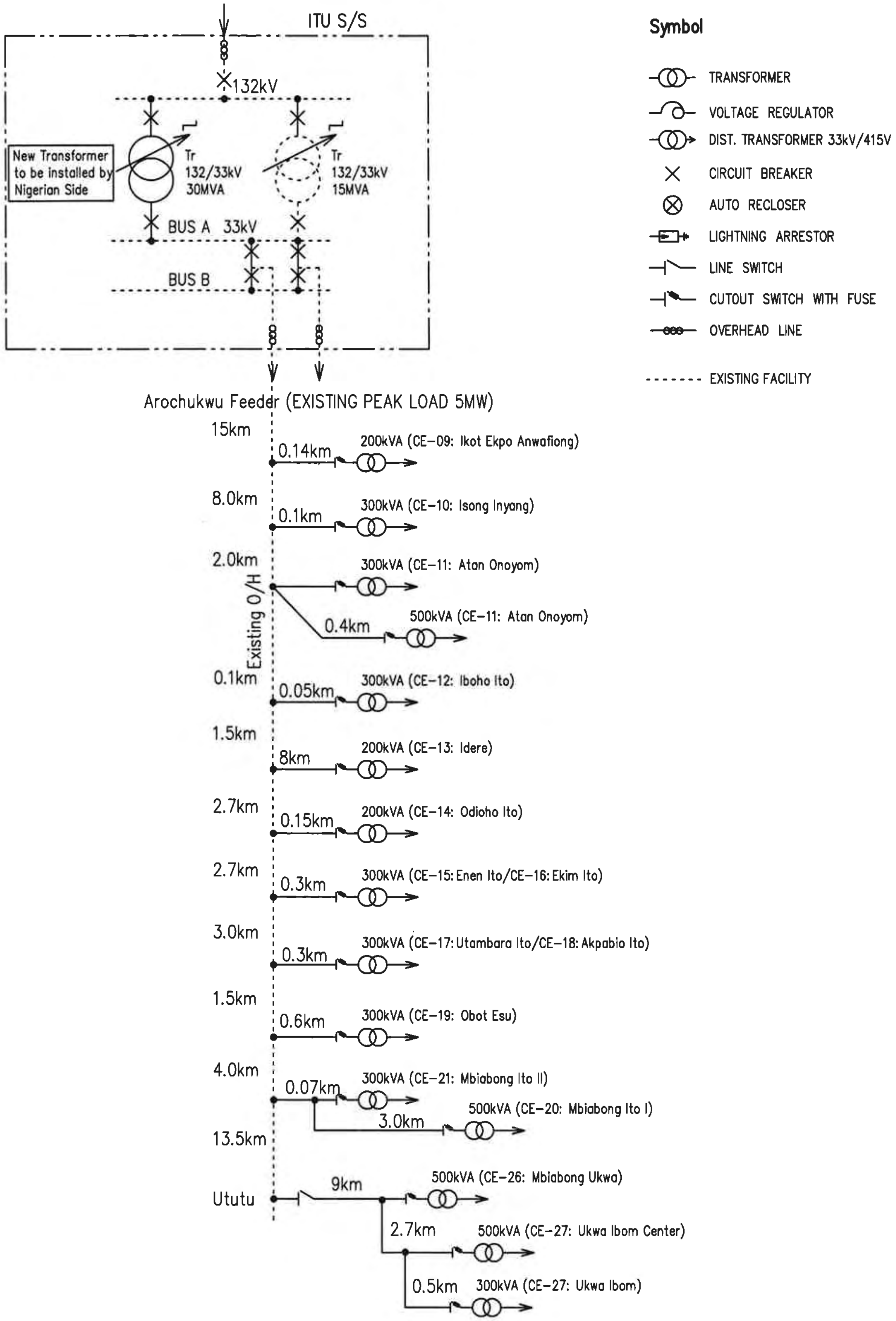


IC-D-01 Route Map of 33kV Distribution Lines of Ibedu Ibiaikot Clan in Akwa Ibom State

IC-D-01 33kV 配電ルート図 アクワ・イボム州イベドゥ・イビアイコット・クラン地区

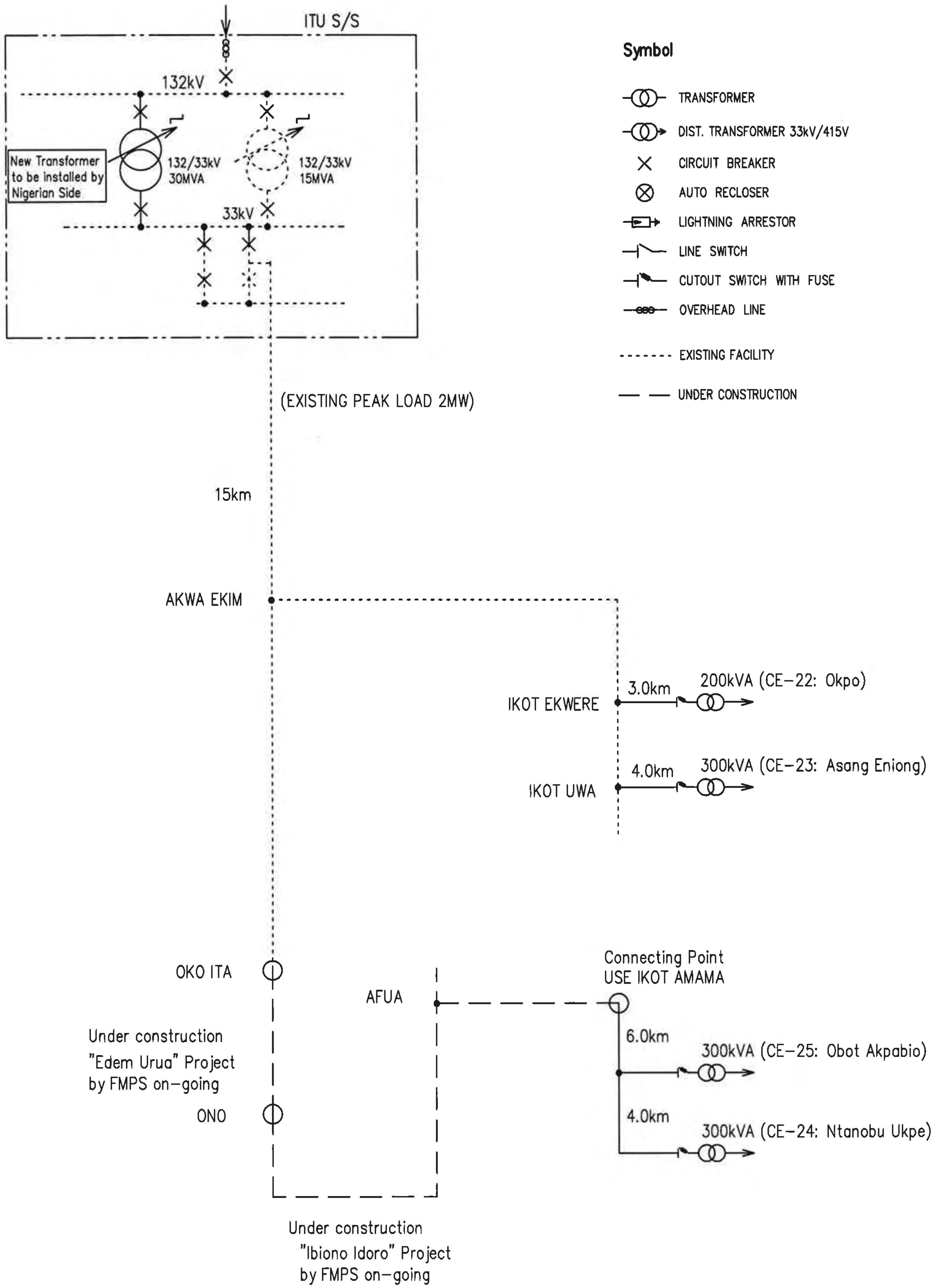


DWG No. EC–G–01: NETWORK DIAGRAM OF EBURUTU COMMUNITIES (1/3)
(CROSS RIVER STATE)
DWG No. EC–G–01: 33kV 配電系統図 クロス・リバー州エブルトゥコミュニティー (1/3)

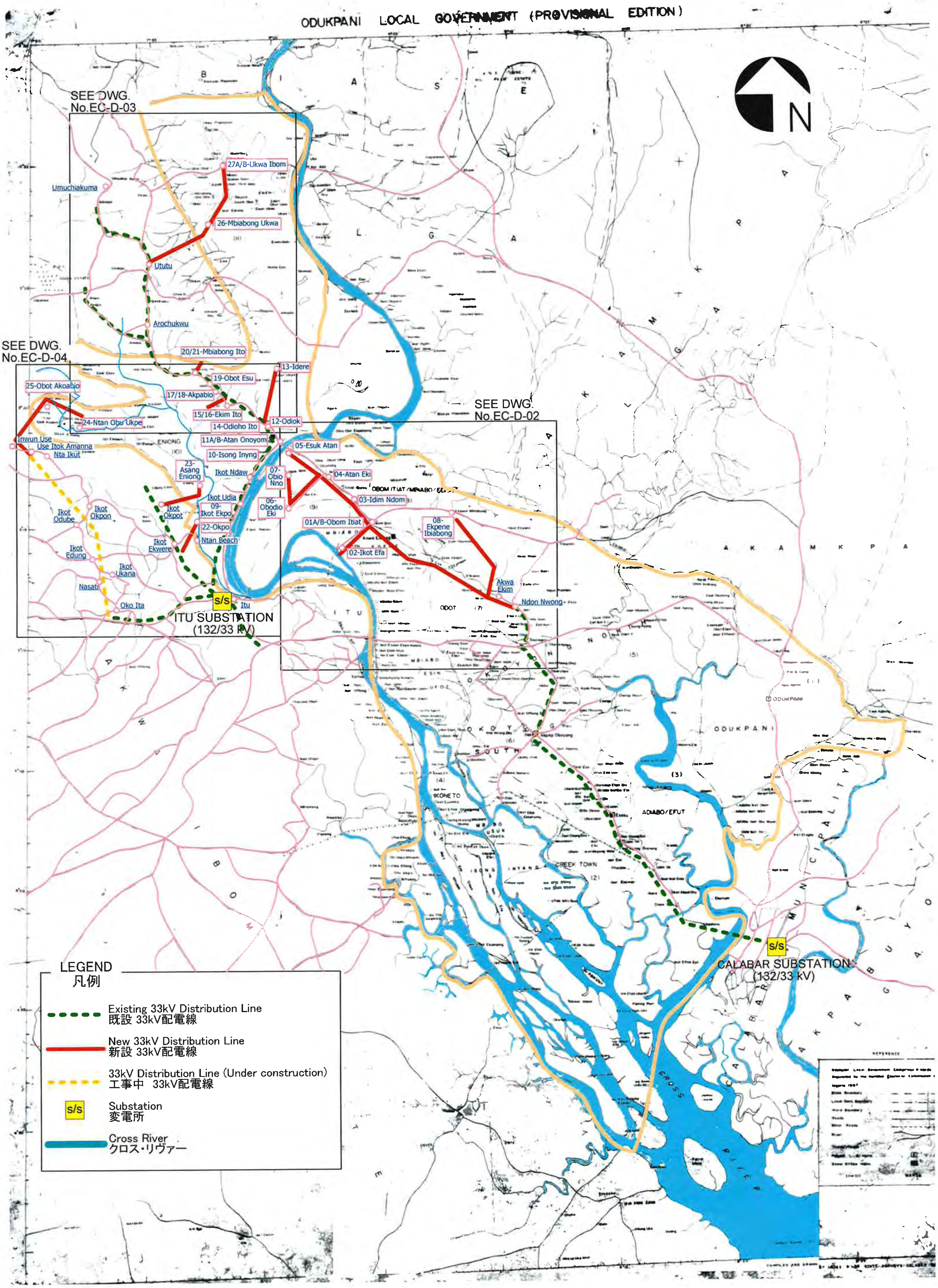


DWG No. EC-G-02: NETWORK DIAGRAM OF EBURUTU COMMUNITIES (2/3)
(CROSS RIVER STATE)

DWG No. EC-G-02: 33kV 配電系統図 クロス・リバー州エブルトゥコミュニティー (2/3)

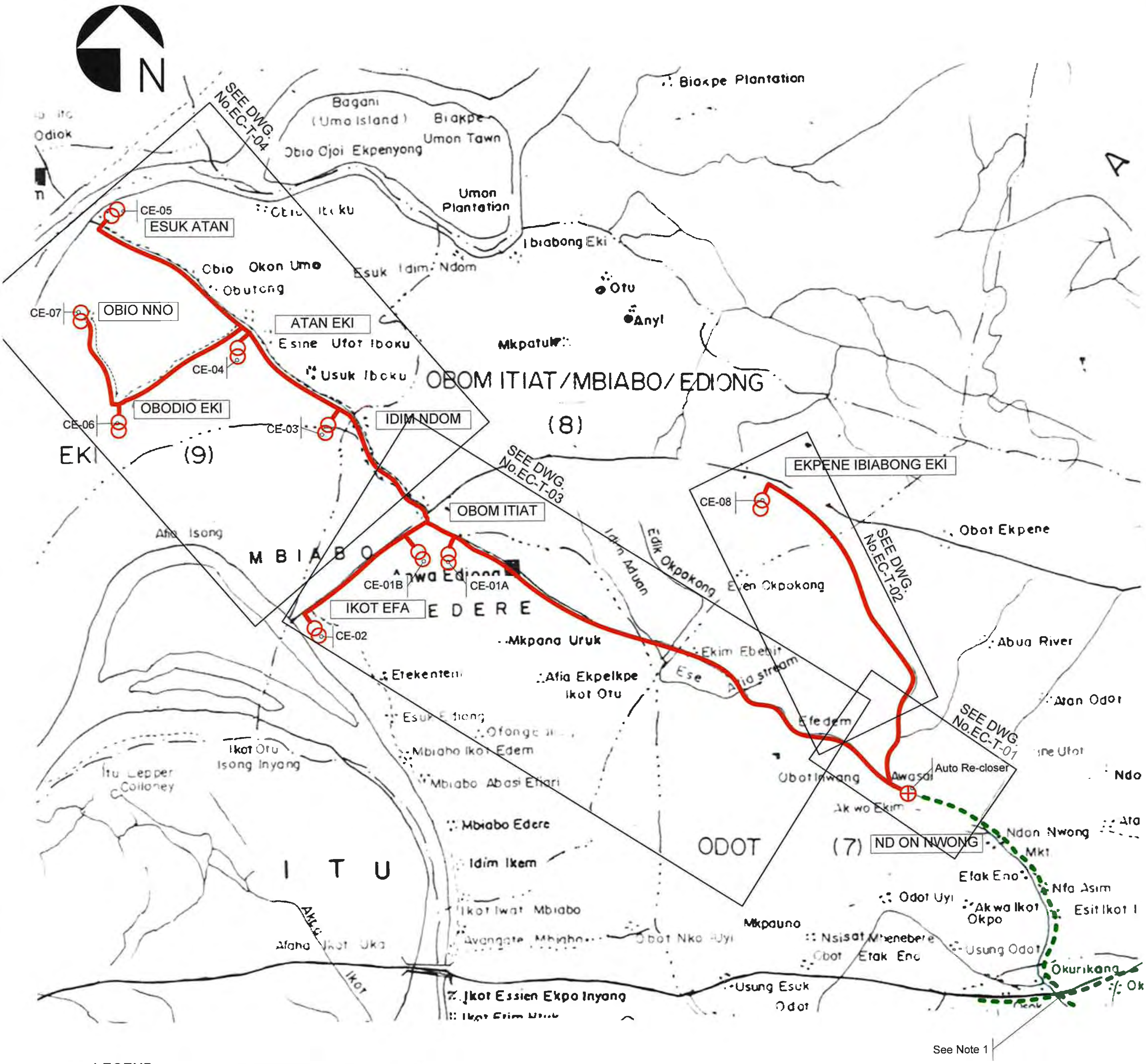


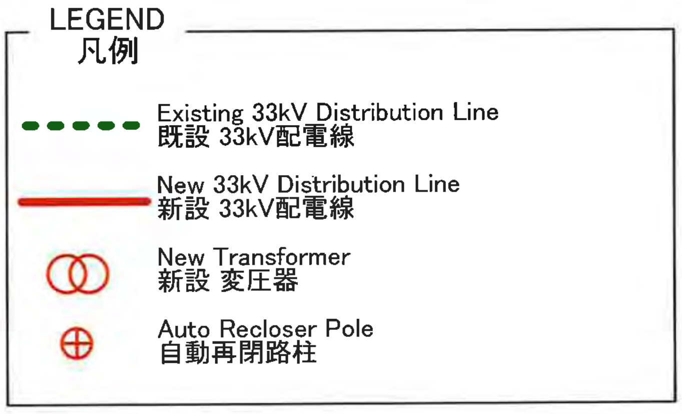
DWG No. EC-G-03: NETWORK DIAGRAM OF EBURUTU COMMUNITIES (3/3)
(CROSS RIVER STATE)
DWG No. EC-G-03: 33kV 配電系統図 クロス･リバー州エブルトゥコミュニティー (3/3)



EC-D-01 Route Map of 33kV Distribution Lines(Eburutu Communities in Cross River State)

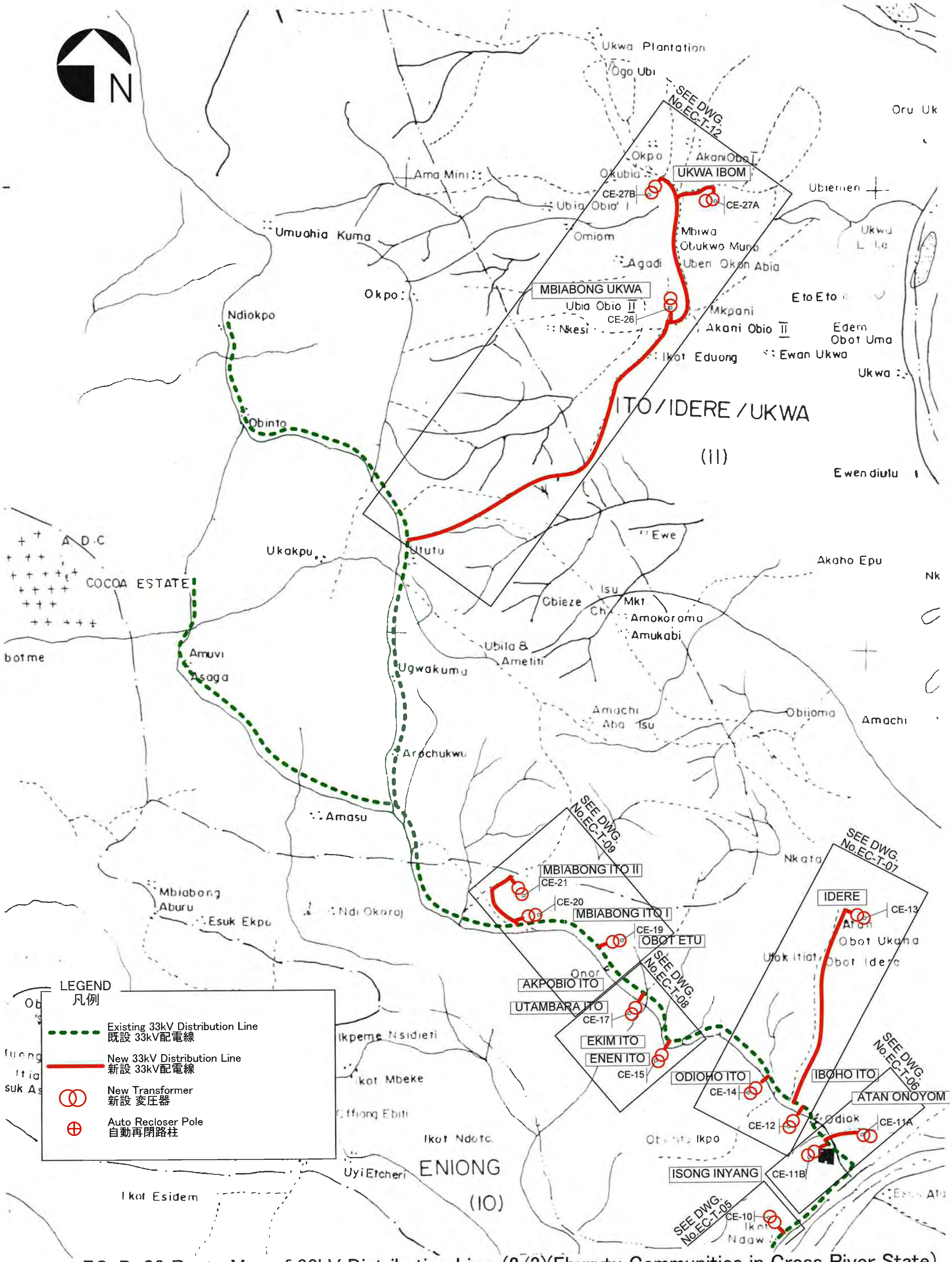
33kV 全体 配電ルート図 クロス・リバー州エブルトゥコミュニティー地区



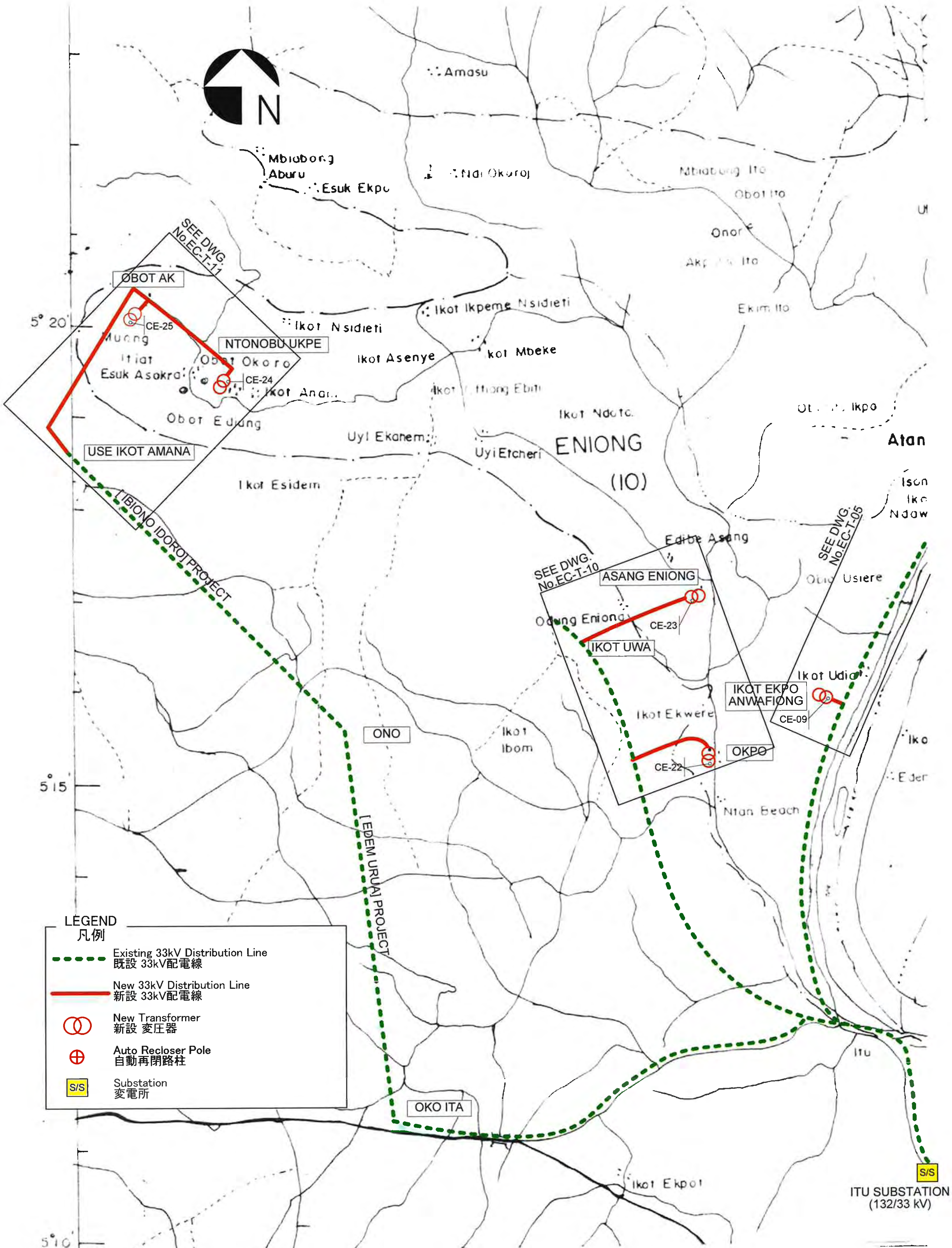


Note; 1.There is 33kV Line to be connected to existing grid.

EC-D-02 Route Map of 33kV Distribution Lines(1/3)(Eburutu Communities in Cross River State)
EC-D-02 33kV 配電ルート図 (1/3) クロス・リバー州エブルトゥコミュニティー地区



EC-D-03 Route Map of 33kV Distribution Lines(2/3)(Eburutu Communities in Cross River State)
EC-D-03 33kV 配電ルート図 (2/3) クロス・リバー州エブルトゥコミュニティー地区



EC-D-04 Route Map of 33kV Distribution Lines(3/3)(Eburutu Communities in Cross River State)
EC-D-04 33kV 配電ルート図 (3/3) クロス・ リバー州エブルトゥコミュニティー地区