No.

Republic of Uganda
Ministry of Energy and Mineral Development
Rural Electrification Agency

BASIC DESIGN STUDY REPORT
ON
THE PROJECT FOR
RURAL ELECTRIFICATION PHASE II
IN
THE REPUBLIC OF UGANDA

JULY 2007

JAPAN INTERNATIONAL COOPERATION AGENCY

YACHIYO ENGINEERING CO., LTD.

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PREFACE

In response to a request from the Government of the Republic of Uganda, the Government of Japan decided to conduct a basic design study on the Project for Rural Electrification Phase II and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Uganda a study team from November 21 to December 15, 2006 for the first field survey, and sent another study team from January 30 to February 23, 2007 for the second field survey.

The team held discussions with the officials concerned of the Government of Uganda, 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 Uganda in order to discuss a draft basic design, and as this result, the present report was finalized.

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

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

July 2007

Masafumi Kuroki
Vice-President
Japan International Cooperation Agency

July 2007

LETTER OF TRANSMITTAL

We are pleased to submit to you the basic design study report on the Project for Rural Electrification Phase II in the Republic of Uganda.

This study was conducted by Yachiyo Engineering Co., Ltd., under a contract to JICA, during the period from November, 2006 to July, 2007. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Uganda 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,

Tadayuki Ogawa
Project manager,
Basic design study team on
the Project for Rural Electrification Phase II
Yachiyo Engineering Co., Ltd.

SUMMARY

SUMMARY

① Country Profile

The Republic of Uganda (hereinafter referred to as "Uganda") is located right on the equator along with Lake Victoria, and is the third largest African nation, covering an area of approx. 241,000km^2, most of which is between 800m and 1,300m above sea level. With a total population of approx. 27.4 million (2006 estimate by the Uganda Bureau of Statistics), it is primarily an agricultural nation producing such farming products as coffee, cotton and tobacco, agriculture thus accounting for approx. 30% of the GDP. However, production and exportation is controlled by climate and market trends, so it remains unstable. Moreover, since beneficiaries from economic growth are concentrated mainly in urban areas, infrastructure development and expansion in rural regions has become a major issue for development in Uganda.

② Background, History and Outline of the Requested Project

With the formulation of the Poverty Eradication Action Plan (PEAP) in 1997, a comprehensive national development plan, the Government of Uganda is advocating rural electrification project as one means of accomplishing "income generation for the rural poor" and considers it to be high priority even in the 3rd revision of the PEAP (2004 to 2008). Alleviating the living disparity between rural and urban areas is also an important issue through the eradication of poverty, by promoting agricultural policy, and by preventing the influx of people into urban centers, in turn thus maintaining public peace and order.

In the Ugandan energy industry, the Uganda Electricity Board (UEB) which was established in 1948 is responsible for planning, operation and maintenance of power generation, transmission and distribution undertakings in a vertical and integrated manner. However, since the Power Sector Reform and Privatization Strategy was approved by Cabinet meeting and the enactment of the Electricity Act in 1999, sector reform has been put forward in a phased manner for the purpose of shifting from a system of monopolized undertakings by UEB to a system which will enable the introduction of private capital. As part of the said reform, in March 2001 UEB were separated into power generation, transmission and substation, and distribution undertakings, and the Uganda Electricity Generation Company Ltd. (UEGCL), the Uganda Electricity Transmission Company Ltd. (UETCL) and the Uganda Electricity Distribution Company Ltd. (UEDCL) were incorporated. With respect to power generation and distribution, the facilities of the three companies will be leased to private enterprises in accordance with a long-term concession agreement, but the transmission undertakings will remain in the public sector for the time being. However, a method of entrusting a private enterprise with the operation of existing facilities and expansion of new facilities is adopted,

while ownership of the existing facilities is to remain in the public sector even in the concession agreement.

The Rural Electrification Agency (REA) entered the rural electrification business in 2003 and has implemented planning and management of electrification in a unified manner under the supervision of the Ministry of Energy and Mineral Development (MEMD) through the Rural Electrification Fund (REF) in order to supply electric power, in an impartial manner, to rural residents. Although the Government of Uganda has endeavored to promote rural electrification through the formulation of the "National Electrification Planning Study (NEPS)" in 1992, the rural electrification rate was still only 4% in comparison with the urban electrification rate at 20% as of 2005 (approx. 6% of the national electrification rate) primarily due to insufficient fiscal appropriation. Although the aim of the "Rural Electrification Strategy and Plan" formulated in 2001 is to achieve a rural electrification rate of 10% by 2012, in reality, the implementation of rural electrification projects with low profitability has fallen behind due to financial difficulties.

In due consideration of these circumstances, the Government of Uganda submitted a request for Japan's Grant Aid for a rural electrification project through improvement of power distribution network at four sites in Eastern, Western and Central Regions. The study areas were selected based on the Priority Rural Electrification Projects (PREPS) in accordance with a draft "Indicative Rural Electrification Master Plan (IREMP)" which is presently being revised, taking into account (i) areas where public peace and order has been secured, (ii) the potential of economic growth, (iii) the location of district headquarters, and (iv) inter-regional balance.

③ Outline of the Study Results and Contents of the Project

In response to this request, the Government of Japan decided to carry out a Basic Design Study and the Japan International Cooperation Agency (JICA) dispatched a Basic Design Study Team in Uganda from November 21 to December 15, 2006 (first field survey) and from January 30 to February 23, 2007 (second field survey) in order to verify the components of the request and to discuss on the contents of the implementation with related authorities in Uganda. Simultaneously the site investigation was conducted and related materials were collected. After returning to Japan, the Basic Design Study Team examined the necessity, the social and economic effects, and the relevance of the Project and compiled the basic design best suited to the project and an implementation plan in a basic design draft final report. Based on this, JICA dispatched the Study Team to Uganda again from May 29 to June 7, 2007 in order to explain the draft final.

In accordance with the "Indicative Rural Electrification Master Plan (IREMP)" which is presently being revised, the overall goal of the Project is to improve the power supply at project sites and to stimulate regional economic growth. Another objective of the Project is to provide a stable source of

electric power to four areas as local centers for agriculture and the fishery, both key industries in Uganda, in order to improve the living standards of local residents, to ensure stability of public facilities, and to revitalize social and economic activities. The basic concept of the Project is to develop distribution lines which are important to the social infrastructure by procuring and installing equipment and materials for 33kV distribution lines necessary to accomplish the above-mentioned goal and replacing 33kV switchgears at the existing 33/11kV substation, in combination with the procurement and installation of low-voltage distribution lines by the Ugandan side.

The Basic Plan of the Project based on the field survey and discussions among concerned parties in Uganda is outlined in the following Table.

Overview of the Basic Plan

Phasing	Phase 1		Phase 2	
Project Site	<Project Site B> Kagadi / Munteme Area in Hoima & Kibale District (Western Region)	<Project Site D> Bukakata Area in Masaka District (Central Region)	<Project Site A> Nabitende / Itanda Area in Iganga District (Eastern Region)	<Project Site C> Bugeso / Iwemba Area in Bugiri District (Eastern Region)
Equipment &Materials Procurement &Installation Plan	Procurement & installation of the following equipment & materials for 33kV distribution system (1) 33 kV distribution line • Existing 33kV distribution line from Kagadi connection point to Munteme connection point: Approx. total length of 65km (2) 33 kV/415-240V distribution transformer 1) 50 kVA : 5 units 2) 100 kVA : 3 units 3) 200 kVA : 7 units (3) One Set of Metering unit	Procurement & installation of the following equipment & materials for 33kV distribution system (1) 33 kV distribution line • Connection point of existing 33kV distribution line to Bukakata village: Approx. total length of 53 km (2) 33 kV/415-240V distribution transformer 1) 50 kVA : 5 units 2) 100 kVA : 2 units 3) 200 kVA : 4 units (3) One Set of Metering unit	Procurement & installation of the following equipment & materials for 33kV distribution system (1) 33 kV distribution line • Connection point of existing 33kV distribution line to Nawangaiza village: Approx. total length of 29 km (2) 33 kV/415-240V distribution transformer 1) 100 kVA : 19 units 2) 200 kVA : 1 unit (3) Replacement of 33kV switchgears at Iganga S/S • Installation of 6 units of 33 kV switchgears (4) One Set of Metering unit	Procurement & installation of the following equipment & materials for 33kV distribution system (1) 33 kV distribution line • Connection point of existing 33kV distribution line to Iwemba village: Approx. total length of 21 km (2) 33 kV/415-240V distribution transformer 1) 100 kVA : 10 units 2) 200 kVA : 1 unit
Equipment & Materials Procurement only Plan	(1) Spare parts & maintenance tools for 33 kV distribution line	(1) Spare parts & maintenance tools for 33 kV distribution line (2) Load Break Switch: 1 unit	(1) Spare parts & maintenance tools for 33 kV distribution line & switchgears	(1) Spare parts & maintenance tools for 33 kV distribution line

④ Construction Period and Estimated Project Cost

In implementing the Project through Japan's Grant Aid scheme, the total cost of the Project to be implemented in accordance with the Japan's Grant Aid scheme will be determined before concluding the Exchange of Notes (E/N) for the Project. Major undertakings to be taken by the Ugandan side include the construction of 33kV distribution lines (from Iganga Substation (33/11kV) to Karilo town), bush clearing on the 33kV distribution line route, procurement and installation of equipment and materials for low voltage distribution lines. The construction period of the Project, including a detailed design, will be approx. 16.0 months for Phase 1 (Project Sites B and D) and approx. 14.5 months for Phase 2 (Project Sites A and C).

⑤ Inspection of the Appropriateness of the Project

The facilities and equipment after the completion of the Project will be operated and maintained by a private enterprise called operator(s) under the supervision of REA, which is the implementing agency of the Project in accordance with a long-term concession agreement after confirming operation experience in similar rural electrification projects, technical capacity and financial soundness through Pre-Qualification process. Since many engineers at the above-mentioned REA and operators have occupational experience at the former Uganda Electricity Board (UEB) and took charge of operation and maintenance of the 33kV distribution lines in previous grant aid projects, the said engineers are considered to have basic operation and maintenance skills with regard to power distribution facilities. In addition, the specifications of each type of distribution equipment to be procured and improved under the Project are also expected not to exceed the scope of equipment procured in the past grant aid projects, therefore, REA, which is the implementing agency, and operator(s) in charge appear to have certain level of operation and maintenance capacity required under the Project. Furthermore, since conditions of the Japanese-produced substations and distribution equipment procured under previous grant aid projects are also favorable, the facilities appear to have been appropriately maintained even after completion of the Project. In addition, it has been confirmed in the Minutes of Discussions (M/D) that ownership of the distribution facilities procured and installed under the Project will be maintained by REA as national assets regardless of the progress of power sector reform.

Total number of beneficiary for the Projects is approx. 76,000. The breakdown of the beneficiary is as follows: approx. 34,000 residents in Nabitende / Itanda Area in Iganga District in the Eastern Region, approx. 13,000 residents in Kagadi / Munteme Area in Hoima and Kibale District in the Western Region, approx. 14,000 residents in Bugeso/Iwemba Area in Bugiri District in the Eastern Region and approx 15,000 residents in Bukakata Area in Masaka District in the Central Region. Through the implementation of the Project, major effects can be expected through the revitalization of the Ugandan economy, improvement in living standards of residents and stable operation of social, welfare and public facilities. The implementation of the requested Japanese cooperation under the Japan's Grant Aid therefore appears to be appropriate. The Ugandan side also has sufficient institution in-place from

the personnel and financial aspects with respect to operation and maintenance of the Project, so no particular problems are expected in the implementation of the Project.

In order to produce the desired and sustainable effects through the Project, major undertakings to be implemented by the Ugandan side are described as follows.

(1) In order to procure and install equipment and materials for 415V low voltage distribution lines, the Ugandan side should ensure smooth installation work by appointing operator(s) who will take charge of the project sites, and by formulating an implementation plan, personnel dispatch schedule, procurement plan of equipment and materials, etc.

(2) Although distribution transformers to meet the estimated power demand five years after the commencement of operation will be procured under the Project, the Ugandan side should prepare the necessary budget to procure additional equipment and materials for an increase in power demand after the commencement of operation by appropriately reviewing power demand forecast and formulating a plan for the procurement of additional transformers after completion of the Project.

(3) The Ugandan side should strictly enforce preventive maintenance, such as bush clearing along the distribution lines, by periodically carrying out onsite patrolling inspections in order to reduce distribution line faults and to ensure a stable power supply system.

(4) In order to establish a fair electricity payment collection system, the Ugandan side should strictly enforce meter reading and collect electricity payment thorough installing individual electricity meters for all consumers.

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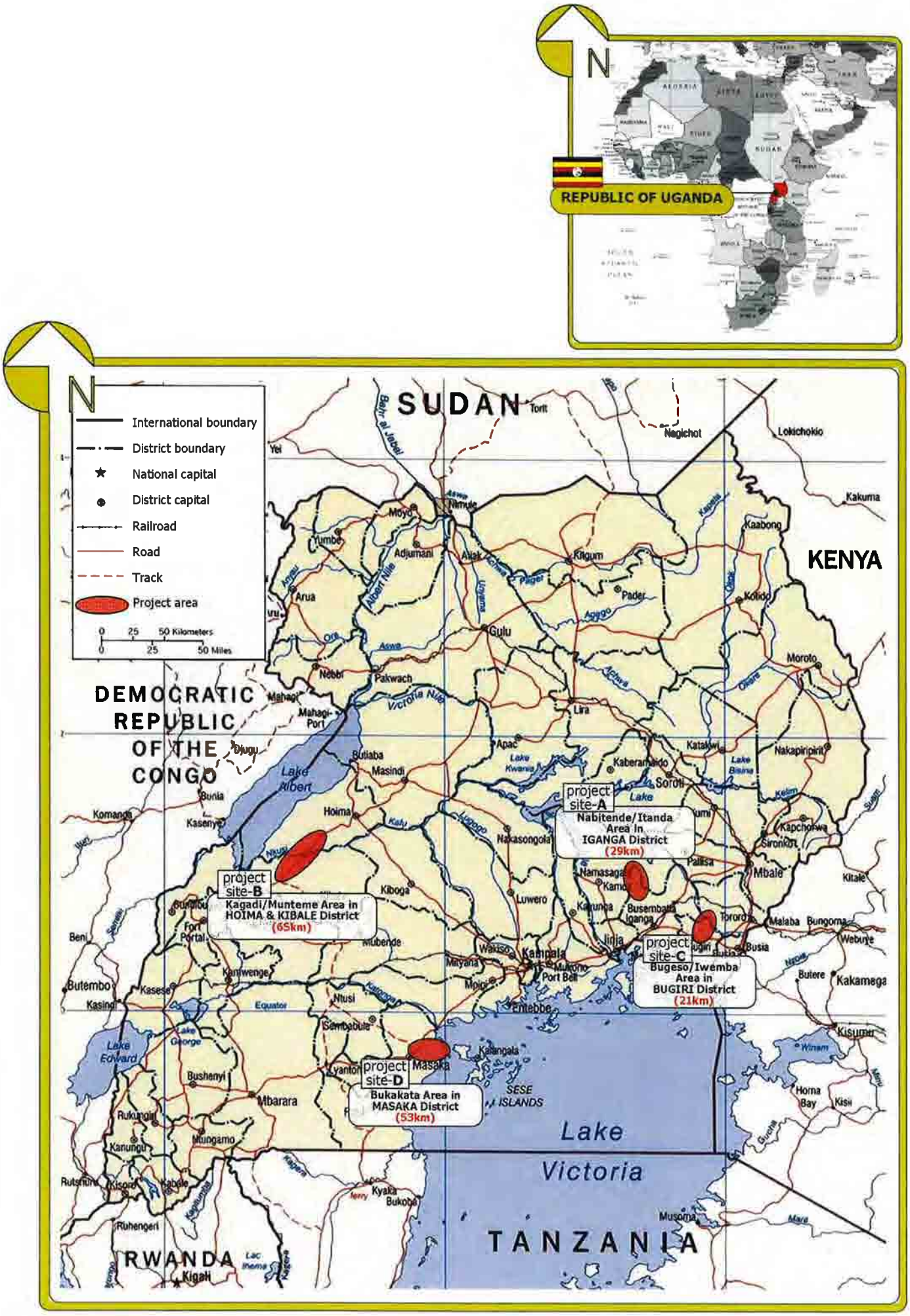

LOCATION MAP OF REPUBLIC OF UGANDA

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ABBREVIATIONS

E／N	Exchange of Notes
ERA	Electricity Regulatory Authority
GDP	Gross Domestic Product
IEC	International Electrotechnical Commission
IREMP	Indicative Rural Electrification Master Plan
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
MEMD	Ministry of Energy and Mineral Development
NEMA	National Environment Management Authority
NEPS	National Electrification Planning Study
NFA	National Forestry Authority
NORAD	Norwegian Agency for Development Cooperation
O&M	Operation and Maintenance
OJT	On the Job Training
PEAP	Poverty Eradication Action Plan
PRSP	Poverty Reduction Strategy Paper
REA	Rural Electrification Agency
REF	Rural Electrification Fund
RESP	Rural Electrification Strategy and Plan
SIDA	Swedish International Development Agency
UEB	Uganda Electricity Board
UEDCL	Uganda Electricity Distribution Company Ltd.
UEGCL	Uganda Electricity Generation Company Ltd.
UETCL	Uganda Electricity Transmission Company Ltd.

CHAPTER 1

BACKGROUND OF THE PROJECT

CHAPTER 1
BACKGROUND OF THE PROJECT

1-1 Background the Project

The Republic of Uganda (hereinafter referred to as "Uganda") is an agricultural nation where agriculture accounts for approx. 30% of GDP. However, the production and export of farm products remains unstable due to weather-related reasons and market trends. Furthermore, benefit of the economic growth is mainly concentrated in urban areas. Consequently, infrastructure development and expansion in rural areas have become an issue of development in Uganda.

With the formulation of the Poverty Eradication Action Plan (PEAP) in 1997, a comprehensive national development plan, the Government of Uganda is advocating rural electrification development as a mean of accomplishing "income generation for the rural poor" and considers it to be high priority even in the 3rd revision of the PEAP (2004 to 2008). In addition, rural electrification is deemed to be top priority in the "Plan for Modernization of Agriculture", formulated in 2000.

Although the Government of Uganda has endeavored to promote rural electrification through the formulation of the "National Electrification planning Study (NEPS)" in 1992, the electrification rate was still only 4% in rural area, and 20% in urban area in 2005 (approx. 6% in the national average) primarily due to insufficient fiscal appropriation.

Although the aim of the "Rural Electrification Strategy and Plan" formulated in 2001 is to achieve a rural electrification rate of 10% by 2012, the implementation of rural electrification projects with lower profit have fallen behind due to financial difficulties. The Government of Uganda submitted a request for Japan's Grant Aid for the Project for Rural Electrification Phase II through development of power distribution network for the following four sites based on the Priority Rural Electrification Projects (PREPS) in accordance with a draft "Indicative Rural Electrification Master Plan (IREMP)", which is presently being revised, in due consideration of the security situation, location of District Headquarters, inter-regional balance, coordination with other donors and the potential of economic growth.

Project Site A: Nabitende / Itanda Area in Iganga District (Eastern Region)

- Procurement and installation of 33kV distribution lines (approx. 29km)
- Procurement and installation of distribution transformers (33kV/415-240V)
- Replacement of 33kV switchgears at the existing 33/11kV Iganga Substation

Project Site B: Kagadi / Munteme Area in Hoima and Kibale District (Western Region)

- Procurement and installation of 33kV distribution lines (approx. 65km)
- Procurement and installation of distribution transformers (33kV/415-240V)

Project Site C: Bugeso / Iwemba Area in Bugiri District (Eastern Region)

- Procurement and installation of 33kV distribution lines (approx. 21km)
- Procurement and installation of distribution transformers (33kV/415-240V)

Project Site D: Bukakata Area in Masaka District (Central Region)

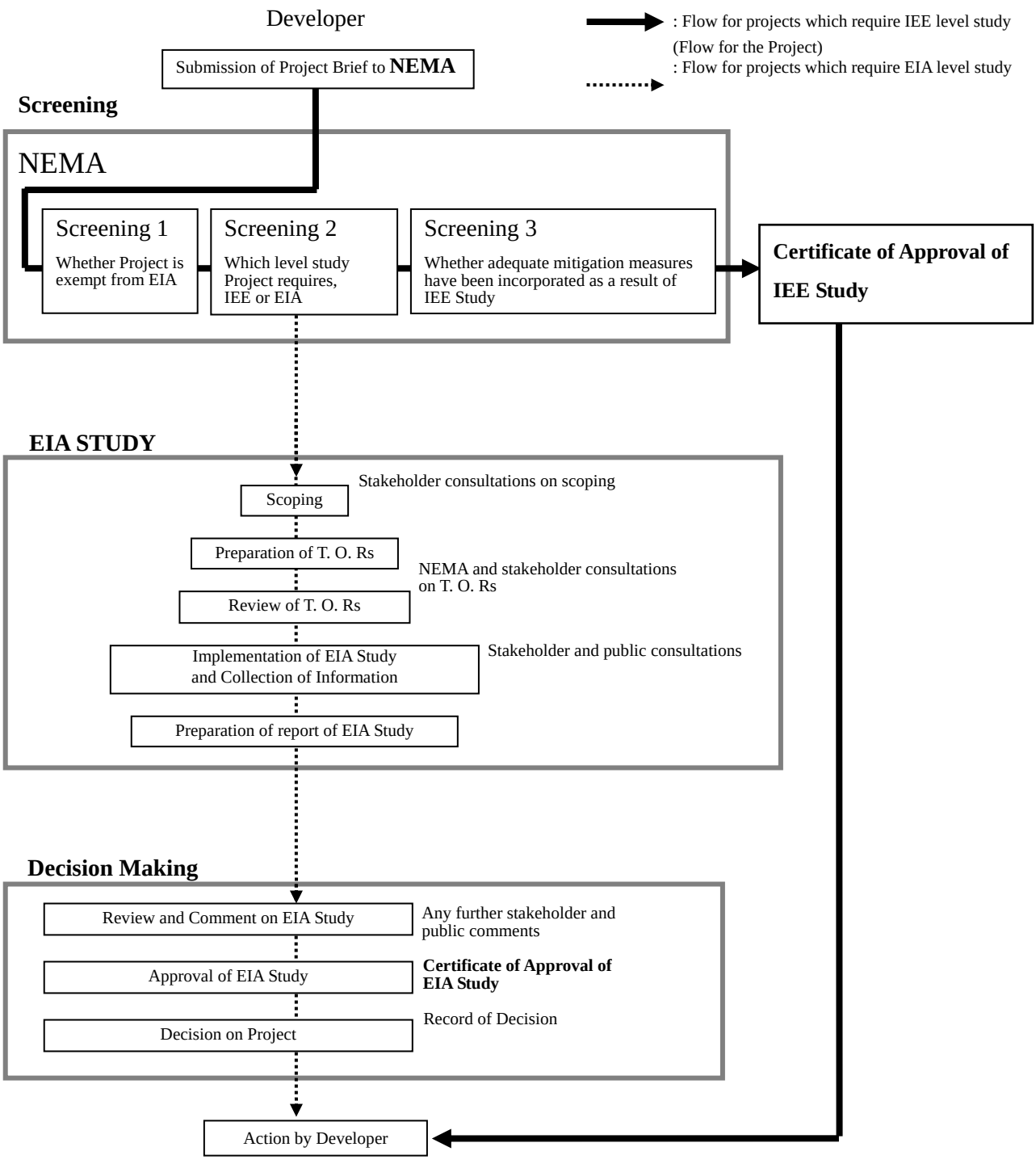
- Procurement and installation of 33kV distribution lines (approx. 53km)
- Procurement and installation of distribution transformers (33kV/415-240V)

1-2 Environmental and Social Considerations

In the implementation of the Project, in accordance with the following Ugandan standards in addition to the "JICA Guidelines for Environmental and Social Considerations", construction and maintenance work will be carried out in cooperation with REA, which is the implementing agency, in due consideration of the mitigation measures for environmental impact taken by the Study Team.

- National Environment Statute, 1995
- The Environment Impact Assessment Regulations, 1998
- Guidelines for Environmental Impact Assessment in Uganda

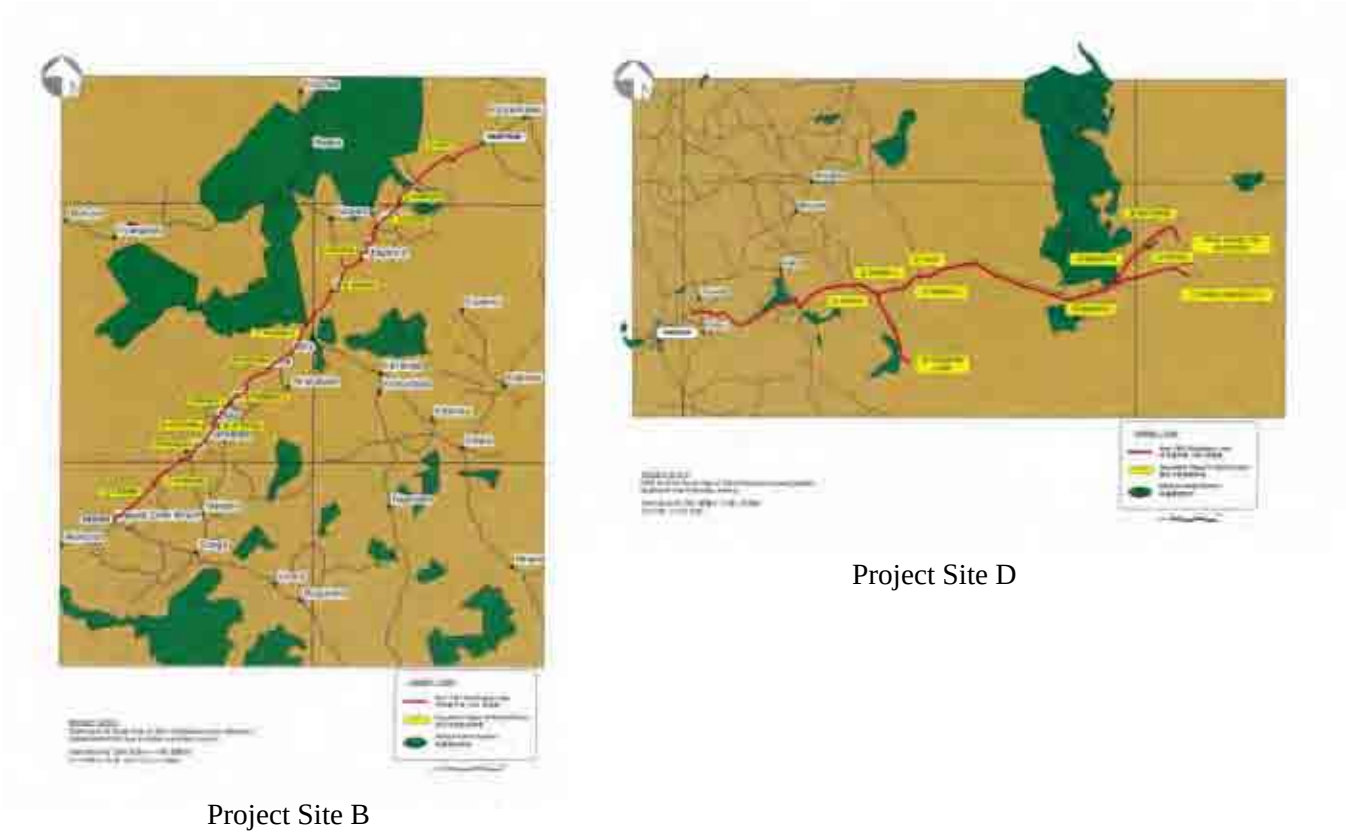
In Uganda, the National Environment Management Authority (NEMA), established in accordance with the "National Environment Statute", examines, coordinates and supervises environmental impact assessments. The project developer must submit to NEMA a Project Brief which includes an outline of the project, anticipated environmental impacts and their mitigation measures. The NEMA screens the project based on the said Project Brief in accordance with the flow in Figure 1-1. The Project also followed this process through the submission of a Project Brief and screening, then NEMA approved the Project on February 7, 2007.



Source: Guidelines for Environmental Impact Assessment in Uganda

Figure 1-1 EIA Process Flow

The distribution line routes at Project sites B and D under the Project partially pass by national forest reserves administered by the National Forestry Authority (NFA). Schematic drawings are shown in Figure 1-2. In the drawings, the 33kV distribution lines for the Project are indicated by solid red lines and the national forest reserves are indicated in dark green.



Project Site D

Project Site B

Figure 1-2 Distribution Routes at Project Sites B and D

In the approval letter from NEMA, a request was also made to obtain project approval from the NFA as a prerequisite. Accordingly, the Study Team submitted the Project Brief to the NFA as well as NEMA, attaching a detailed drawing which shows the location of the boundary between the national forest reserves and distribution line routes under the Project (detailed drawing of the environs using solid red lines and green areas in Figure 1-2). After that, approval for the Project was obtained from the NFA on February 15, 2007. In the approval letter, official permission was granted for the installation of distribution lines along national forest reserves so long as they are installed along the roadside within the road reserve (15m from the center of a road).

The Scope of Work for other requirements described in the approval letter from the NEMA and the NFA is shown in Table 1-1. In the implementation of the Project, in addition to the mitigation

measures indicated in the Project Brief, those requirements should be carried out in cooperation with the Rural Electrification Agency (REA) which is the implementing agency.

Table 1-1 Other Requirements of the National Environment Management Authority and the National Forestry Authority

Work Item		Description	Implementation	
			Japan	Uganda
1. Other Requirements by the NEMA				
(1)	Compensation to local residents	Any loss of land or farming products by local residents resulting from the installation of distribution lines should be dealt with appropriately in accordance with related legislation.		○
(2)	Ensuring safety of local residents	Local residents living along the periphery of the installation of distribution lines should be made aware of any risk in order to protect equipment.		○
(3)	Periodical confirmation of oil leakage	Adequate periodical monitoring should be carried out in order to prevent oil leakage from transformers.	○ (During construction)	○ (After operation)
(4)	Mitigation of impact on ecosystem	Adequate measures should be taken in order to mitigate the impact of construction work and operation on the surrounding ecosystem.	○ (During construction)	○ (After operation)
(5)	Adequate collection, control and disposal of waste oil	Qualified individuals should collect, control and dispose of oil drained from transformers in accordance with the 1999 National Environment (waste management) Regulations.		○
(6)	Other waste products	Other waste produced through the implementation of the Project should be adequately disposed of in accordance with the 1999 National Environment (waste management) Regulations.		
		Instructions and a disposal method should be carried out in accordance with the 1999 National Environment (waste management) Regulations.		○
		Disposal should be implemented in accordance with the 1999 National Environment (waste management) Regulations.	○	
(7)	Wearing of personal protective equipment (PPE)	Individuals engaged in construction work should be monitored at all times to ensure they wear adequate personal protective equipment.	○	
(8)	Ensuring of STD and HIV/AIDS	Every attempt should be made to prevent those who engaged in construction work from becoming infected with HIV/AIDS by providing sufficient education on STDs and HIV/AIDS.	○	
(9)	Patrol monitoring and recording	Environmental impact items indicated in the Project Brief should be monitored and be recorded in accordance with Section 77 of the National Environment Act Cap 153.		○
(10)	Other	If unanticipated environmental impact arises, it should be adequately dealt with in accordance with Section 22 (4) of the National Environment Act Cap 153.	○	○
2. Other Requirements by the NFA				
(1)	Strict observation of permitted distance for bush clearing	Bush clearing should be strictly controlled so that it falls within the Road Reserve (15m from the center of the road).		○
(2)	Prevention of waste dumping	Waste products associated with the installation of distribution lines during construction work and after the commencement of operation should be strictly controlled to prevent dumping within the National Forest reserve.		○
(3)	Ownership of trees felled in National Forest Reserves	It should be made known that the National Forest Authority has ownership over trees felled in the National Forest Reserves.	○	○

CHAPTER 2

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CHAPTER 2
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2-1 Basic Concept of the Project

2-1-1 Overall Goal and Project Objectives

With the formulation of the Poverty Eradication Action Plan (PEAP) in 1997, a comprehensive national development plan, the Government of Uganda is advocating rural electrification development as one means of accomplishing "income generation for the rural poor" and considers it to be high priority even in the 3rd revision of the PEAP (2004 to 2008). In addition, rural electrification is deemed to be top priority in the "Plan for Modernization of Agriculture", formulated in 2000.

Although the Government of Uganda has endeavored to promote rural electrification through the formulation of the "National Electrification planning Study (NEPS)" in 1992, the electrification rate was still only 4% in rural area, and 20% in urban area in 2005 (approx. 6% in the national average) primarily due to insufficient fiscal appropriation.

Rural Electrification Agency (REA) commenced its operation in 2003, but many electrification projects have been suspended due to insufficient funds for electrification. Although the aim of the "Rural Electrification Strategy and Plan" formulated in 2001 is to achieve a rural electrification rate of 10% by 2012, residents of underserved areas are compelled to use kerosene lamps or firewood and private generators, thus also hindering administrative and public services such as hospitals and schools.

In accordance with the draft "Indicative Rural Electrification Master Plan (IREMP)" which is presently being revised, the overall goal of the Project is to improve the power supply at project sites and to stimulate regional economic growth. Another objective of the Project is to provide a stable source of electric power to four areas as local bases for agriculture and the fishery, both key industries in Uganda, in order to improve the living standards of local residents, to ensure stability of public facilities, and to revitalize social and economic activities.

2-1-2 Outline of the Project

The aim of the Project is to develop distribution lines which are important social infrastructure, through the procurement and installation of equipment and materials for 33kV distribution lines necessary to accomplishing the above-mentioned goal, combined with the procurement and installation of low-voltage distribution lines by Ugandan side.

Generally speaking, the requested Japanese assistance involves the procurment and installation of equipment and materials for distribution and substation equipment necessary for electrification at the project sites.

Project Site A: Nabitende / Itanda Area in Iganga District (Eastern Region)

- Procurement and installation of 33kV distribution lines (approx. 29km)
- Procurement and installation of distribution transformers (33kV/415 - 240V)
- Replacement of 33kV switchgears at the existing 33/11kV Iganga Substation

Project Site B: Kagadi / Munteme Area in Hoima and Kibale District (Western Region)

- Procurement and installation of 33kV distribution lines (approx. 65km)
- Procurement and installation of distribution transformers (33kV/415 - 240V)

Project Site C: Bugeso / Iwemba Area in Bugiri District (Eastern Region)

- Procurement and installation of 33kV distribution lines (approx. 21km)
- Procurement and installation of distribution transformers (33kV/415 - 240V)

Project Site D: Bukakata Area in Masaka District (Central Region)

- Procurement and installation of 33kV distribution lines (approx. 53km)
- Procurement and installation of distribution transformers (33kV/415 - 240V)

2-2 Basic Design of the Requested Japanese Assistance

2-2-1 Design Policy

2-2-1-1 Basic Policy

In accordance with the “Indicative Rural Electrification Master Plan (IREMP)” which is presently being revised, 33kV distribution lines and distribution transformers will be procured and installed for a total length of 168km at four sites in the Eastern, Western and Central Regions. In addition, the replacement of deteriorated 33kV switchgear at the existing 33/11kV Iganga Substation as a power source at the project site will fall within the scope of the Japanese works. Equipment and materials for low-voltage distribution lines will be procured and installed by Ugandan side.

The capacity of equipment to be procured under the Project will also be planned based on the power demand forecast at project sites. The capacity of the 33kV distribution equipment and materials will be of adequate scale to meet the forecast power demand five years after commencement of operaton.

2-2-1-2 Natural Conditions

(1) Altitude

The project sites are located on highland at an altitude of approx. 1,300m. In general, the dielectric strength of electrical appliances drops 1% for every 100m increase in altitude when the altitude exceeds 1,000m. Accordingly, equipment and materials with insulation suitable for highlands should be carefully selected in due consideration of safety and durability.

(2) Temperature

The temperature at projects sites is fairly constant and warm throughout the year and fall within a range of 15°C and 35°C. As the distribution equipment to be adopted under the Project will be outdoor type, careful attention should be paid to any increase in the ambient temperature due to direct sunlight so as not to hinder operation and maintenance from the aspects of structure and performance by keeping distribution equipment within a normal operating temperature.

(3) Humidity and Rainfall

The humidity ranges from 60% to 90% throughout the year and it is relatively comfortable. However, the adoption of space heaters for sealed boards should be examined in order to prevent condensation due to temperature fluctuations.

2-2-1-3 Socio-economic Conditions

Although life in Kampala, the capital of Uganda, can be expected to be relatively convenient, the social infrastructure in rural areas as in the Project sites has fallen behind, and so living conditions remain extremely poor. In addition, since English is not widely spoken and medical facilities have not been fully developed in some areas, the conditions for long-term stay for foreigners are quite inconvenient. Consequently, a construction schedule should be prepared at the nearest towns (such as Jinja and Fort Portal) as bases in order to secure safe accommodation and an emergency communication system during the construction period of the Project.

2-2-1-4 Construction and Procurement Conditions, Special Situations and Commercial Practice

Kampala is the center of the politics and economy so there is a boom in large-scale construction projects such as large hotels, commercial buildings and housing complexes. As several foreign general contractors (builders) have located in the capital territory, construction conditions are favorable. However, the infrastructure has fallen behind and construction conditions remain poor at the project

sites. Consequently, in the formulation of a construction plan, special attention should be given to the method of transporting construction machinery and materials from the capital or the nearest city and the environment in which a field office is to be built.

2-2-1-5 Effective Use of Local Companies (Builders, Consultants)

(1) Effective Use of Local Construction Companies

Since there are foreign general contractors or electrical firms in Kampala, it is relatively easy to procure local workers, transportation vehicles and construction work machinery and materials in Uganda. It is therefore possible to place orders with local companies for distribution line work or foundation work for 33kV switchgears under the Project.

On the other hand, since the construction department of the former Uganda Electricity Board (UEB) was responsible for the installation work for substation facilities delivered through previous assistance, there is no in-house construction department at the present organization of which the functions were separated now. Local companies have little experience of equipment installation work. In addition, adjustment and testing at the time of installation and after installation requires highly advanced engineers. Therefore, aside from workers it will be difficult to effectively utilize local companies. Consequently, it will be necessary to dispatch engineers from Japan in order to ensure quality control, technical transfer and management of work schedule.

(2) Effective Use of Local Equipment and Materials

Aggregate, cement, reinforcing bars and wooden poles utilized in foundation work are locally available and are frequently adopted. In the formulation of a construction plan, locally available equipment and materials should be adopted as much as possible. If an adequate quantity of wooden poles cannot be secured due to the construction scale, they will be procured from a third country (Kenya, Tanzania, etc.). In Uganda, since the major components of distribution facilities required for the Project (distribution transformers, lighting arresters, load break switches and metering units) must be imported, it will be impossible to effectively utilize local equipment, and will therefore be procured from Japan or third countries.

(3) Procurement from Third Countries

The 33kV switchgears to be procured and installed under the Project and other main components are not manufactured in Uganda. Due to the limited funds from self-financing, although various equipment and materials will be procured from other African nations (such as South Africa, Tanzania and Kenya), Asian nations (such as China and India) and European nations, few

manufactures have an after-service system necessary to respond to faults or repair works or procurement of spare parts. In discussions with REA, it was requested that Japanese products shall be procured for the main components, such as distribution panels or distribution transformers for 33kV distribution lines, instead of adopting products manufactured in third countries due to their low reliability.

Since power distribution and substation equipment procured under previous assistance through the “1999 Rural Electrification Project (JICA)” is currently being operated in a stable manner and without incident, operators (such as UMEME) are familiar with the operation and maintenance of Japanese equipment and are confident that the after-sale service of Japanese manufacturers will enable to realize lower failure rate of main distribution and substation equipment. Those operators will conclude concession agreement with REA, and take charge of operation and maintenance after completion of the Project.

As described above, the reliability of Japanese products is extremely high in Uganda, so they have requested that Japanese products be procured for the main components under the Project through Japan's Grant Aid.

Taking the above situation into consideration, the following equipment and materials will be procured for the Project.

Table 2.2-1 Country of Origin of Equipment and Materials for the Project

Equipment and Materials	Procurement Source		
	Uganda	Japan	Third Country
1. Distribution Transformers		○	
2. Load Break Switches		○	
3. Cutout Switches with Fuses		○	
4. Lighting Arresters		○	
5. Metering Unit			○
6. Aluminum Conductors		○	
7. Wooden Poles	○		○
8. Other Electrical Materials (insulators, cross arms & stay wires)		○	
9. Switchgears		○	
10. Maintenance Tools & Emergency Spare Parts		○	

In the transportation of equipment and materials to be procured from Japan or third countries, a packaging method sufficient enough to endure long-term ocean transport, unloading at a port and inland transport to the project sites will be adopted.

The Port of Mombassa in Kenya can be considered as a candidate port for unloading equipment and materials. The said port has improved large-scale unloading facilities thus there is no difficulty to disembark those equipment and materials under the Project.

For import customs clearance, equipment suppliers should prepare necessary documents in advance and ensure the shortest possible period of custom clearance in order to meet the overall implementation schedule.

With respect to construction machinery for equipment installation and transportation, 50-ton level cranes or trailers can be leased locally, so there are no specific problems in the implementation of the Project.

2-2-1-6 Operation and Maintenance

Operators have ever operated and maintained the national power grid including 33kV distribution lines in a direct-management manner up to the present, with long-term concession agreement with REA for the purpose of inviting private enterprise. Generally speaking, substations and distribution lines in the 33kV distribution systems in Kampala and urban areas have been appropriately operated and maintained and the present operation conditions at each facility are favorable.

However, the substations and distribution lines, etc. in rural areas near from consumers have not been adequately maintained, and there are a lot of malfunction due to domestic economic conditions, insufficient spare parts and deterioration. In addition, engineers and technicians of operators may not fully understand the latest power distribution equipment. Japanese engineers will therefore provide on-the-job training (OJT) in the operation and maintenance of 33kV switchgears for the relevant equipment during the construction period of the Project. Simultaneously, special consideration will be given to effective and efficient operation of the facilities to be constructed by providing necessary spare parts, testing instruments, maintenance tools, operation and maintenance manuals, and recommendations on an operation and maintenance system after the commencement of operation.

2-2-1-7 Grade Setting for Facilities and Equipment

In due consideration of the various conditions mentioned above, the scope, bill of quantities and engineering grade of procurement and installation of equipment and materials will be formulated based on the following principles.

(1) Scope of Facilities and Equipment

Since the target year of the Project is considered to be five years from the completion of installation, the minimum but necessary configuration and specifications of facilities will be selected through procurement and installation of new distribution lines and 33kV switchgears by extending the existing 33kV distribution network in order to supply stable electric power to local residents and to social and public facilities such as hospitals and schools at the project sites.

In order to ensure a design that is both technically and economically appropriate, the minimum but necessary configuration and specifications for facilities will be selected by adopting products that conform to international standards with regards to specifications of materials as much as possible and by keeping the types of materials and equipment to a minimum. In principle, the specifications of distribution transformers and distribution lines will be selected to meet the power demand five years after the commencement of operation.

(2) Grade Setting

In designing 33kV distribution lines and 33kV switchgears to be constructed and procured under the Project, special attention will be given to ensure that the engineering level of operators entrusted by REA which will be responsible for operation and maintenance of the facilities, and technical standard of those operators will be observed after completion of installation.

2-2-1-8 Procurement and Construction Period

On the assumption of implementing the Project in accordance with the Japan's Grant Aid scheme, installation should be completed within a single year. In order to complete the Project within the scheduled installation period, and to effectively display the expected effects through the electrification, the installation schedule by Japanese side and Ugandan side should be coordinated, in due consideration of inland transportation routes, a transport method, period and various procedures, etc.

2-2-2 Basic Plan (Equipment Plan)

2-2-2-1 Preconditions

(1) Power Demand Forecast at Project Sites

The power demand five years after commencement of operation at each project site was estimated through the following procedures based on the current power demand estimate.

1) Calculation of Population and Number of Households

A census implemented in 2002 is the most recent population statistics in Uganda, and the findings were compiled in the "2002 Uganda Population and Housing Census". According to the findings, the family make-up per single household appears to be 4.7 person as a national average. In addition to collection of the most recent data in the Study, indicators other than population and the number of households, information on living standards of local residents such as the number of schools, the number of wells as headwaters, the number of hospitals and industries (commerce, agriculture and fishery) which are important factors to evaluate the priority for the project sites, were estimated through an interview survey and a questionnaire survey from local administrative offices, personnel responsible for local administration and site reconnaissance. Based on the findings of the surveys, potential consumers for each proposed site were deemed to be the number of consumers in each project site.

In addition, the unit power demand presently applied by REA in rural electrification projects will also be adopted for the Project. Depending on the type of consumer, unit consumption will be applied as shown in Table 2.2-2. A diversity factor of 0.85 will be applied.

Table 2.2-2 Unit Power Demand for Power Demand Forecast

Consumer Type	Unit Consumption per Consumer	Demand Factor
General Residences	0.172 kW	0.7
Shops & Clinics	1.06 kW	0.7
Others (Schools, Hospitals, Factories)	3.5 kW	1.0

Source: Hydropower Development Master Plan (HDMP) (1997)

2) Growth Rate in Peak Demand

The growth rate in peak demand for rural electrification in general can be classified as; ① the connection rate of consumers that will connect to power grid after commencement of the Project, ② the population growth rate in project sites, and ③ the power demand increase per unit consumption mainly through an income growth after electrification. Consequently, since the growth rate applied in the National Electrification Planning study (NEPS) is regarded to be appropriate even for the Project, the average annual growth rate to be applied for the Project will be determined as follows.

- Until five years after commencement of operation: 4% annual

3) Population Growth Rate at Project Sites before Electrification

Assuming that the number of general households obtained in the Study is the number of households as of end of 2006, the population growth rate of general households anticipated until 2009, which is the year for commencement of operation, will be determined as follows based on the findings of the 2002 National Census.

Population Growth Rate (2002 National Census)

- Project Site A: Nabitende / Itanda Area in Iganga District (Eastern Region)
  Annual rate of 3.2%
- Project Site B: Kagadi / Munteme Area in Hoima and Kibale District (Western Region)
  Annual rate of 5.2%
- Project Site C: Bugeso / Iwemba Area in Bugiri District (Eastern Region)
  Annual rate of 4.7%
- Project Site D: Bukakata Area in Masaka District (Central Region) Annual rate of 0.8%

4) Power Demand Forecast for the Target Year

Since the target year of the Project is regarded to be five years after completion of installation and commencement of operation, the power demand forecast at the project sites are shown in Table 2.2-3 to Table 2.2-6, assuming the number of households for electrification at the project sites and various conditions such as above-mentioned growth rate of power demand. As shown in the said tables, the peak demand necessary for four sites under the Project will be approx. 4.2MW five years from the commencement of operation, which is approx. 2% of the available generation capacity as of 2006. The Project is therefore expected to have an extremely small impact on the power demand and supply balance nationwide.

- Project Site A: Nabitende / Itanda Area in Iganga District (Eastern Region)
  1,732 kW (Y2015)
- Project Site B: Kagadi / Munteme Area in Hoima and Kibale District (Western Region)
  1,352 kW (Y2014)
- Project Site C: Bugeso / Iwemba Area in Bugiri District (Eastern Region)
  1,003 kW (Y2015)
- Project Site D: Bukakata Area in Masaka District (Central Region) 853 kW (Y2014)

Table 2.2-3 Power Demand Forecast at Project Site

(Project Site A: Nabitende / Itanda Area in Iganga District in Eastern Region)

Project Site A (Nabitende/Itanda Area in Iganga District)										
Parish	***Residential***	***Water Pump***	***Schools***		***Health Center***		***Maize & rice mill***	***Shop/ Kiosk***	***Total***	***Demand*** (KW)
			Primary	***Secondary***	***Grade IV***	***Others***				
Namungalwe	1,453	3	5	6		2	1	24	***1,494***	***247***
Nabitende	899	7	3	1		1	1	26	***938***	***170***
Naluko	730	5	2				1	5	***738***	***120***
Ituba	967	6	4	1		1	2	12	***993***	***172***
Bugono	584	8	3		1			8	***596***	***118***
Itanda	1,003	9	3	1		1	1	2	***1,020***	***172***
Kiwanyi	791	2	3			1		14	***797***	***124***
Nawangaiza	818	3	2			1		22	***824***	***133***
Total	***7,245***	***43***	***25***	***9***	***1***	***7***	***6***	***113***	***7,449***	***1,255***

(Unit: kW)

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	**2015**
Namungalwe	***247***	255	263	271	280	291	303	315	327	**340**
Nabitende	***170***	176	181	187	193	201	209	217	226	**235**
Naluko	***120***	123	127	131	136	141	147	153	159	**165**
Ituba	***172***	177	183	189	195	202	210	219	228	**237**
Bugono	***118***	122	126	130	134	140	145	151	157	**163**
Itanda	***172***	177	183	189	195	203	211	219	228	**237**
Kiwanyi	***124***	128	132	136	140	146	152	158	164	**171**
Nawangaiza	***133***	137	142	146	151	157	163	170	177	**184**
Total	***1,255***	***1,295***	***1,337***	***1,380***	***1,424***	***1,481***	***1,540***	***1,602***	***1,666***	***1,732***

Population Growth ***3.20% / year***

Load Growth ***4.00% / year***

Table 2.2-4 Power Demand Forecast at Project Site

(Project Site B: Kagadi / Munteme Area in Hoima and Kibale District in Western Region)

Project Site B (Kagadi/Munteme Area in Hoima and Kibale District)										
Parish	***Residential***	***Water Pump***	***Schools***		***Health Center***		***Maize & rice mill***	***Shop/ Kiosk***	***Total***	***Demand*** (KW)
			Primary	***Secondary***	***Grade IV***	***Others***				
Kigo	32		1	1			1	8	***43***	***20***
Kabwoya	106	3	6	2		1	2	31	***151***	***82***
Kitooke	53	2	2				1	7	***58***	***29***
Kicanga	53	3	2				1	13	***59***	***37***
Karama	64	4	1				1	9	***70***	***35***
Pachwa 2	255	1	2				2	34	***260***	***73***
Pachwa 1	170	3	4			1	3	21	***202***	***72***
Mabaale	532	4	6	6		1	4	53	***606***	***174***
Kitemuzi	213	2	3				1	16	***219***	***58***
Kaitemba	170	1	3				1	9	***175***	***45***
Mugalike	383	5	4	3		2	3	10	***410***	***108***
Kyenzige	638	5	8	6		2	3	60	***722***	***200***
Kiryane	64	1	1					8	***66***	***21***
Total	***2,734***	***34***	***43***	***18***	***-***	***7***	***23***	***279***	***3,138***	***954***

(Unit: kW)

Year	2006	2007	2008	2009	2010	2011	2012	2013	**2014**
Kigo	***20***	21	22	24	25	26	27	28	**29**
Kabwoya	***82***	86	91	96	99	103	107	112	**116**
Kitooke	***29***	31	32	34	35	37	38	40	**41**
Kicanga	***37***	39	41	43	45	47	49	50	**52**
Karama	***35***	37	39	41	43	45	46	48	**50**
Pachwa 2	***73***	77	81	86	89	93	96	100	**104**
Pachwa 1	***72***	76	79	84	87	90	94	98	**102**
Mabaale	***174***	183	193	203	211	219	228	237	**247**
Kitemuzi	***58***	62	65	68	71	74	77	80	**83**
Kaitemba	***45***	47	49	52	54	56	59	61	**63**
Mugalike	***108***	113	119	125	130	135	141	146	**152**
Kyenzige	***200***	210	221	233	242	252	262	272	**283**
Kiryane	***21***	22	23	24	25	26	27	28	**29**
Total	***954***	***1,004***	***1,056***	***1,111***	***1,156***	***1,202***	***1,250***	***1,300***	***1,352***

Population Growth ***5.20% / year***

Load Growth ***4.00% / year***

Table 2.2-5 Power Demand Forecast at Project Site

(Project Site C: Bugeso / Iwemba Area in Bugiri District in Eastern Region)

Project Site C (Bugeso/Iwemba Area in Bugiri District)										
Parish	***Residential***	***Water Pump***	***Schools***		***Health Center***		***Maize & rice mill***	***Shop/ Kiosk***	***Total***	***Demand*** (KW)
			Primary	***Secondary***	***Grade IV***	***Others***				
Bugeso	524	3	3	1			10	30	***571***	***145***
Iwemba	682	6	3	2		1	12	15	***721***	***174***
Buyala	518	5	3	1		1	7	5	***540***	***123***
Nabirere	563	5	2				5	14	***575***	***120***
Nambo	575	3	2			1	8	11	***600***	***124***
Total	***2,862***	***22***	***13***	***4***	***-***	***3***	***42***	***75***	***3,021***	***686***

(Unit: kW)

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	**2015**
Bugeso	***145***	152	159	166	174	181	188	196	204	**212**
Iwemba	***174***	183	191	200	210	218	227	236	245	**255**
Buyala	***123***	129	135	141	148	154	160	166	173	**180**
Nabirere	***120***	126	132	138	144	150	156	162	169	**176**
Nambo	***124***	129	136	142	149	155	161	167	174	**181**
Total	***686***	***718***	***752***	***787***	***824***	***857***	***892***	***927***	***964***	***1,003***

Population Growth ***4.70% / year***

Load Growth ***4.00% / year***

Table 2.2-6 Power Demand Forecast at Project Site

(Project Site D: Bukakata Area in Masaka District in Central Region)

Project Site D (Bukakata Area in Masaka District)										
Parish	Residential	Water Pump	Schools		Health Center		Maize & rice mill	Shop/ Kiosk	Total	Demand (KW)
			Primary	Secondary	Grade IV	Others				
Kayugi/Serinya	46	1	2	1				8	***58***	***25***
Nabugabo Camp	43	2						22	***67***	***28***
Ssunga	989	2	7	2		1		4	***1,005***	***161***
Kigo	43	1						1	***45***	***9***
Bunaddu	32	3	1					5	***41***	***22***
Katiko	43	2	1					7	***53***	***21***
Lambu Landing site	1,277		1			1		120	***1,399***	***247***
Bukakata	426	6	2			1		8	***443***	***86***
Kachanga	426						1	40	***467***	***84***
Total	***3,322***	***17***	***14***	***3***		***3***	***1***	***215***	***3,575***	***525***

(Unit: kW)

Year	2006	2007	2008	2009	2010	2011	2012	2013	**2014**
Kayugi/Serinya	***25***	26	26	26	27	28	29	31	**32**
Nabugabo Camp	***28***	29	29	29	30	32	33	34	**35**
Ssunga	***161***	163	164	165	172	179	186	193	**201**
Kigo	***9***	9	10	10	10	10	11	11	**12**
Bunaddu	***22***	22	22	22	23	24	25	26	**27**
Katiko	***21***	21	21	21	22	23	24	25	**26**
Lambu Landing site	***247***	249	251	253	263	274	285	296	**308**
Bukakata	***86***	87	87	88	92	95	99	103	**107**
Kachanga	***84***	85	86	86	90	94	97	101	**105**
Total	***684***	***690***	***695***	***701***	***729***	***758***	***788***	***820***	***853***

Population Growth ***0.80% / year***

Load Growth ***4.00% / year***

(2) Electric Power System Plan

1) Method for Connecting Existing and New Distribution Lines

New 33kV distribution lines will be connected to the existing 33kV distribution system and be extended to project sites. The said connection method is shown in Table 2.2-7 based on the location of existing 33kV distribution lines and access roads to the project sites.

Concerning the distribution line for Project Site A, the Japanese side will extend the line to the project site after the Ugandan side extends it from the existing Iganga Substation to Karilo.

Table 2.2-7 Connection Method between New 33kV Distribution Lines and Existing 33kV Distribution System

Project Site	Connection of New 33kV Distribution Line
<Project Site A> Nabitende / Itanda Area in Iganga District (Eastern Region)	The line will be extended through T-branching at Namungalwe village from the 33kV distribution line extended from Iganga Substation.
<Project Site B> Kagadi / Munteme Area in Hoima & Kibale District (Western Region)	The line will be extended from the terminal of the existing 33kV distribution line at Kagadi / Munteme connection points.
<Project Site C> Bugeso / Iwemba Area in Bugiri District (Eastern Region)	The existing 33kV distribution line will be extended through T-branching at Naluwerere village.
<Project Site D> Bukakata Area in Masaka District (Central Region)	The existing 33kV distribution line will be extended through T-branching at Masaka village.

2) Measures for Voltage Drop

There are no problems of voltage fluctuation at Project Sites A, C and D. However, according to the findings of the power flow simulation, the voltage drop of 33kV distribution lines significantly exceeds the reference value (allowable limit) (±10%) at Project Site B (Kagadi / Munteme Area in Hoima & Kibale District in Western Region). Since the distance from the existing Nkonge Substation to the end of distribution lines is long (approx. 230km), measures against voltage drop should be taken. With regard to such measures, an Automatic Voltage Regulator (AVR) will be installed at the distribution substation (Kakumiro) by Ugandan side to keep the appropriate rage of voltage.

Table 2.2-8 Results of Power Flow Simulation at Project Sites

Project Site	Voltage Drop (kV) (Voltage Drop Ratio against Rated Voltage)
<Project Site A> Nabitende / Itanda Area in Iganga District (Eastern Region)	0.99 kV (-3%)
<Project Site B> Kagadi / Munteme Area in Hoima & Kibale District (Western Region)	6.27 kV (-19%)
<Project Site C> Bugeso / Iwemba Area in Bugiri District (Eastern Region)	2.31 kV (-7%)
<Project Site D> Bukakata Area in Masaka District (Central Region)	2.31 kV (-7%)

Remark: The allowable limit of voltage drop for the 33kV system in accordance with the REA standards is ±10%.

2-2-2-2 General Plan

The following design conditions have been established in order to determine the applicable quantities and specifications of facilities, equipment and materials for the Project.

(1) Climatic and Site Conditions

	<Project Site A> Nabitende / Itanda Area in Iganga District (Eastern Region)	<Project Site B> Kagadi / Munteme Area in Hoima & Kibale District (Western Region)	<Project Site C> Bugeso / Iwemba Area in Bugiri District (Eastern Region)	<Project Site D> Bukakata Area in Masaka District (Central Region)
(a) Altitude	1,140 m	1,238 m	1,150 m	1,225 m
(b) Ambient Temperature (Maximum)	30 ˚C	35 ˚C	30 ˚C	29 ˚C
(c) Ambient Temperature (Minimum)	16 ˚C	17 ˚C	16 ˚C	14 ˚C
(d) Relative Humidity (Maximum)	85 %	88 %	85 %	90 %
(e) Monthly Maximum Rainfall	210 mm (August)	197 mm (September)	210mm (August)	120 mm (September)
(f) Monthly Mean Rainfall	110 mm	109 mm	110mm	75mm
(g) Monthly Average Number of Rainy Days	16	16	17	13
(h) Average Wind Velocity	16.7 km/h	11.1 km/h	22.2 km/h	―
(i) Isokeraunic Level (IKL) (Annual Number of Days of Thunderstorms)	160	177	226	―
(j) Mean Solar Radiation Intensity	198.2 W/m^2	182.9 W/m^2	209.8 W/m^2	180.4 W/m^2

(2) Electrical System Conditions

(a) Distribution Voltage: 33 kV, 3 phase 3 wire (Max. 36kV)
415-240 V, 3 phase 4 wire

(b) Frequency: 50 Hz

(c) Maximum Short Circuit Capacity: 33 kV system: 25 kA

(d) Grounding System: 33 kV system effectively earthed

(e) Grounding Resistance: No more than 10 Ω

(f) Lightning Impulse Withstand Voltage (LIWV):
170 kV, 70kV for commercial frequency withstand voltage

(g) Creepage Distance: 16mm/kV

(h) Color Coding: IEC standards (red, yellow, blue, black)

(i) Insulator Material and Color: Porcelain, brown

(j) Protection Class and Plate Thickness for Distribution Panels:
No less than IP43 of protection class, no less than 2.3mm of thickness

(k) Safety Factor: 2.0 (pole, foundation)
2.5 (conductor, cross arm)
2.0 (insulator)

(l) Clearance for Distribution Lines, etc.:

1. Minimum Clearance
   1) Phase to phase (33 kV) 430mm
   2) Phase to ground (33 kV) 380mm
2. Minimum height from ground level
   1) Road Crossing 7.5m
   2) Roadside 6.5m
3. Distance of Pole Location from the road edge
   Not more than 10m (district road): Project Sites A and C
   Not more than 15m (national road): Project Sites B and D

(3) Applicable Codes/Standards and Units

In the design of the Project, as shown below, in due consideration of conformity with existing facilities in Uganda, relevant international standards such as IEC, ISO and the Japanese standards will be applied to major equipment and facilities as well as the Ugandan National Primary Grid Code. Since the standards for former Uganda Electricity Board (UEB) will be applied to electrical work in principle, the Japanese standards will be supplementary applied. In addition, the International System of Units (SI) will be utilized.

(a) International Electrotechnical Commission (IEC):

Applied to major functions of electrical products in general

(b) British Standard (BS):

Applied to electrical products in general

(c) International Standardization Organization (ISO):

Applied to performance evaluation of industrial products in general

(d) Japanese Industrial Standard (JIS):

Applied to industrial products in general

(e) Japanese Electrotechnical Commission (JEC):

Applied to electrical products in general

(f) Standard of Japan Electrical Manufactures' Association (JEM):

Same as above

(g) Japan Electric Association Code (JEAC):

Same as above

(h) Japan Cable Maker's Association Standard (JCS):

Applied to electrical wires and cables

(i) Technical standards on electrical equipment:

Applied to electrical work in general

2-2-2-3 Overview of the Basic Plan

(1) Basic Plan

The basic plan of the Project is outlined in Table 2.2-9 in accordance with basic design policy as mentioned earlier (Refer to 2-2-1).

Table 2.2-9 Overview of the Basic Plan

Phasing	Phase 1		Phase 2	
Project Site	<Project Site B> Kagadi / Munteme Area in Hoima & Kibale District (Western Region)	<Project Site D> Bukakata Area in Masaka District (Central Region)	<Project Site A> Nabitende / Itanda Area in Iganga District (Eastern Region)	<Project Site C> Bugeso / Iwemba Area in Bugiri District (Eastern Region)
Equipment &Materials Procurement &Installation Plan	Procurement & installation of the following equipment & materials for 33kV distribution system (1) 33 kV distribution line • Existing 33kV distribution line from Kagadi connection point to Munteme connection point: Approx. total length of 65km (2) 33 kV/415-240V distribution transformer 1) 50 kVA : 5 units 2) 100 kVA : 3 units 3) 200 kVA : 7 units (3) One Set of Metering unit	Procurement & installation of the following equipment & materials for 33kV distribution system (1) 33 kV distribution line • Connection point of existing 33kV distribution line to Bukakata village: Approx. total length of 53 km (2) 33 kV/415-240V distribution transformer 1) 50 kVA : 5 units 2) 100 kVA : 2 units 3) 200 kVA : 4 units (3) One Set of Metering unit	Procurement & installation of the following equipment & materials for 33kV distribution system (1) 33 kV distribution line • Connection point of existing 33kV distribution line to Nawangaiza village: Approx. total length of 29 km (2) 33 kV/415-240V distribution transformer 1) 100 kVA : 19 units 2) 200 kVA : 1 unit (3) Replacement of 33kV switchgears at Iganga S/S • Installation of 6 units of 33 kV switchgears (4) One Set of Metering unit	Procurement & installation of the following equipment & materials for 33kV distribution system (1) 33 kV distribution line • Connection point of existing 33kV distribution line to Iwemba village: Approx. total length of 21 km (2) 33 kV/415-240V distribution transformer 1) 100 kVA : 10 units 2) 200 kVA : 1 unit
Equipment & Materials Procurement only Plan	(1) Spare parts & maintenance tools for 33 kV distribution line	(1) Spare parts & maintenance tools for 33 kV distribution line (2) Load Break Switch: 1 unit	(1) Spare parts & maintenance tools for 33 kV distribution line & switchgears	(1) Spare parts & maintenance tools for 33 kV distribution line

(2) Replacement Plan for 33kV Switchgears

Installation work to be implemented by Japanese side under the Project involves the replacement of 33kV switchgears at the existing Iganga Substation in Project Site A (Nabitende / Itanda Area in Iganga District in the Eastern Region). Components of equipment to be utilized for the relevant work will be selected based on the following basic issues and equipment outline.

1) Basic Issues

In the selection of equipment and materials necessary for construction of the 33kV switchgears, special attention will be paid to ensure user-friendly and safe operation and maintenance of equipment after completion of the relevant facility. Therefore, outdoor type enclosed switchgears will be applied in order to shorten the installation period for

equipment and materials. In principle, maintenance crew will monitor and control the switchgears on-site.

33kV switchgear cubicles (hereinafter referred to as switchgear cubicles) will be designed in due consideration of climatic conditions at the project sites. In addition, lightning arresters will be installed at the leading-in and drawing-out sections of the existing facilities in order to protect the equipment from lightning. Since there are already fences around the existing substations premises, safety measures have already been taken for local residents.

The existing 33kV distribution line will be run from the existing cable pole into the switchgear cubicle via underground cables by constructing new cable cradles. The line will be connected to the existing 33/11kV transformer for Karilo District via underground cable. For power distribution to Bugiri District, the existing cable rising pole at the substation will be utilized.

Circuit breakers (vacuum type, 36kV, 630A, 25kA), in-house transformers, disconnection switches, measuring instruments and protection relays, etc. will be installed and accommodated in each cubicle in order to supply in-house power source, and to monitor and to protect the systems. A reclosing system will be applied to the feeder line in order to improve the reliability of the power supply by automatically re-closing circuit breakers when they trip at a minor ground fault. Switchgear panels will be composed of six cubicles and equipment to be accommodated in each cubicle is shown in Table 2.2-10.

Table 2.2-10 Overview of Switchgear Cubicles at Iganga Substation in Nabitende / Itanda Area in Iganga District (Eastern Region)

No.	Cubicle Name	Equipment to be Accommodated
1	Circuit Breaker Cubicle (Power Incoming)	Vacuum circuit breaker, converter for instruments, transformer for instruments, overcurrent relay, ground relay, earthing switch, watt meter, watt-hour meter, var-hour meter, voltmeter, ammeter, multi transducer
2	Circuit Breaker Cubicle (Transformer)	Vacuum circuit breaker, converter for instruments, overcurrent relay, ground relay, earthing switch, watt-hour meter, var-hour meter, voltmeter, ammeter, multi transducer
3	Circuit Breaker Cubicle (Power Distribution)	Vacuum circuit breaker, converter for instruments, reclosing relay, overcurrent relay, ground relay, earthing switch, watt meter, watt-hour meter, var-hour meter, ammeter, multi transducer
4	Transformer Cubicle for Metering	Transformer for instruments, overcurrent relay, voltmeter,
5	Circuit Breaker Cubicle (Power Distribution)	Vacuum circuit breaker, converter for instruments, reclosing relay, overcurrent relay, ground relay, earthing switch, watt meter, watt-hour meter, var-hour meter, ammeter, multi transducer
6	Station Transformer, DC Power Supply Cubicle	Station transformer 50 kVA, DC power supply panel

2) Overview of Station Facilities

Specifications for 33kV switchgears to be constructed and cables for connecting switchgear cubicles under the Project are outlined as follows.

Table 2.2-11 Specifications of 33 kV Switchgears and Connection Cables for Existing Distribution Lines

Section	Cable Specifications	Remark
33kV Cable Rising Pole to 33kV Switchgear	19/33 kV, copper conductor, XLPE insulation, PVC sheath, 185mm^2 (single core) with armor	To satisfy 15 MVA of line capacity
33kV Switchgear to Transformer	Same as above	Same as above
33kV Switchgear (Feeder Cubicle) to 33kV Cable Rising Pole	Same as above	Same as above

(Note) XLPE: Cross-linked Polyethylene, PVC: Polyvinyl Chloride

(3) 33kV Distribution Line Plan

In the procurement and installation of materials and equipment for 33kV distribution lines to be implemented by the Japanese side under the Project, the facilities will be designed based on the following basic issues and equipment and materials outline.

1) Basic Issues

The facilities will be designed in accordance with Ugandan standards. Specifications of equipment and materials to be procured by the Japanese side will be compatible with existing equipment owned or utilized by the Ugandan side as much as possible in order to ensure unified management of equipment.

2) Overview of 33kV Distribution Line Plan

① Route Selection

The routes for distribution line by district were decided based on the results of examining a distribution line route map prepared in advance and geographical map through actual site reconnaissance with engineers from Ugandan side and confirmation of obstacles and objects along the routes and particular local conditions. The basic routes are shown in the Basic Design Drawings R-01, R-02, R-03 and R-04.

② Selection of Pole Span

In due consideration of conductor size, tensile load and strength of electric pole, pole spans in accordance with REA standards will be adopted.

- Standard span of general 33kV distribution pole: 80 to100m
- Long-distance span of 33kV distribution pole: 200 to 300m
- Standard interval arrangement of section pole: every 8 span

③ Type of Conductors for Overhead Distribution Lines

REA standards for All Aluminum Alloy Conductor (AAAC) will be adopted for the specifications of conductors for 33kV overhead distribution lines and the size will be as follows.

- 33kV distribution line: AAAC 100mm^2 (The size of existing distribution lines will be taken into account.)

The procured quantity of conductors for overhead distribution lines will be calculated by multiplying the plane distance (design quantity) to be measured in the drawing by 10% of the construction margin, in addition to the 3% dip, for the trunk lines and lateral lines to the location of pole transformers. The planned quantity of 33kV distribution lines to be installed by Japanese side will be calculated by multiplying the design quantity by 1.03 of the margin. Consequently, the quantity of conductors for overhead distribution lines to be procured and installed under the Project is shown in Table 2.2-12.

④ Type and Shape of Electric Poles

Wooden poles, which are the standard material used by Ugandan side, will be utilized for electric poles. The length of the electric poles will be 12m for 33kV standard voltage class. However, 15m wooden poles will be applied for long distance spans.

The Ugandan standard of 16mm/kV will be adopted for the surface creepage distance of pin insulators and suspension insulators to be utilized in 33kV distribution lines. In addition, hot-dip galvanized mild steel will be applied to cross arms.

The type, application and quantity of electric poles are shown in Table 2.2-13. The quantity of electric poles is calculated by multiplying the planned quantity to be measured in the drawings by the construction margin (5%).

Table 2.2-12 Quantity of 33kV Overhead Distribution Lines

Item		<Project Site A> Nabitende / Itanda Area in Iganga District (Eastern Region)	<Project Site B> Kagadi / Munteme Area in Hoima & Kibale District (Western Region)	<Project Site C> Bugeso / Iwemba Area in Bugiri District (Eastern Region)	<Project Site D> Bukakata Area in Masaka District (Central Region)	Total
33 kV Distribution Line	Type of Electric Wire	AAAC 100mm^2	AAAC 100mm^2	AAAC 100mm^2	AAAC 100mm^2	
	① Length	29 km	65 km	21 km	53 km	168 km
	② Design Quantity (3 phase, ①×3)	87 km	195 km	63 km	159 km	504 km
	③ Planned Quantity (②×1.10×1.03)	98.57 km	220.94 km	71.38 km	180.15 km	571.04 km
	④ Installed Quantity (②×1.03)	89.61 km	200.85 km	64.89 km	163.77 km	519.12 km

Remarks: The standard 2km drum will be applied.

Table 2.2-13 Quantity of Electric Poles by Type for 33kV Distribution Lines

Pole Type	Usage	Material	Length (m)	No. of Poles per set (piece)	Rate by pole usage	<Project Site A> Nabitende / Itanda Area in Iganga District (Eastern Region)			<Project Site B> Kagadi / Munteme Area in Hoima & Kibale District (Western Region)			<Project Site C> Bugeso / Iwemba Area in Bugiri District (Eastern Region)			<Project Site D> Bukakata Area in Masaka District (Central Region)			Total Set ( ) indicates the number of electric poles.
						⑧ Design Quantity	⑨ Refilling Quantity (⑧x0.05)	Subtotal (set) ⑧+⑨	⑧ Design Quantity	⑨ Refilling Quantity (⑧x0.05)	Subtotal (set) ⑧+⑨	⑧ Design Quantity	⑨ Refilling Quantity (⑧x0.05)	Subtotal (set) ⑧+⑨	⑧ Design Quantity	⑨ Refilling Quantity (⑧x0.05)	Subtotal (set) ⑧+⑨	
A	Intermediate Pole (0 to 5 deg.)	Wooden Pole	12	1	Actual Quantity	206	11	217	466	24	490	146	8	154	394	20	414	1275 (1275)
B	Light Angle Pole (5 to 15 deg.)	Wooden Pole	12	1	Actual Quantity	34	2	36	104	6	110	36	2	38	71	4	75	259 (259)
C	Light Angle Pole (15 to 60 deg.)	Wooden Pole	12	2	Actual Quantity	7	1	8	14	1	15	2	1	3	9	1	10	36 (72)
D	Light Angle Pole (60 to 90 deg.)	Wooden Pole	12	2	Actual Quantity	2	1	3	1	1	2	2	1	3	5	1	6	14 (28)
E	Section Pole (Horizontal)	Wooden Pole	12	2	Actual Quantity	20	1	21	43	3	46	11	1	12	13	1	14	93 (186)
F	Section Pole (Vertical)	Wooden Pole	12	2	Actual Quantity	-	-	-	-	-	-	-	-	-	21	2	23	23 (23)
G	Terminal Pole	Wooden Pole	12	2	Actual Quantity	4	1	5	-	-	-	3	1	4	3	1	4	13 (26)
H	Load Break Switch Pole	Wooden Pole	12	2	Actual Quantity	4	1	5	6	1	7	4	1	5	6	1	7	24 (48)
J	T-off Pole	Wooden Pole	11, 12	2	Actual Quantity	24	2	26	15	1	16	14	1	15	12	1	13	70 (140)
K	Transformer Pole	Wooden Pole	12	2	Actual Quantity	20	1	21	15	1	16	11	1	12	11	1	12	61 (122)
L	3-member pole	Wooden Pole	15	3	Actual Quantity	-	-	-	4	1	5	-	-	-	-	-	-	5 (15)
M	Metering Unit Pole	Wooden Pole	12	2	Actual Quantity	1	1	2	1	1	2	-	-	-	1	1	2	6 (12)
N1	Connection Pole (Extension Type)	-	-	-	Actual Quantity	-	-	-	2	1	3	-	-	-	-	-	-	3 (0)
N2	Connection Pole (Cross Type)	Wooden Pole	12	2	Actual Quantity	-	-	-	-	-	-	-	-	-	1	1	2	2 (4)

Note: For equipment (such as transformers and lighting arresters) the actual number is indicated.

⑤ 33 kV/415-240 V Distribution Transformer

(a) Selection of Capacity and Quantity

Distribution transformers will be installed in order to degrade the voltage from 33kV distribution lines to low distribution voltage (415/240V) for each consumer at the project sites. In order that peak power demand for the target year will be met, the capacity of distribution transformers will be selected among the REA standard transformer capacity and the optimal number of units will be decided based on the particular condition at the project sites. In addition, good quality power should be provided by installing distribution transformers as close as possible to load centers in areas with high load density, especially for public facilities such as hospitals where large power demand is expected.

In order to ensure that the voltage fluctuation of distribution transformers procured under the Project remains within a range of ±7.5%, distribution transformers will have ±2.5%, ±5% tap (no-load tap changer on the high-voltage side). In order to ensure efficiency and economy of distribution lines, the low-voltage side will adopt a three-phase, four-wire system.

The capacity and quantity of distribution transformers at the project sites are shown in Table 2.2-14. Accordingly, the total number of units of distribution transformers to be procured under the Project will be 57.

(b) Installation Method

All distribution transformers will be installed using a pole-mounted configuration. The REA standard pole dressing drawings will be utilized.

Table 2.2-14 Capacity and Number of Units of Distribution Transformers

Site Name	Villages to be Electrified (Parish/Trading Center)	Number of Distribution Transformers		
		50 kVA	100 kVA	200 kVA
<Project Site A> Nabitende / Itanda Area in Iganga District (Eastern Region)	Namungalwe		2	1
	Nabitende		3	
	Naluko		2	
	Ituba		3	
	Bugono		2	
	Itanda		3	
	Kiwanyi		2	
	Nawangaiza		2	
	Subtotal	0	19	1
<Project Site B> Kagadi / Munteme Area in Hoima & Kibale District (Western Region)	Kigo	1		
	Kabwoya			1
	Kitooke	1		
	Kicanga	1		
	Karama	1		
	Pachwa 2			1
	Pachwa 1			1
	Mabaale			2
	Kitemuzi		1	
	Kaitemba		1	
	Mugalike			1
	Kyenzige		1	1
	Kiryane	1		
	Subtotal	5	3	7
<Project Site C> Bugeso / Iwemba Area in Bugiri District (Eastern Region)	Bugeso		1	1
	Iwemba		3	
	Buyala		2	
	Nabirere		2	
	Nambo		2	
	Subtotal	0	10	1
<Project Site D> Bukakata Area in Masaka District (Central Region)	Kayugi/Serinya	1		
	Nabugabo Camp	1		
	Ssunga		1	1
	Kigo	1		
	Bunadd	1		
	Katiko	1		
	Lambu Landing site		1	1
	Bukakata			1
	Kachnga			1
	Subtotal	5	2	4
Total		**10**	**34**	**13**

⑥ Installation of Load Break Switches

For maintenance and inspection of the 33kV distribution lines at project sites, load break switches to break the load current will be installed at an appropriate distance for long-distance lines, connecting points and junctions of the existing 33kV distribution lines at 8-mile intervals (approx. 13km) in accordance with REA regulations.

⑦ Installation of Fused Cutout Switches

Fused cutout switches will be installed on the high-voltage side of distribution transformers (33kV side) to be procured at the project sites, for the purpose of protecting the transformers from overload and short circuit faults, and for opening circuits for line maintenance.

⑧ Installation of Lightning Arresters

Lightning arresters will be installed on the 33kV side in order to protect distribution transformers and load break switches from lightning strikes.

(4) Schematic Specifications of Equipment and Materials

Components of equipment and materials to be utilized in the above-mentioned (2) to (3) are shown in Table 2.2-15 and Table 2.2-16.

Table 2.2-15 Components of Construction Plan of Switchgears at Iganga Substation

No.	Item / Equipment	Specifications	Quantity
1-1	Station Facility Construction 1) Foundation for Equipment 2) Ground Net	 Bare copper wire	1 set
1-2	33kV Switchgear Cubicle 1) Switchgear Cubicle (1) Type (2) Protection Code 2) Circuit Breaker (1) Type (2) Rating 3) Converter for Metering Instruments (1) Type (2) Rating 4) Transformer for Metering Instruments (1) Type (2) Rating 5) Earthing Switch (1) Type 6) Station Transformer (1) Type (2) Rating 7) DC Power Supply System (1) Battery Cell (2) Battery Charger 8) Measuring Instruments & Control Switch 9) Protection Relay	(Refer to DWG No. E-05) Outdoor, metal enclosed type with space heater IP43 or higher Vacuum type, draw-out 3 phase,36 kV, 630 A, 25 kA(sym 1sec) Indoor, resin-molded type 400-200/5 A Indoor, resin-molded type 3-poles, 33 kV/$\sqrt{3}$／110 V/$\sqrt{3}$ Manual operation Indoor, oil-immersed 3 phase, 50 Hz, 33 kV/415-240 V 50 kVA Nickel cadmium alkaline, 60 AH,DC110 V Full-wave rectification, 60 AH, DC110 V Ammeter, voltmeter, voltage detector, control switch, position indicator, watt meter, var-hour meter, watt-hour meter Multi transducer, on-off indicator - Over current relay - Over current ground relay - Over voltage relay - Auto re-closing relay	6 panels
1-3	33 kV Power Cables & Accessories 1) 33 kV Cable (1) Applicable Standard (2) Type (3) Size 2) Cable Treatment Material (1) Type	 IEC or equivalent 19/33 kV XLPE insulation, copper conductor, PVC sheath, single core, cable with armer 185 mm^2 - Outdoor, heat contraction type - Indoor , heat contraction type	50 m (for 3 phases) 3 sets 3 sets
1-4	Low Voltage Power Cable & Control Cable 1) Low Voltage Power Cable (1) Applicable Standard (2) Type 2) Control Cable (1) Standard (2) Type	 IEC or equivalent 600 V/1000 V XLPE insulation, PVC sheath, copper conductor IEC or equivalent 600 V PVC insulation, copper conductor, copper tape shield	 1 set 1 set
1-5	Earthing Material 1) Earthing Wire 2) Earthing Rod	 60 mm^2 bare copperstranded conductor or equivalent Copper coated steel rod with lead terminal, D14 mm x L1,500 mm or equivalent	 1 set 1 set

Table 2.2-16 Components of 33kV Distribution Lines Construction Plan

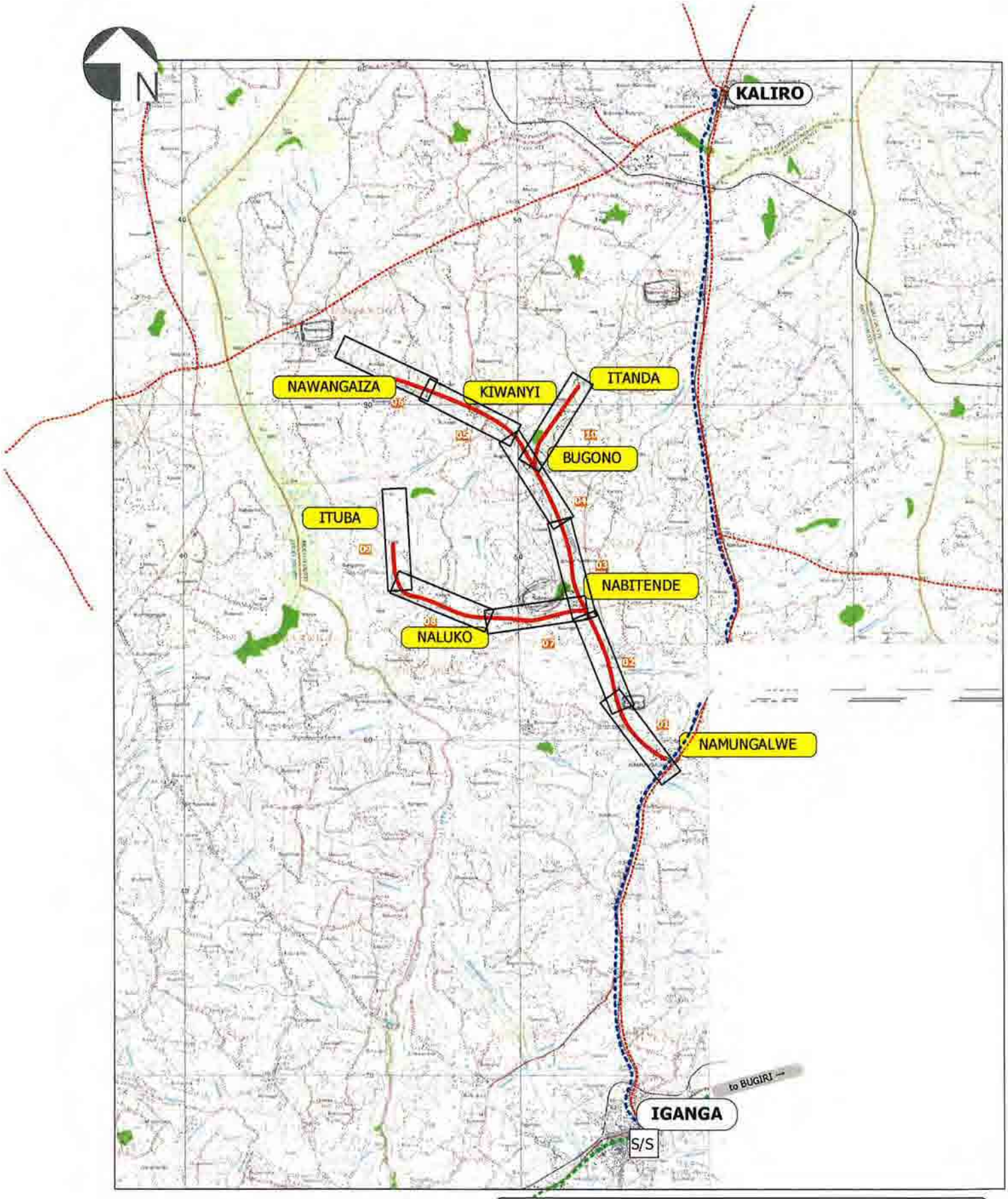
No.	Item / Equipment	Specifications	Quantity
2-1	33 kV Overhead Electric Pole		Refer to the Text (Table 2.2-13)
	1) Material	Wooden pole	
	2) Length	11, 12 & 15 m	
	3) Type		
	(1) Intermediate Pole	Line angle : 0 to 5 deg.	
	(2) Light Angle Pole	〃 : 5 to15 deg.	
	(3) Mid Angle Pole	〃 : 15 to 60 deg.	
	(4) Heavy Angle Pole	〃 : 60 to 90 deg. H type	
	(5) Section Pole (Horizontal)	Installation: every 8 span, H type	
	(6) Section Pole (Vertical)	Installation: every 8 span	
	(7) Terminal Pole	H type	
	(8) Load Breaker Switch Pole	H type	
	(9) T-off pole	H type	
	(10) Transformer Pole	H type	
	(11) 3-member Pole		
	(12) Metering Unit Pole	H type	
	(13) Connection Pole to existing line (extension type)		
	(14) Connection Pole to existing line (cross type)		
	4) Accessories	Pole cap, nail	
2-2	33kV Overhead Distribution Line		Refer to the Text (Table 2.2-12)
	1) Applicable Standard	IEC or equivalent	
	2) Type	All Aluminum Alloy Conductor (AAAC)	
	3) Nominal Section Size	100 mm^2	
2-3	Insulator		
	1) Pin Insulator		
	(1) Applicable Standard	IEC or equivalent	1 set
	(2) Type	Porcelain glazed, color: brown	
	(3) Nominal Voltage	33 kV	
	(4) Basic Impulse Insulation Level	170 kV	
	2) Suspension Insulator		
	(1) Applicable Standard	IEC or equivalent	1 set
	(2) Type	Porcelain glazed, color: brown, disc type	
	(3) Nominal Voltage	33 kV	
	(4) Minimum Creepage Distance	16 mm / kV	
	(5) Basic Impulse Insulation Level	105 kV	
2-4	Pole Assembly Material		
	1) Cross Arm		
	(1) Material	Mild steel	1 set
	(2) Finish	Hot-dipped galvanized	
	(3) Section Shape	L, C shape	
	2) Anchor Shackle		
	(1) Type	Bolt clamping type	1 set
	(2) Material	Steel	
	3) Ball Clevis & socket eye		
	(1) Material	Ductile iron or steel	1 set
	(2) Finish	Hot-dipped galvanized	
	4) Suspension Clamp		
	(1) Material	Main body: Nodular graphite cast iron	
		Holder: Aluminum alloy casting	1 set
	5) Branch Line		
	(1) Material	Zinc-coated steel wire	
	(2) Size	45 mm^2 (2.90 mm x 7) or equivalent	
	6) Stay Insulator		1 set
	(1) Line Voltage	33 kV	
	(2) Material	Porcelain glazed, color: brown	
	7) Stay Anchor		1 set
	(1) Material	Steel plates	

No.	Item / Equipment	Specifications	Quantity
	(2) Tensile Load	6 tons	
	8) Turnbuckle		1 set
	(1) Material	Mild steel	
	(2) Finish	Hot-dipped galvanized	
	9) Anti-Climbing	PVC	1 set
	10) Nail	Low carbon steel	1 set
	11) Staple	Low carbon steel	1 set
	12) Display Board	ODA mark, pole number, danger plate	1 set
	13) Barbed Wire for Anti Climbing		1 set
2-5	Load Breaker Switch		21 units
	1) Applicable Standard	IEC or equivalent	
	2) Type	3 phase, 630A, outdoor type, manual operation	
	3) Nominal Voltage	33 kV	
	4) Rated Voltage	36 kV	
	5) Short-time Current	16 kA or more	
2-6	Lightning Arrester		231 units
	1) Applicable Standard	IEC or equivalent	(1 unit/phase)
	2) Type	Outdoor type, gapless type	
	3) Nominal Voltage	33 kV	
	4) Rated Voltage	36 kV	
	5) Discharge Current	5kA (for distribution transformer)	
2-7	Fused Cutout Switch		171 units
	1) Applicable Standard	IEC or equivalent	(1 unit/phase)
	2) Type	Outdoor type, 6.3 to 25 A (depending on transformer capacity)	
	3) Nominal Voltage	33 kV	
	4) Rated Voltage	36 kV	
2-8	Distribution Transformer		10 units
	1) Applicable Standard	IEC	(50 kVA)
	2) Type	Oil immersed, outdoor type	34 units
	3) Phase	- 3-phase 3-wire (on primary high-voltage side)	(100 kVA)
		- 3-phase 4-wire (on secondary low-voltage side)	13 units
	4) Frequency	50 Hz	(200 kVA)
	5) Capacity	- 50 kVA	
		- 100 kVA	
		- 200 kVA	
	6) Rated Voltage (at on-use load)	33 kV/415 to 240 V	
2-9	Watt-hour Meter		3 units
	1) VT/CT	33 kV, outdoor type, oil filled, pole mounted type	
	2) Watt-hour Meter	3-phase 3-wire, 50Hz, real power, reactive power, interactive (two-way) measuring type	
2-10	Earthing Materials for Transformer and Equipment		1 set
	1) Earthing Wire	38 mm^2 (transformer), 14 mm^2 (equipment)	
		Bare copperstranded conductor or equivalent	1 set
	2) Earthing Wire	Copper coated steel rod with lead terminal, D14 mm x L1,500 mm or equivalent	
2-11	Connector for Overhead Conductor		1 set
	1) Type	Bolt clamping type	
	2) Material	Aluminum alloy casting	

2-2-3 Basic Design Drawings

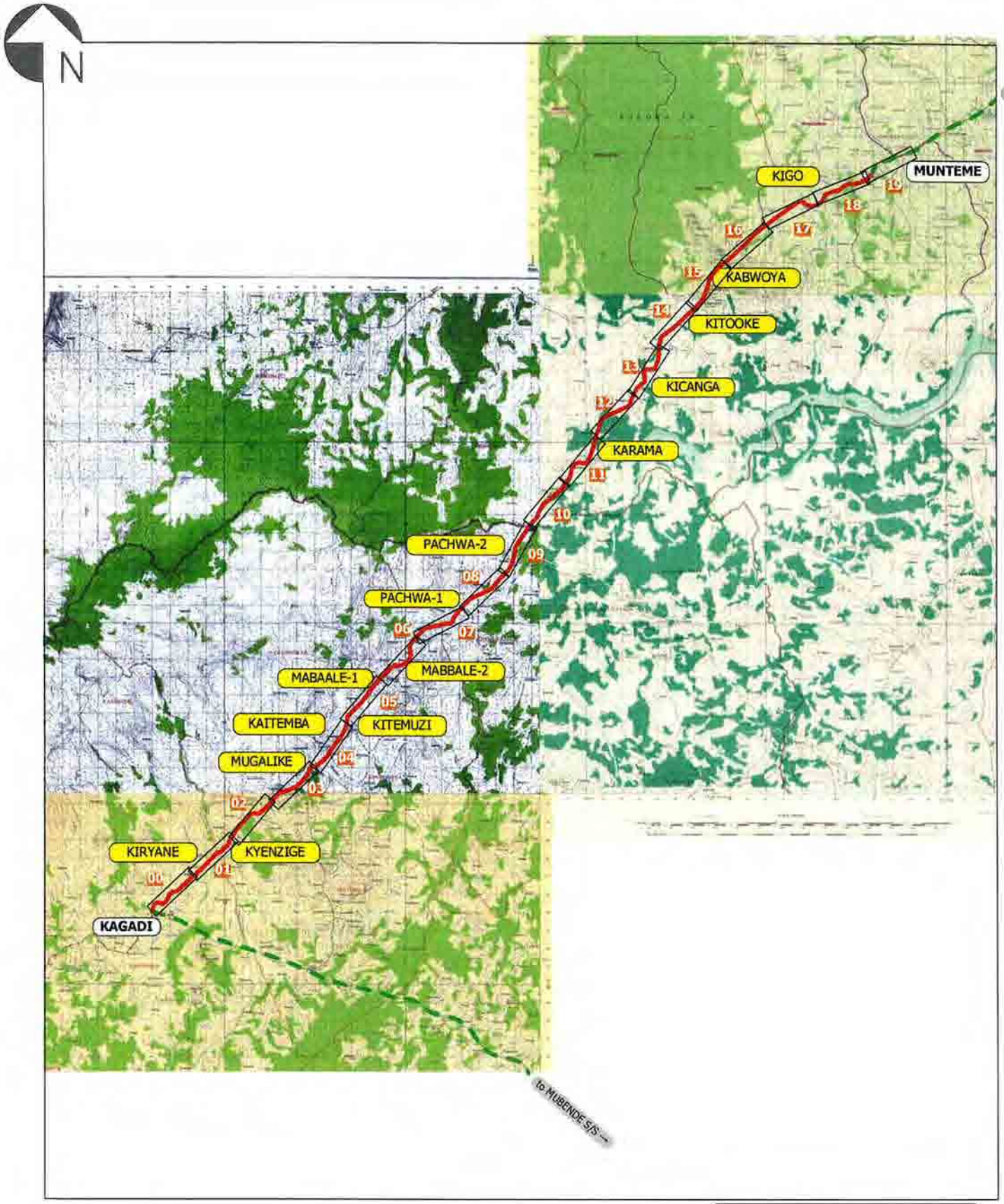
The basic design drawings for the Project are listed as follows.

Classification	DWG No.	Drawing Title
General Route Plan of 33kV Distribution Line	R-01	Route Map of 33kV Distribution Lines (Eastern Region) (Nabitende / Itanda Area in Iganga District)
	R-02	Route Map of 33kV Distribution Lines (Western Region) (Kagadi / Munteme Area in Hoima & Kibale District)
	R-03	Route Map of 33kV Distribution Lines (Eastern Region) (Bugeso / Iwemba Area in Bugiri District)
	R-04	Route Map of 33kV Distribution Lines (Central Region) (Bukakata Area in Masaka District)
33kV Distribution Single Line Diagram	E-01	Single Line Diagram for Project Site A (Nabitende / Itanda Area in Iganga District)
	E-02	Single Line Diagram for Project Site B (Kagadi / Munteme Area in Hoima & Kibale District)
	E-03	Single Line Diagram for Project Site C (Bugeso / Iwemba Area in Bugiri District)
	E-04	Single Line Diagram for Project Site D (Bukakata Area in Masaka District)
	E-05	Single Line Diagram for Iganga Substation
Pole Dressing Drawings for 33kV Distribution Lines	T-01	Intermediate Pole (0 to 5 deg.)
	T-02	Light Angle Pole (5 to 30 deg.)
	T-03	Heavy Angle Pole (30 to 50 deg.)
	T-04	Heavy Angle Pole (50to 90 deg.)
	T-05	Section Pole (Horizontal)
	T-06	Section Pole (Vertical)
	T-07	Terminal Pole
	T-08	Load Break Switch Pole
	T-09	T-off Pole
	T-10	Transformer Pole
	T-11	3-member Pole
	T-12	Bulk Metering Unit Pole
	T-13	Connection Plan to the existing Line (Extension Type)
	T-14	Connection Plan to the existing Line (Cross Type)
Site Layout Plan for Iganga Substation	L-01	Layout Plan of Iganga Substation



PROJECT SITE A
DWG No.R-01 Route Map of 33kV Distribution Lines (Eastern)
(NABITENDE / ITANDA Area in IGANGA District)

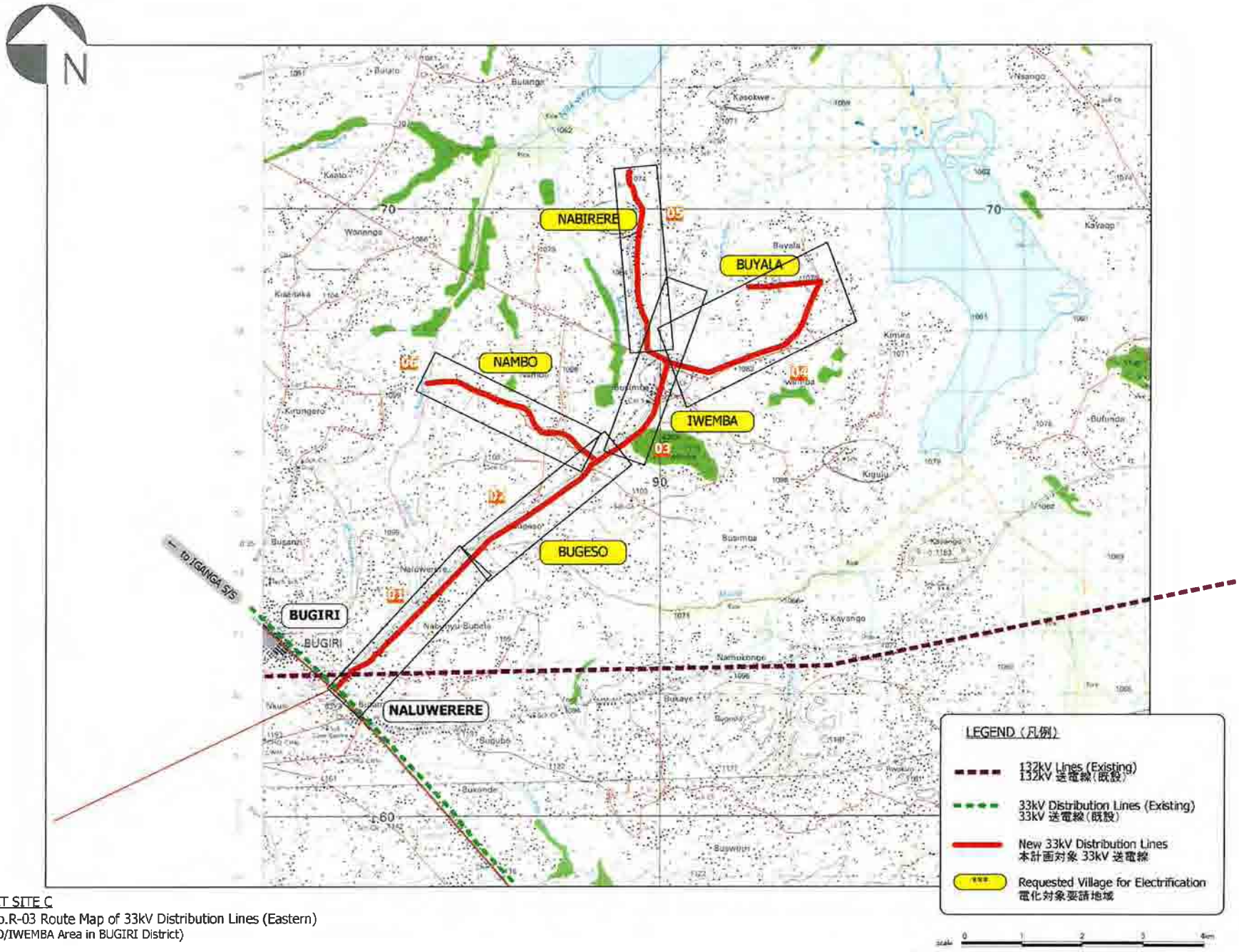
DWG No.R-01 33kV 配電ルート図(東部州)
(イガンガ県 ナビテンデ/イタンダ地区)



PROJECT SITE B

DWG No.R-02 Route Map of 33kV Distribution Lines (Western)
(KAGADI/MUNTEME Area in HOIMA and KIBALE District)

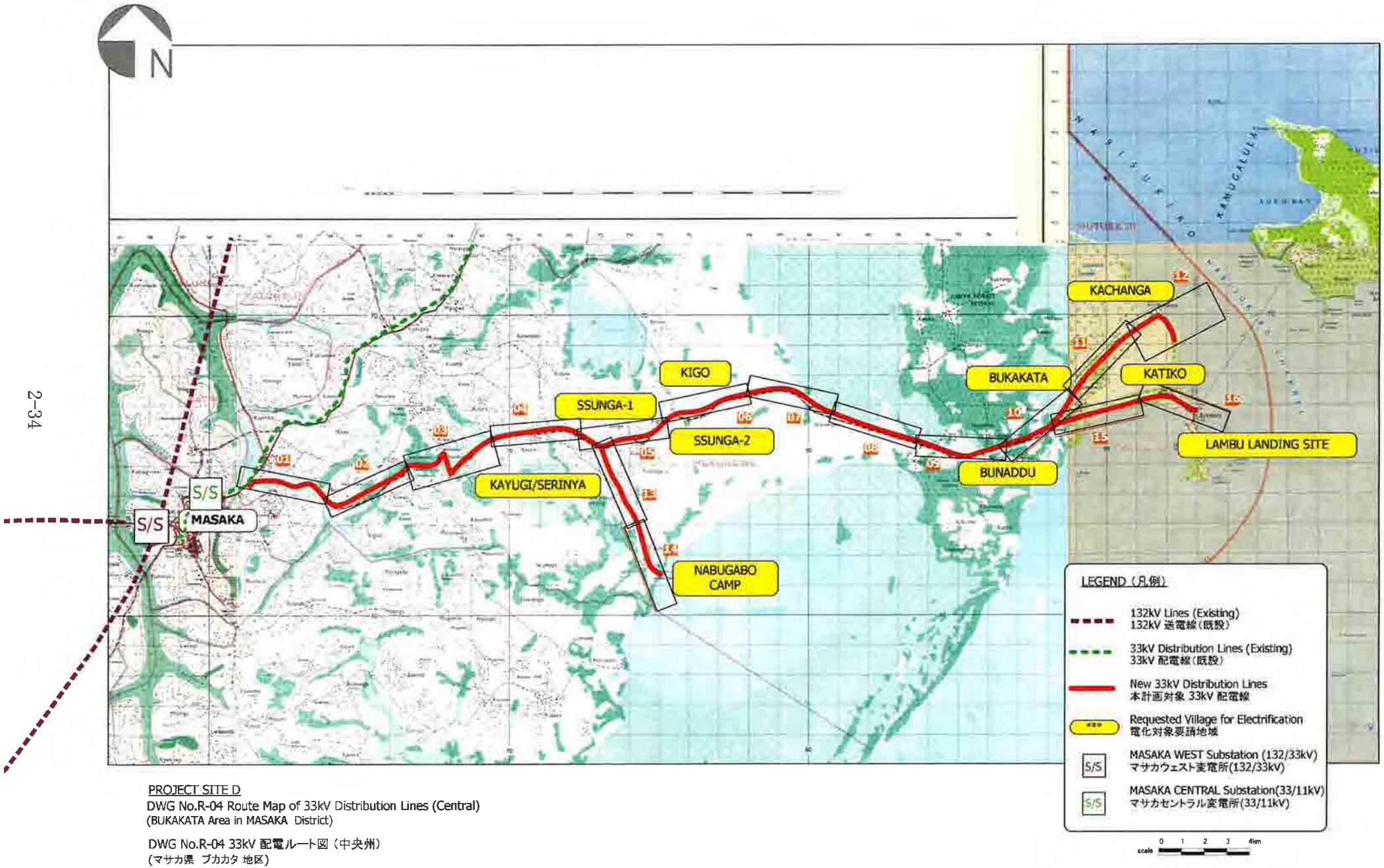
DWG No.R-02 33kV 配電ルート図(西部州)
(ホイマ県・キバレ県 カガディ/ムンテメ地区)



PROJECT SITE C

DWG No.R-03 Route Map of 33kV Distribution Lines (Eastern)
(BUGESO/IWEMBA Area in BUGIRI District)

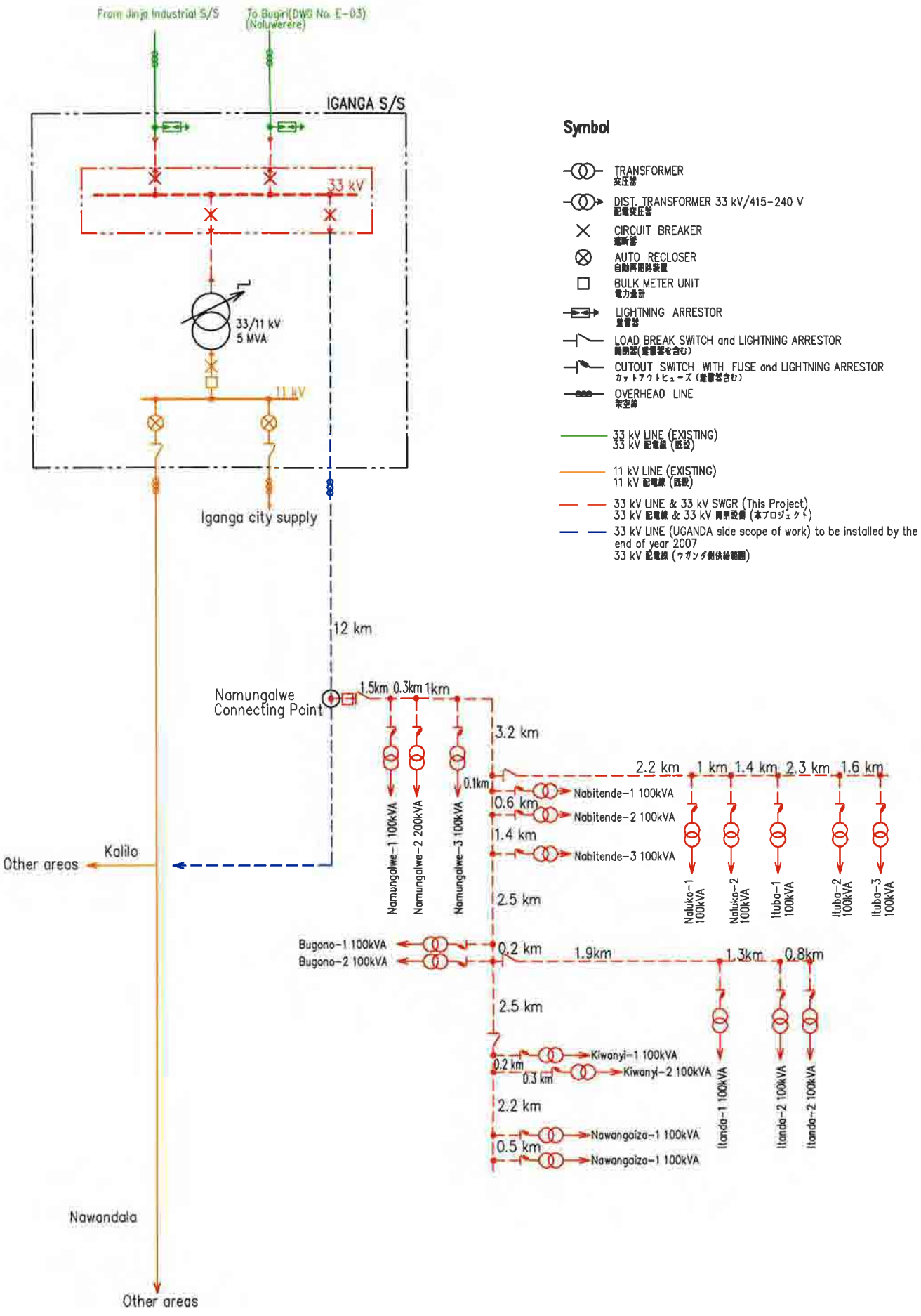
DWG No.R-03 33kV 配電ルート図（東部州）
(ブギリ県 ブセオ/イウェンバ地区)



PROJECT SITE D

DWG No.R-04 Route Map of 33kV Distribution Lines (Central)
(BUKAKATA Area in MASAKA District)

DWG No.R-04 33kV 配電ルート図（中央州）
（マサカ県 ブカカタ 地区）



DWG No. E-01: Single Line Diagram for PROJECT SITE A

(NABITENDE/ITANDA Area in IGANGA District)

DWG No. E-01: 33/11kV 配電系統図 PROJECT SITE A

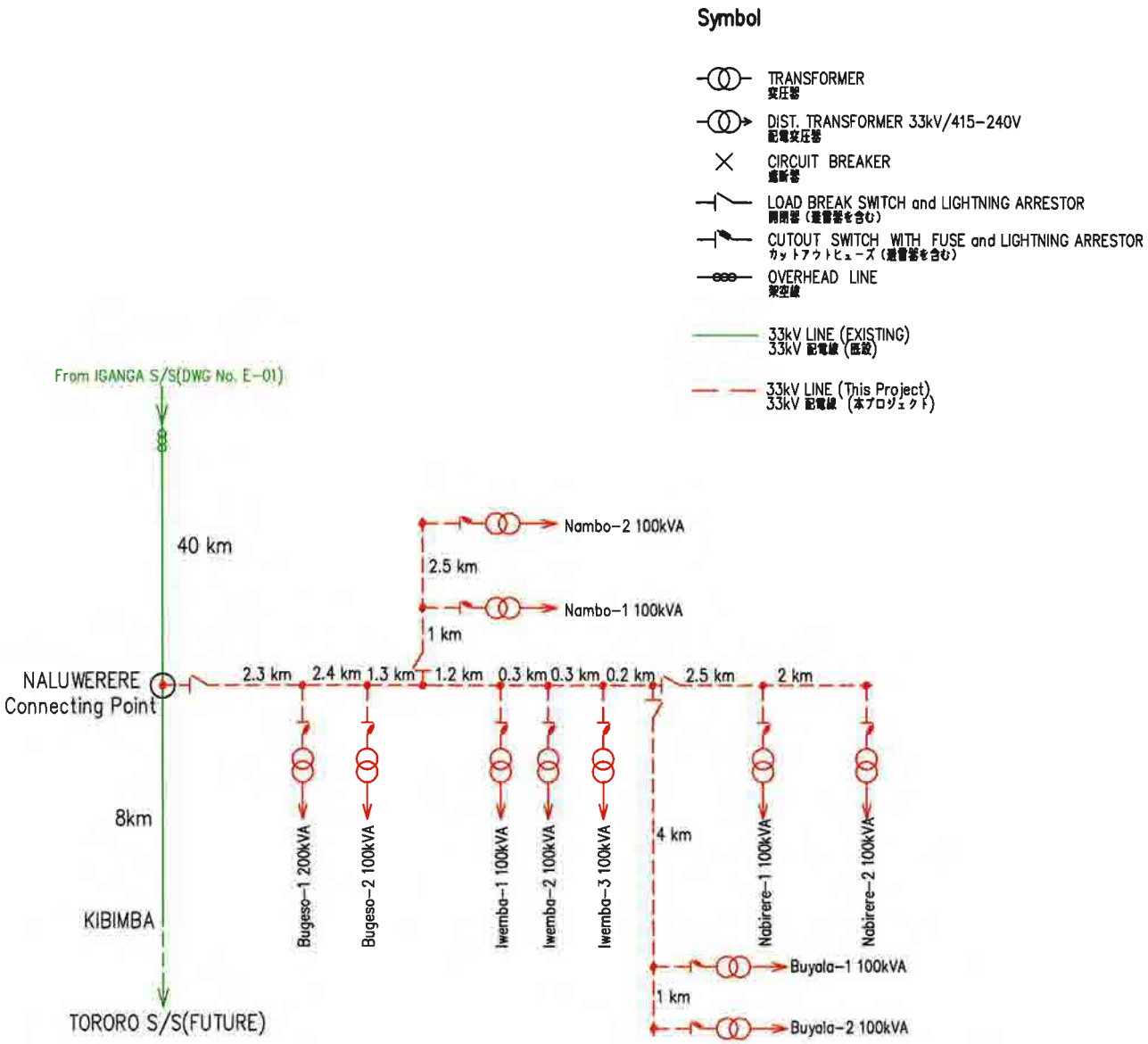
(イガンガ県 ナビテンデ/イタンダ地区)

DWG No. E-02: Single Line Diagram for PROJECT SITE B

(KAGADI/MUNTEME Area in HOIMA and KIBALE District)

DWG No. E-02: 33kV 配電系統図 PROJECT SITE B

(ホイマ県・キバレ県 カガディ/ムンテメ地区)

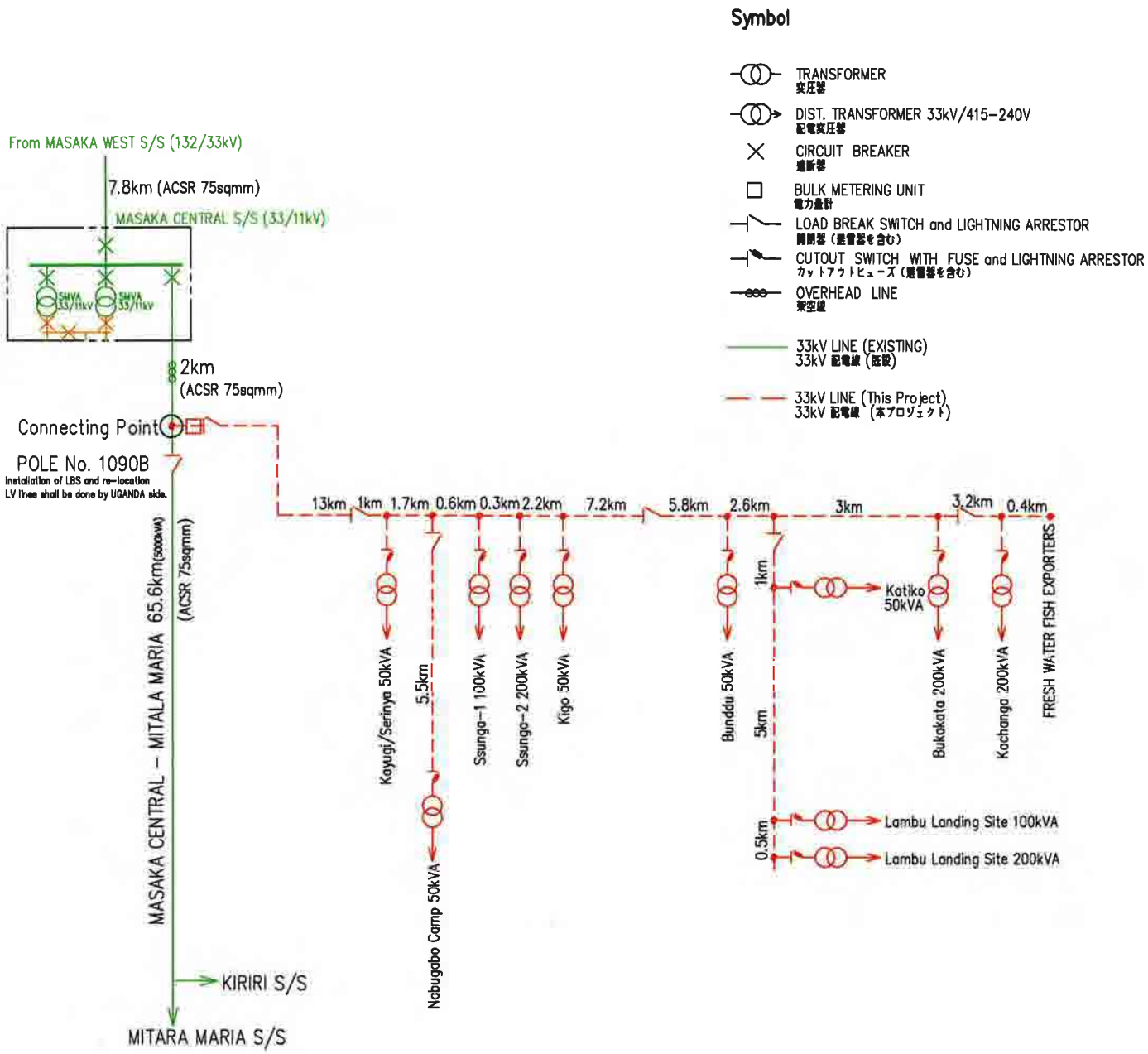


DWG No. E-03: Single Line Diagram for PROJECT SITE C

(BUGESO/IWEMBA Area in BUGIRI District)

DWG No. E-03: 33kV 配電系統図 PROJECT SITE C

（ブギリ県 ブセオ/イウェンバ地区）

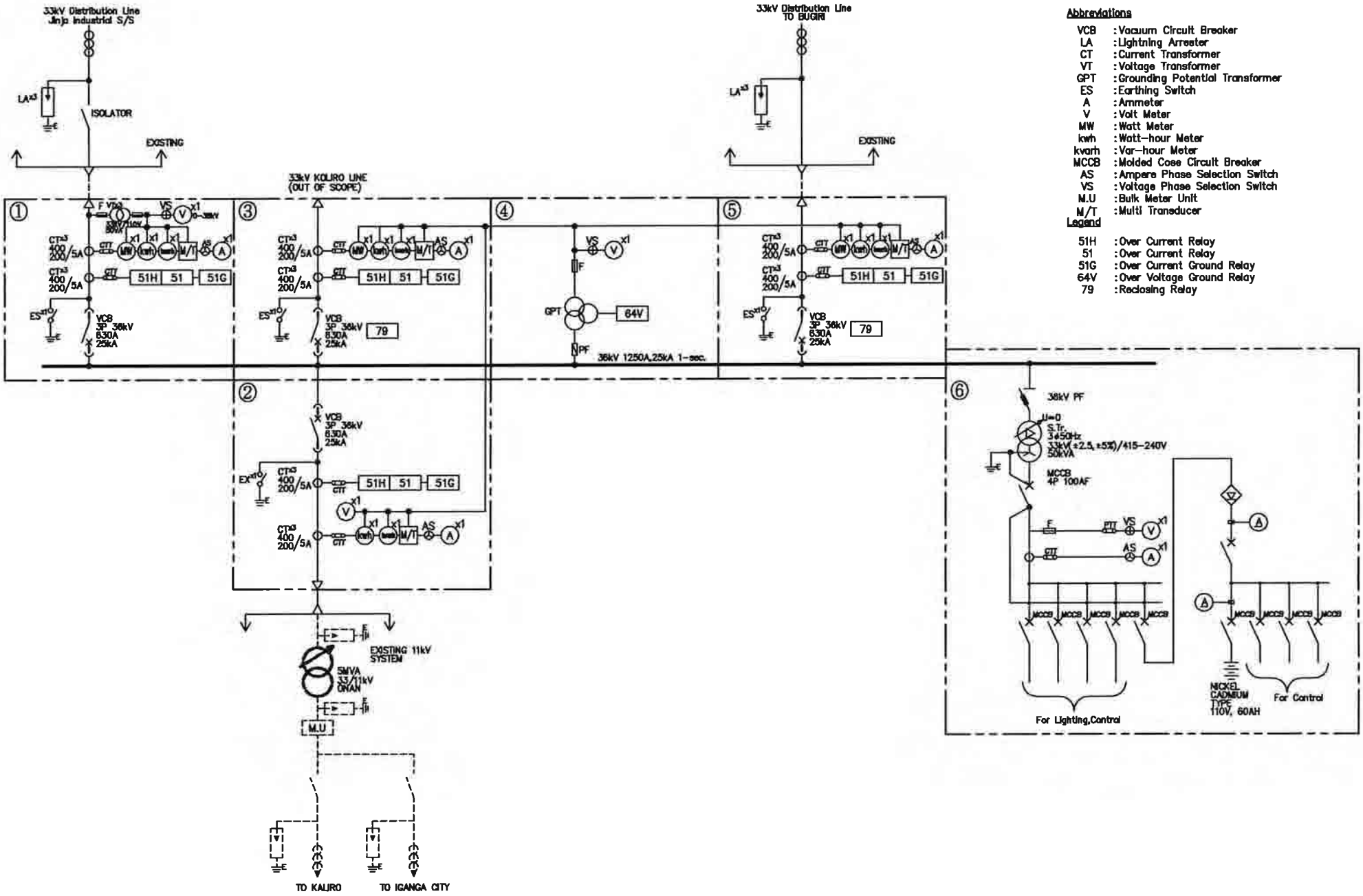


DWG No. E-04: Single Line Diagram for PROJECT SITE D

(BUKAKATA Area in MASAKA District)

DWG No. E-04: 33kV 配電系統図 PROJECT SITE D

（マサカ県　ブカカタ地区）



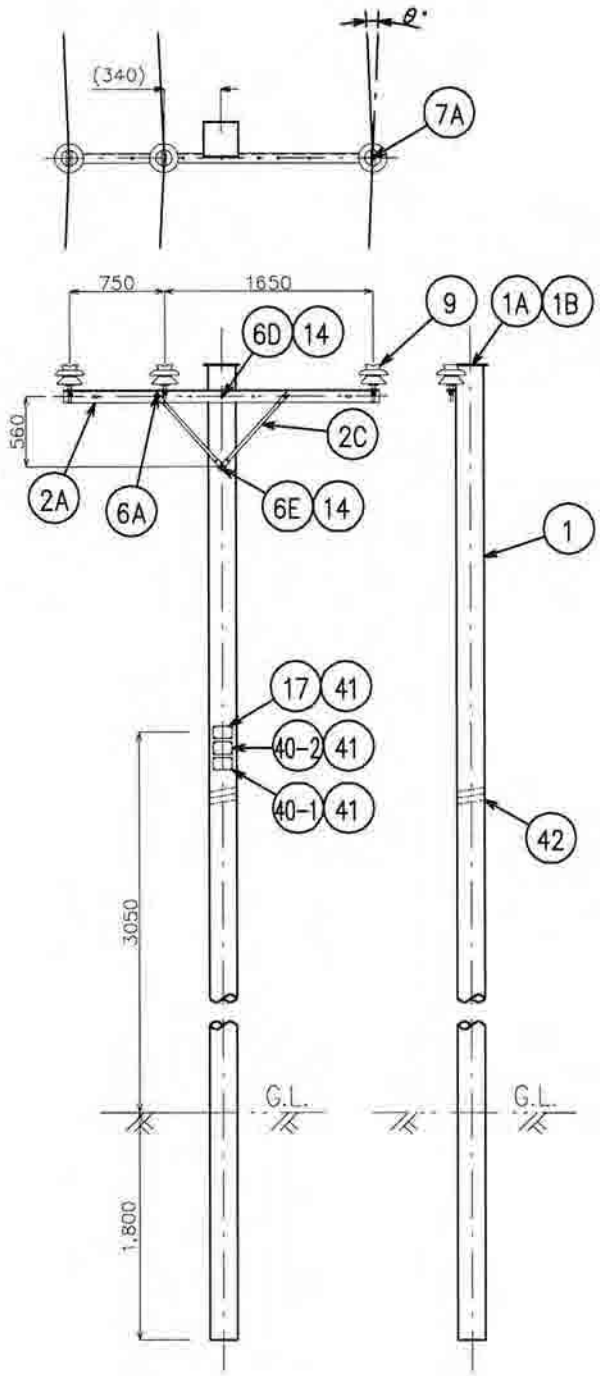
Abbreviations

VCB	:Vacuum Circuit Breaker
LA	:Lightning Arrester
CT	:Current Transformer
VT	:Voltage Transformer
GPT	:Grounding Potential Transformer
ES	:Earthing Switch
A	:Ammeter
V	:Volt Meter
MW	:Watt Meter
kwh	:Watt-hour Meter
kvarh	:Var-hour Meter
MCCB	:Molded Case Circuit Breaker
AS	:Ampere Phase Selection Switch
VS	:Voltage Phase Selection Switch
M.U	:Bulk Meter Unit
M/T	:Multi Transducer

Legend

51H	:Over Current Relay
51	:Over Current Relay
51G	:Over Current Ground Relay
64V	:Over Voltage Ground Relay
79	:Reclosing Relay

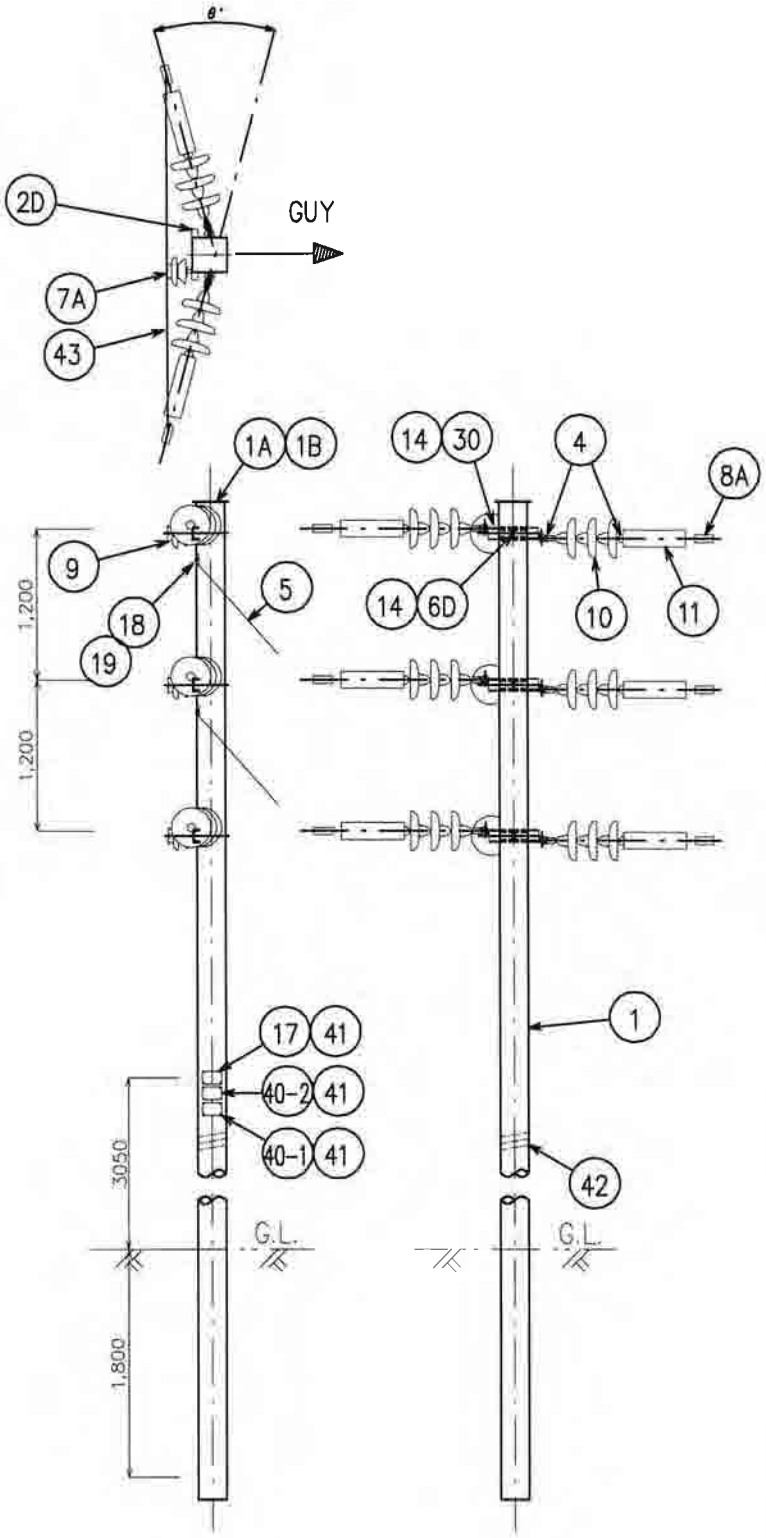
DWG. No.E-05 Single Line Diagram for IGANGA SUBSTATION
DWG. No.E-05 イガンガ変電所単線結線図



STRAIGHT LINE POLE $0 \leq \theta \leq 5$

PART.NO.	DESCRIPTION	Q'TY	摘 要
1	Wooden Pole (12m)	1	木柱 (12m)
1A	Pole Cap	1	電柱防護キャップ
1B	Pole Cap Nails	2	キャップ固定用釘
2A	Crossarm L100X75X7-2500	1	腕金 L100X75X7-2500
2C	Crossarm Brace	2	腕金用ブレス
6A	Bolt & Nut M16x50(Crossarm/Brace)	2	ボルトナット M16x50
6D	Bolt & Nut M16x350(Crossarm/Brace)	1	ボルトナット M16x350
6E	Bolt & Nut M16x400(Pole/Brace)	1	ボルトナット M16x400
7A	Preformed Top Tie	3	頂部タイ
9	33kV Pin Insulator	3	33kV ピン碍子
14	Square Washer	2	角座金
17	Number Plate	1	プレート
40-1	Danger Plate	1	危険表示
40-2	ODA Plate	1	ODAマーク
41	Nail (for Plate)	12	釘 (プレート用)
42	Anti Climbing Barbed Wire(7m)	1	昇開防止鉄条鋼鉄線(7m)

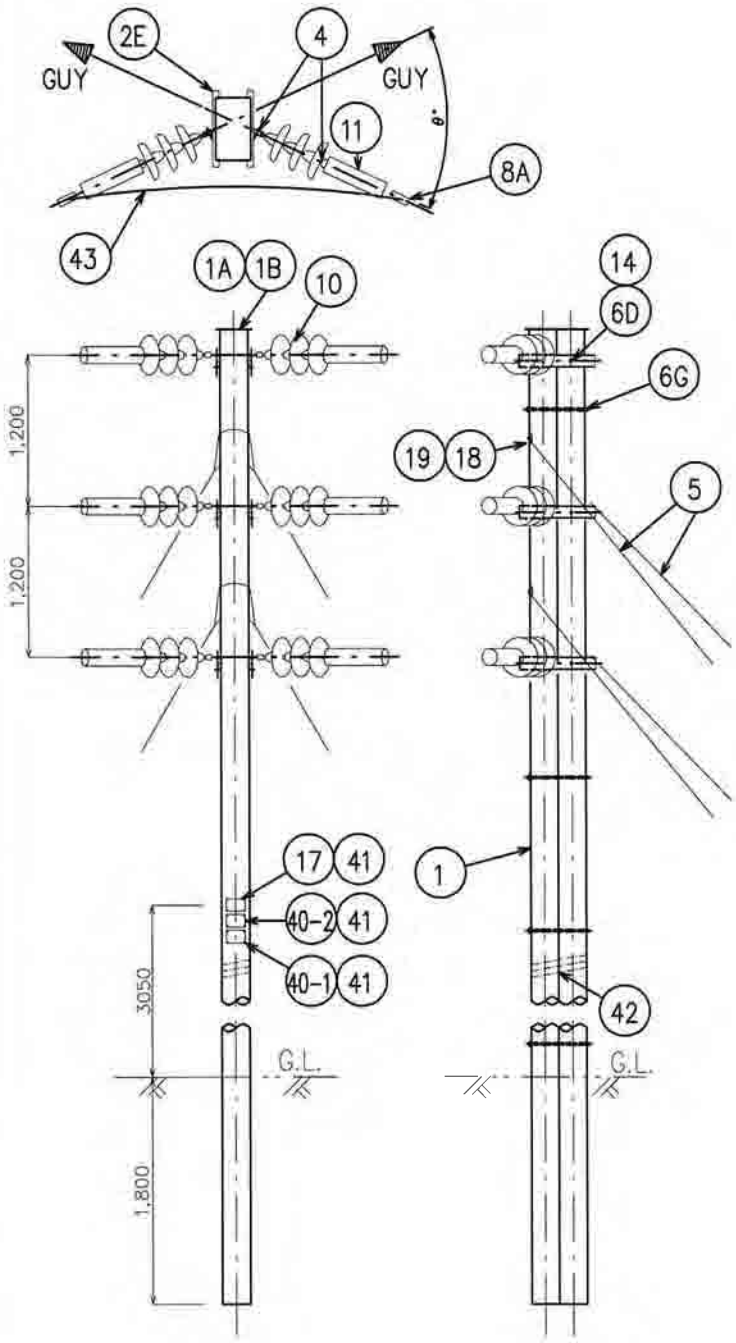
SCALE	1/60
TITLE	TYPE A INTERMEDIATE(Angle 0 to 5 deg) 引通し柱 (0度~5度)
DRG.NO.	T-01



LIGHT ANGLE POLE 5≤θ≤30

PART.NO.	DESCRIPTION	Q'TY	項 目
1	Wooden Pole (12m)	1	木柱 (12m)
1A	Pole Cap	1	電柱防腐キャップ
1B	Pole Cap Nails	2	キャップ固定用釘
2D	Crossarm C100X50X5-300	3	腕金 C100X50X5-300
4	Anchor Shackle	6	アンカーシャックル
4	Ball Clevis	6	ボールクレビス
4	Socket Eye	6	ソケットアイ
5A	Strain Plate	2	耐張プレート
5B	Dead End Grip for Pole	2	巻付グリップポール用
5C	Dead End Grip for Thimber	2	巻付グリップ
5D	Dead End Grip for Insulator	4	巻付グリップ碍子用
5E	Stay Wire 45sqmm (15m)	2	支線
5F	Stay Insulator 33kV	2	支線碍子
5G	Stay Rod	2	支線ロット
5H-1	Stay Plate	2	支線プレート
5H-2	Stay Anchor	2	支線アンカー
5I	Turnbackle	2	ターンバックル
5J	Ivy Protection	2	ツタ防止
6D	Bolt & Nut M16x350(Crossarm/Pole)	3	ボルトナット M16x350
7A	Preformed Top Tie	3	頂部タイ
8A	Conector (Al 100/Al 100)	6	コネクター
9	33kV Pin Insulator	3	33kV ピン碍子
10	Disc Insulator	18	耐張碍子
11-1	Dead End Clamp	6	引留めクランプ
11-2	Adopter for Dead End Clamp	6	引留めクランプ用ホルダー
14	Square Washer	9	角座金
17	Number Plate	1	プレート
18	Nail	8	引留材(釘)
19	Staple	8	ステップル
30	Eye Bolt (M20x350)	6	アイボルト(M20x350)
40-1	Danger Plate	1	危険表示
40-2	ODA Plate	1	ODAマーク
41	Nail (for Plate)	12	釘(プレート用)
42	Anti Climbing Barbed Wire(7m)	1	昇柱防止用有刺鉄線(7m)
43	Conductor (AAAC 100sqmm)	10m	電線

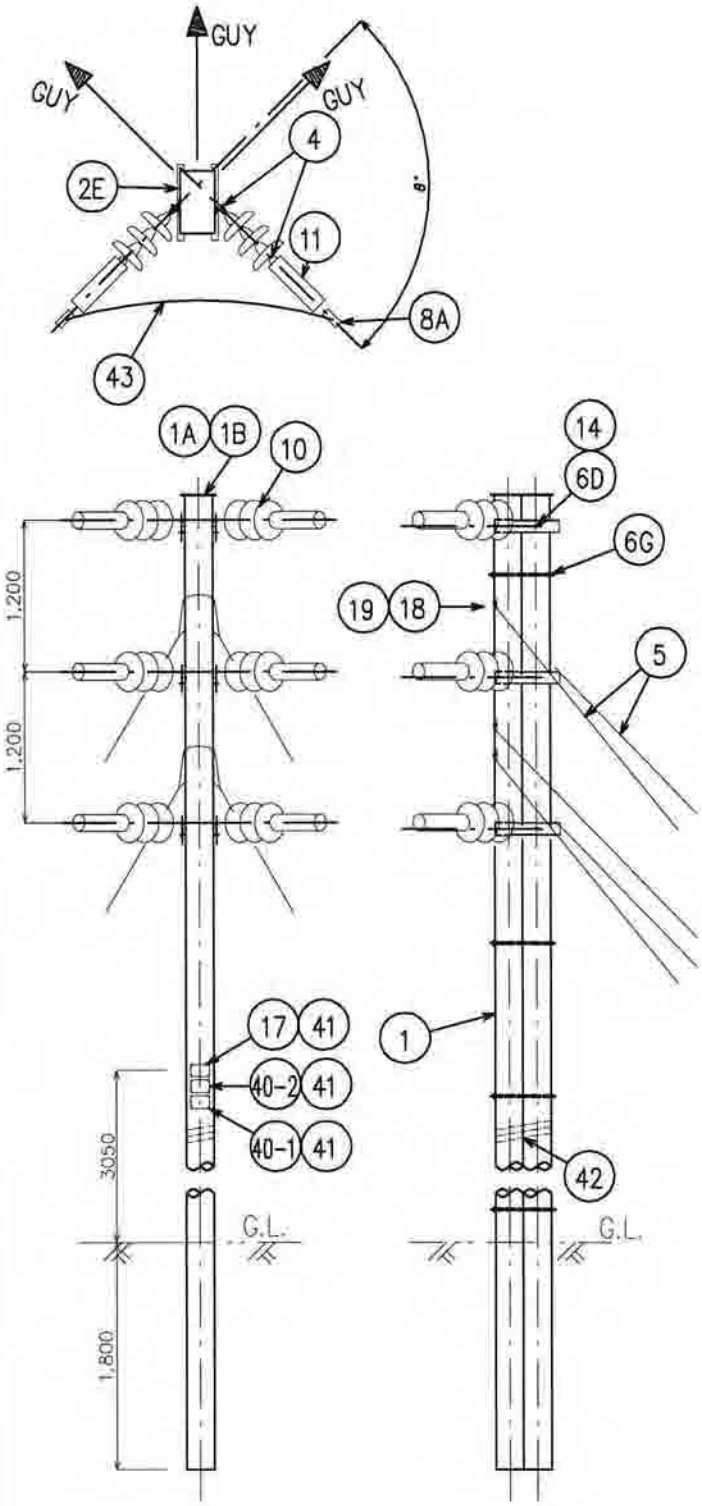
SCALE	1/60	
TITLE TYPE B LIGHT ANGLE POLE(Angle 5 to 30deg) 角度柱 (5度~30度)		DRG.NO. T-02



HEAVY ANGLE POLE 30≦θ≦50

PART.NO.	DESCRIPTION	Q'TY	項 目
1	Wooden Pole (12m)	2	木柱 (12m)
1A	Pole Cap	2	電柱防護キャップ
1B	Pole Cap Nails	4	キャップ固定用釘
2E	Crossarm L100X75X7-600	6	腕金 L100X75X7-600
4	Anchor Shackle	6	アンカーシャックル
4	Ball Clevis	6	ボールクレビス
4	Socket Eye	6	ソケットアイ
5A	Strain Plate	4	耐張プレート
5B	Dead End Grip for Pole	4	巻付グリップポール用
5C	Dead End Grip for Thimber	4	巻付グリップ
5D	Dead End Grip for Insulator	8	巻付グリップ碍子用
5E	Stay Wire 45sqmm (15m)	4	支線
5F	Stay Insulator 33kV	4	支線碍子
5G	Stay Rod	4	支線ロッド
5H-1	Stay Plate	4	支線プレート
5F-2	Stay Anchor	4	支線アンカー
5I	Turnbackle	4	ターンバックル
5J	Ivy Protection	4	ツタ防止
6D	Bolt & Nut M16x350(Crossarm/Pole)	6	ボルトナット M16x350
6G	Bolt & Nut M20x800 with square washer	4	ボルトナット M20x800 角座金
8A	Conector (Al 100/Al 100)	6	コネクター
10	Disc Insulator	18	耐張碍子
11-1	Dead End Clamp	6	引留めクランプ
11-2	Adapter for Dead End Clamp	6	引留めクランプ用ホルダー
14	Square Washer	12	角座金
17	Number Plate	1	プレート
18	Nail	16	引留材(釘)
19	Staple	16	ステップル
40-1	Danger Plate	1	危険表示
40-2	ODA Plate	1	ODAマーク
41	Nail (for Plate)	12	釘(プレート用)
42	Anti Climbing Barbed Wire(7m)	2	昇降防止用有刺鉄線(7m)
43	Conductor (AAAC 100sqmm)	10m	電線

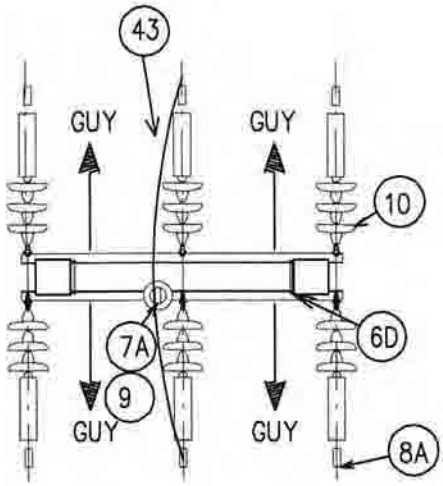
SCALE	1/60
TITLE	TYPE C HEAVY ANGLE POLE(Angle30 to 50deg) 角度柱 (30度~50度)
DRG.NO.	T-03

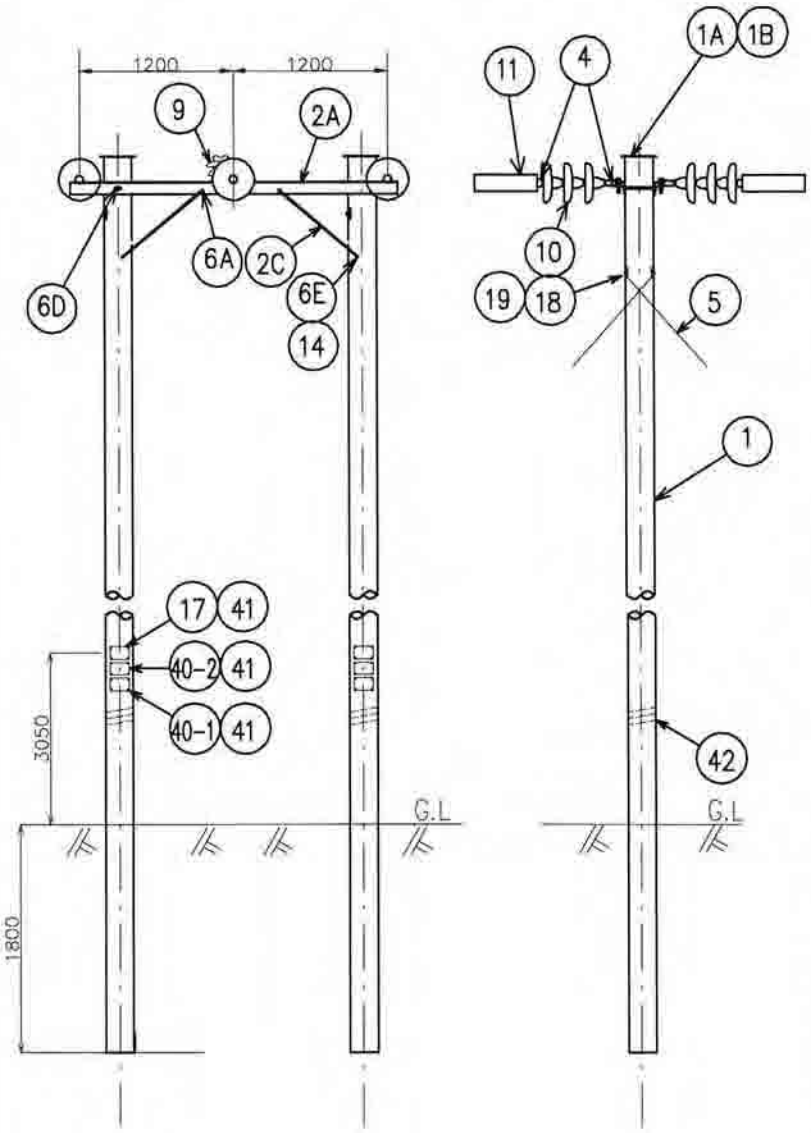


HEAVY ANGLE POLE 50≦θ≦90

PART.NO.	DESCRIPTION	Q'TY	項 目
1	Wooden Pole (12m)	2	木柱 (12m)
1A	Pole Cap	2	電柱防腐キャップ
1B	Pole Cap Nails	4	キャップ固定用釘
2E	Crossarm L100X75X7-600	6	腕金 L100X75X7-600
4	Anchor Shackle	6	アンカーシャックル
4	Ball Clevis	6	ボールクレビス
4	Socket Eye	6	ソケットアイ
5A	Strain Plate	5	耐張プレート
5B	Dead End Grip for Pole	5	巻付グリップポール用
5C	Dead End Grip for Thimber	5	巻付グリップ
5D	Dead End Grip for Insulator	10	巻付グリップ碍子用
5E	Stay Wire 45sqmm (15m)	5	支線
5F	Stay Insulator 33kV	5	支線碍子
5G	Stay Rod	5	支線ロット
5H-1	Stay Plate	5	支線プレート
5H-2	Stay Anchor	5	支線アンカー
5I	Turnbuckle	5	ターンバックル
5J	Ivy Protection	5	ツタ防止
6D	Bolt & Nut M16x350(Crossarm/Pole)	6	ボルトナット M16x350
6G	Bolt & Nut M20x800 with square washer	4	ボルトナット M20x800 角座金
8A	Conector (Al 100/Al 100)	6	コネクター
10	Disc Insulator	18	耐張碍子
11-1	Dead End Clamp	6	引留めクランプ
11-2	Adapter for Dead End Clamp	6	引留めクランプ用ホルダー
14	Square Washer	12	角座金
17	Number Plate	1	プレート
18	Nail	20	引留材(釘)
19	Staple	20	ステップル
40-1	Danger Plate	1	危険表示
40-2	ODA Plate	1	ODAマーク
41	Nail (for Plate)	12	釘 (プレート用)
42	Anti Climbing Barbed Wire(7m)	2	昇柱防止用有刺鉄線(7m)
43	Conductor (AAAC 100sqmm)	10m	電線

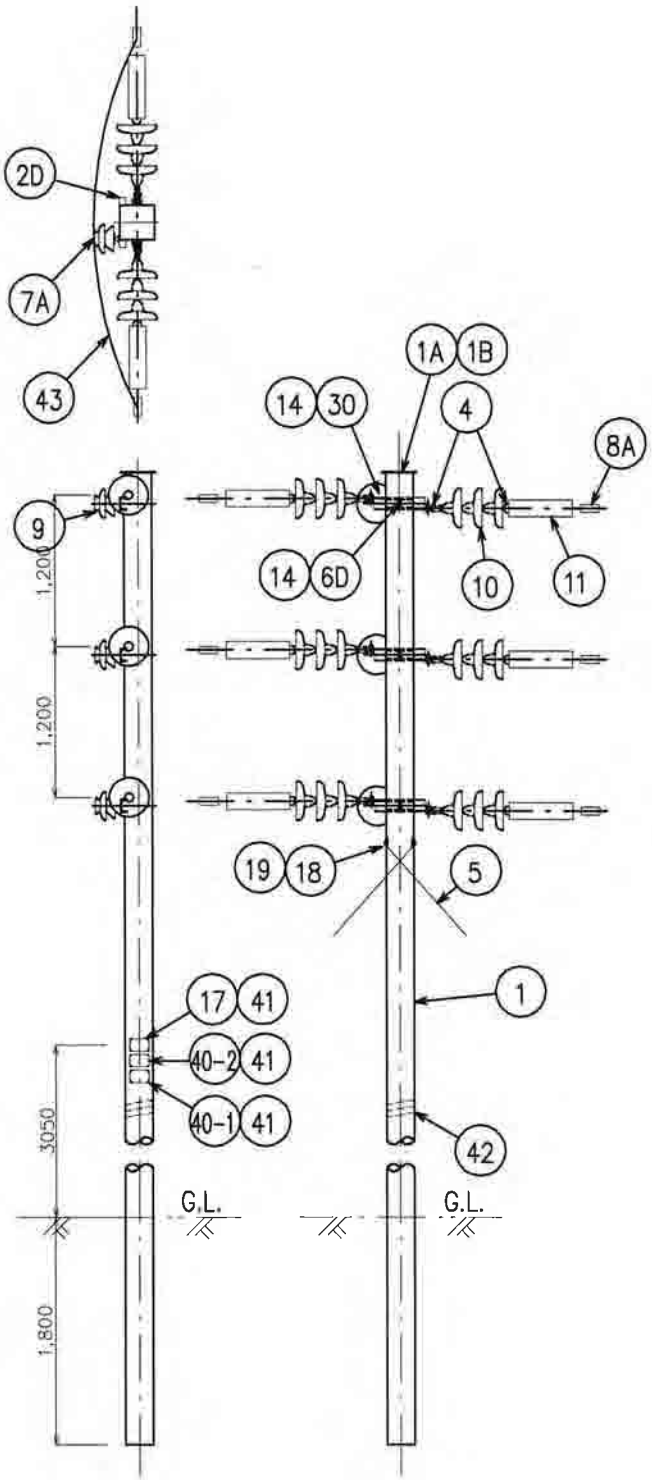
SCALE	1/60	
TITLE TYPE D HEAVY ANGLE POLE(Angle 50to 90deg) 角度柱 (50度~90度)		DRG.NO. T-04





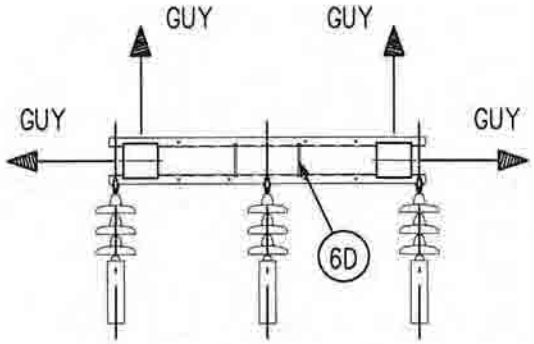
PART.NO.	DESCRIPTION	Q'TY	項 目
1	Wooden Pole (12m)	2	木柱 (12m)
1A	Pole Cap	2	電柱防護キャップ
1B	Pole Cap Nails	4	キャップ固定用釘
2A	Crossarm L100X75X7-2500	2	腕金 L100X75X7-2500
2C	Crossarm Brace	4	腕金用ブレス
4	Anchor Shackle	6	アンカーシャックル
4	Ball Clevis	6	ボールクレビス
4	Socket Eye	6	ソケットアイ
5A	Strain Plate	4	耐張プレート
5B	Dead End Grip for Pole	4	巻付グリップポール用
5C	Dead End Grip for Thimber	4	巻付グリップ
5D	Dead End Grip for Insulator	8	巻付グリップ碍子用
5E	Stay Wire 45sqmm (15m)	4	支線
5F	Stay Insulator 33kV	4	支線碍子
5G	Stay Rod	4	支線ロット
5H-1	Stay Plate	4	支線プレート
5H-2	Stay Anchor	4	支線アンカー
5I	Turnbackle	4	ターンバックル
5J	Ivy Protection	4	ツタ防止
6A	Bolt & Nut M16x50(Crossarm/Brace)	4	ボルトナット M16x50
6D	Bolt & Nut M16x350(Crossarm/Pole)	4	ボルトナット M16x350
6E	Bolt & Nut M16x400(Pole/Brace)	1	ボルトナット M16x400
7A	Preformed Top Tie	1	頂部タイ
8A	Conector (AI 100/AI 100)	6	コネクター
9	33kV Pin Insulator	1	33kV ピン碍子
10	Disc Insulator	18	耐張碍子
11-1	Dead End Clamp	6	引留めクランプ
11-2	Adapter for Dead End Clamp	6	引留めクランプ用ホルダー
14	Square Washer	4	角座金
17	Number Plate	1	プレート
18	Nail	8	引留材(釘)
19	Staple	8	ステップル
40-1	Danger Plate	1	危険表示
40-2	ODA Plate	1	ODAマーク
41	Nail (for Plate)	12	釘(プレート用)
42	Anti Climbing Barbed Wire(7m)	2	昇降防止用有刺鉄線(7m)
43	Conductor (AAAC 100sqmm)	10m	電線

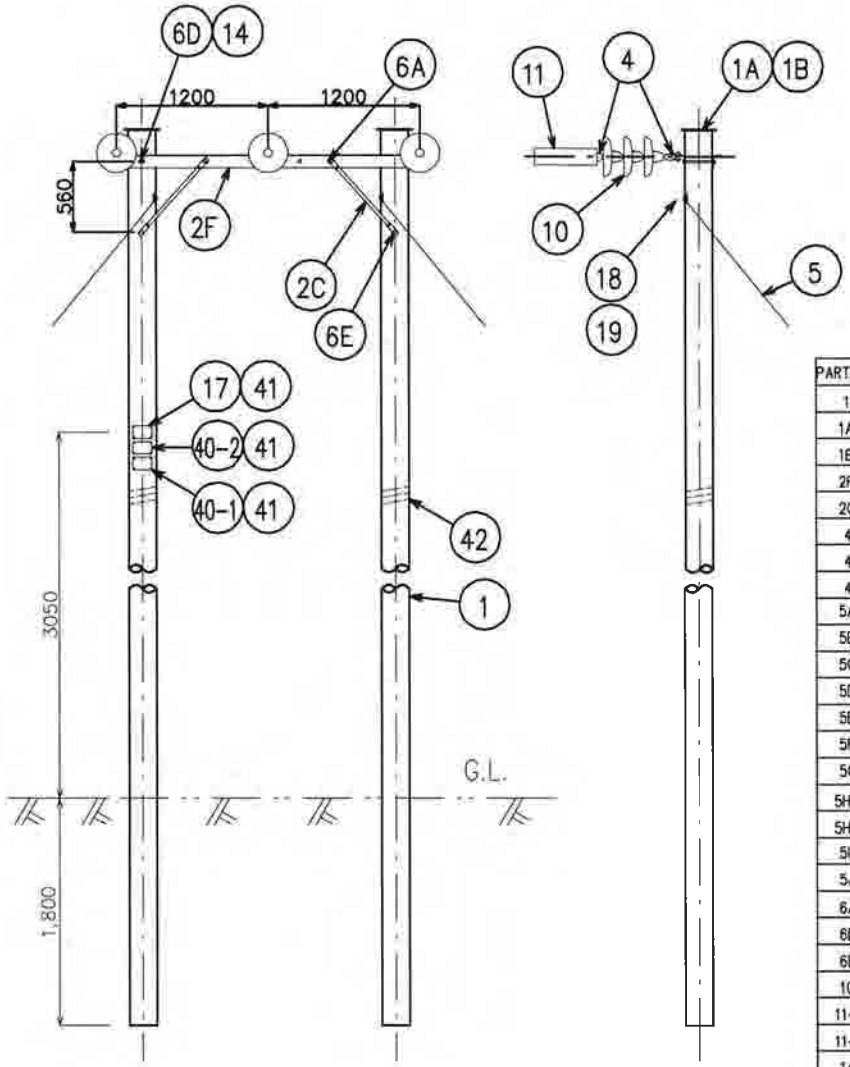
SCALE	1/60
TITLE TYPE E SECTION POLE 両留止柱	DRG.NO. T-05



PART.NO.	DESCRIPTION	Q'TY	項 目
1	Wooden Pole (12m)	1	木柱 (12m)
1A	Pole Cap	1	電柱防腐キャップ
1B	Pole Cap Nails	2	キャップ固定用釘
2D	Crossarm C100X50X5-300	3	腕金 C100X50X5-300
4	Anchor Shackle	6	アンカーシャックル
4	Ball Clevis	6	ボールクレビス
4	Socket Eye	6	ソケットアイ
5A	Strain Plate	2	耐張プレート
5B	Dead End Grip for Pole	2	巻付グリップポール用
5C	Dead End Grip for Thimber	2	巻付グリップ
5D	Dead End Grip for Insulator	4	巻付グリップ碍子用
5E	Stay Wire 45sqmm (15m)	2	支線
5F	Stay Insulator 33kV	2	支線碍子
5G	Stay Rod	2	支線ロット
5H-1	Stay Plate	2	支線プレート
5H-2	Stay Anchor	2	支線アンカー
5I	Turnbackle	2	ターンバックル
5J	Ivy Protection	2	ツタ防止
6D	Bolt & Nut M16x350(Crossarm/Pole)	3	ボルトナット M16x350
7A	Preformed Top Tie	3	頂部タイ
8A	Conector (Al 100/Al 100)	6	コネクター
9	33kV Pin Insulator	3	33kV ピン碍子
10	Disc Insulator	18	耐張碍子
11-1	Dead End Clamp	6	引留めクランプ
11-2	Adapter for Dead End Clamp	6	引留めクランプ用ホルダー
14	Square Washer	9	角座金
17	Number Plate	1	プレート
18	Nail	8	引留材(釘)
19	Staple	8	ステップル
30	Eye Bolt(M25x350)	6	アイボルト
40-1	Danger Plate	1	危険表示
40-2	ODA Plate	1	ODAマーク
41	Nail (for Plate)	12	釘(プレート用)
42	Anti Climbing Barbed Wire(7m)	1	昇柱防止用有刺鉄線(7m)
43	Conductor (100 sqmm)	10m	電線

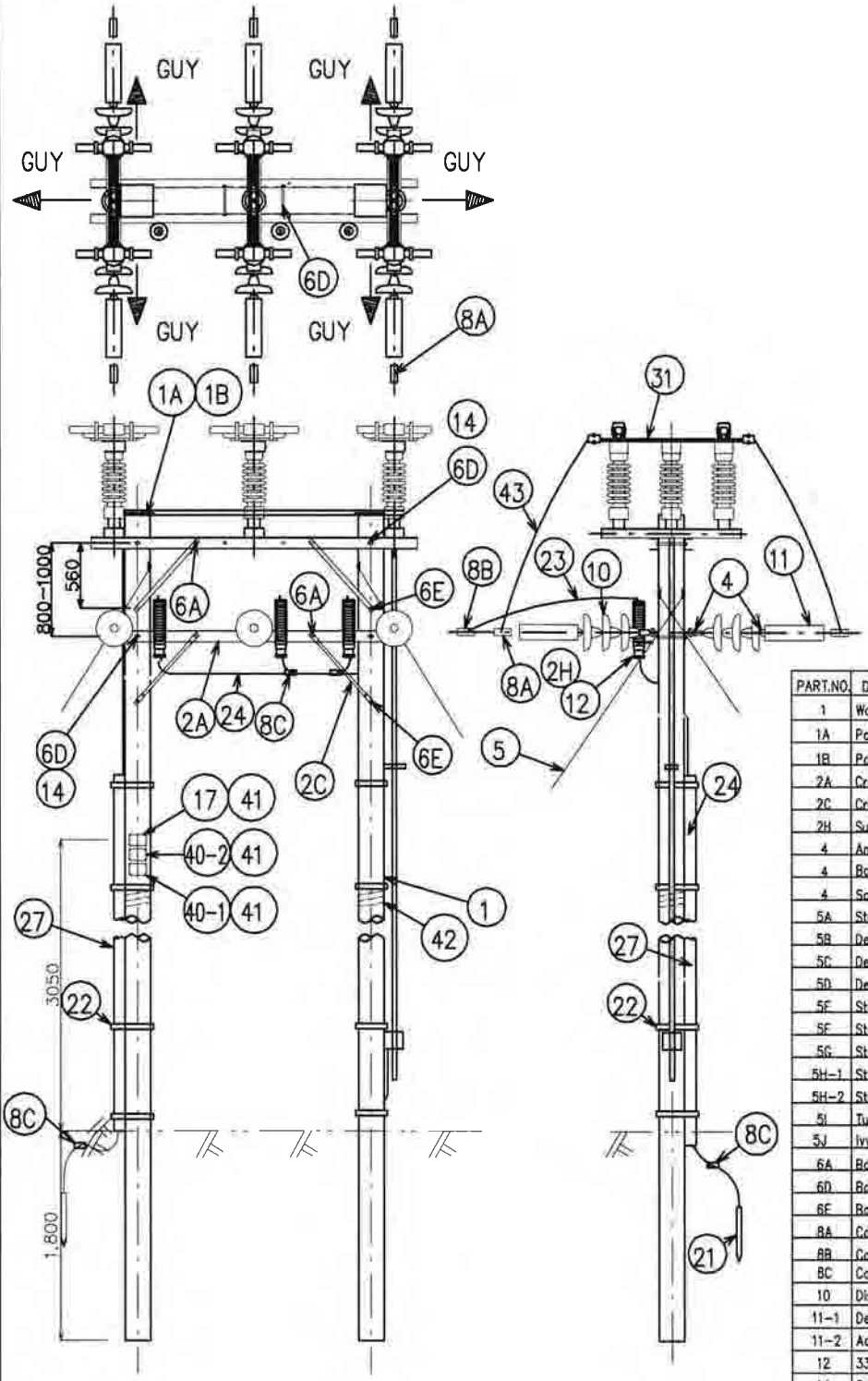
SCALE	1/60	
TITLE TYPE F SECTION POLE (VERTICAL) 両引留柱(垂直)		DRG.NO. T-06





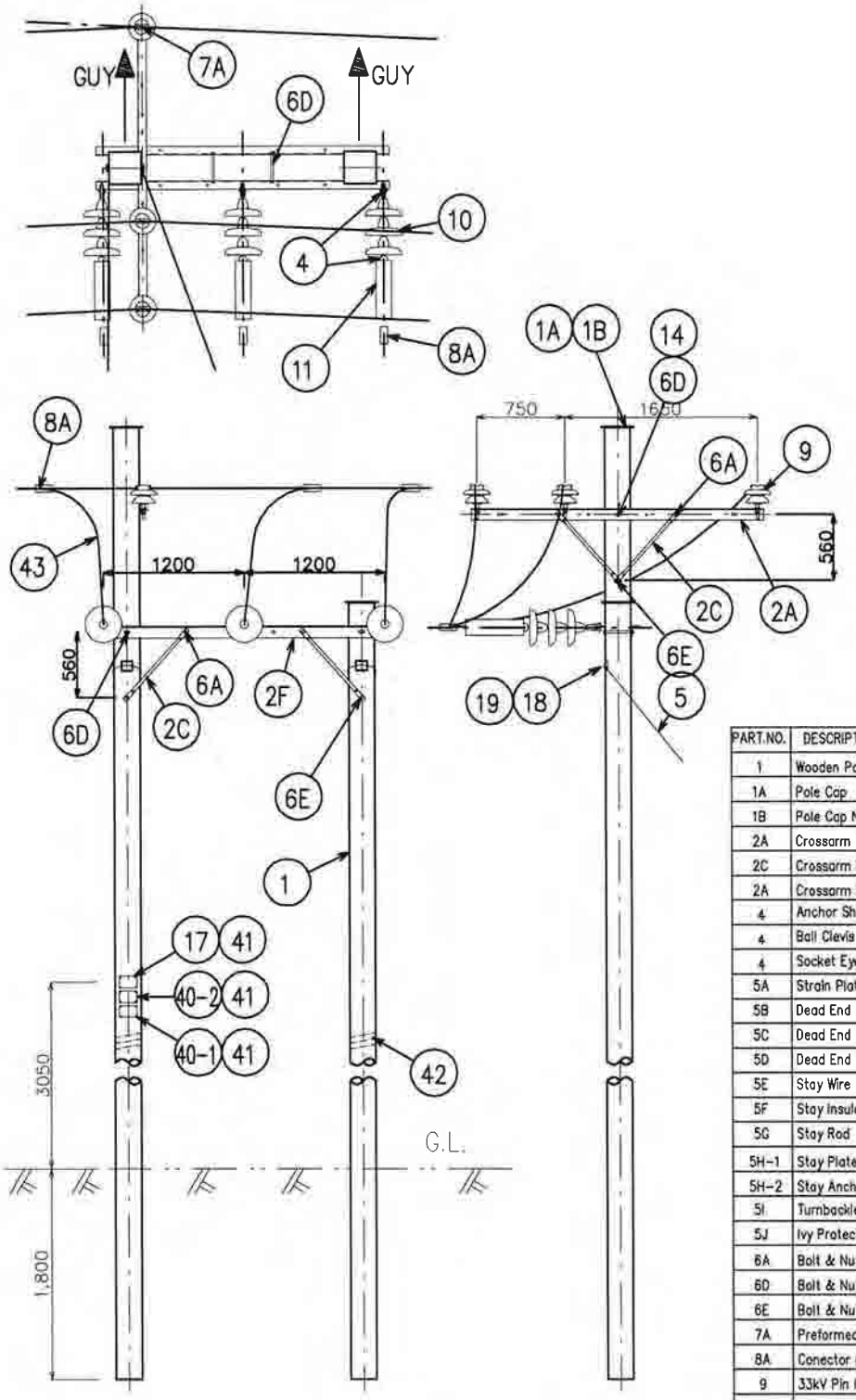
PART.NO.	DESCRIPTION	Q'TY	項 目
1	Wooden Pole (12m)	2	木柱 (12m)
1A	Pole Cap	2	電柱防護キャップ
1B	Pole Cap Nails	4	キャップ固定用釘
2F	Crossarm L100X100X10-2500	2	腕金 L100X100X10-2500
2C	Crossarm Brace	4	腕金用ブレス
4	Anchor Shackle	3	アンカーシャックル
4	Ball Clevis	3	ボールクレビス
4	Socket Eye	3	ソケットアイ
5A	Strain Plate	4	耐張プレート
5B	Dead End Grip for Pole	4	巻付グリップポール用
5C	Dead End Grip for Thimber	4	巻付グリップ
5D	Dead End Grip for Insulator	8	巻付グリップ碍子用
5E	Stay Wire 45sqmm (15m)	4	支線
5F	Stay Insulator 3.3kV	4	支線碍子
5G	Stay Rod	4	支線ロット
5H-1	Stay Plate	4	支線プレート
5H-2	Stay Anchor	4	支線アンカー
5I	Turnbackle	4	ターンバックル
5J	Ivy Protection	4	ツタ防止
6A	Bolt & Nut M16x50(Crossarm/Brace)	4	ボルトナット M16x50
6D	Bolt & Nut M16x350(Crossarm/Pole)	4	ボルトナット M16x350
6E	Bolt & Nut M16x400(Pole/Brace)	2	ボルトナット M16x400
10	Disc Insulator	9	耐張碍子
11-1	Dead End Clamp	3	引留めクランプ
11-2	Adapter for Dead End Clamp	3	引留めクランプ用ホルダー
14	Square Washer	4	角座金
17	Number Plate	1	プレート
18	Nail	16	引留材(釘)
19	Staple	16	ステップル
40-1	Danger Plate	1	危険表示
40-2	ODA Plate	1	ODAマーク
41	Nail (for Plate)	12	釘(プレート用)
42	Anti Climbing Barbed Wire(7m)	2	昇降防止用有刺鉄線(7m)

SCALE	1/60	
TITLE TYPE G TERMINAL POLE 終端柱		DRG.NO. T-07



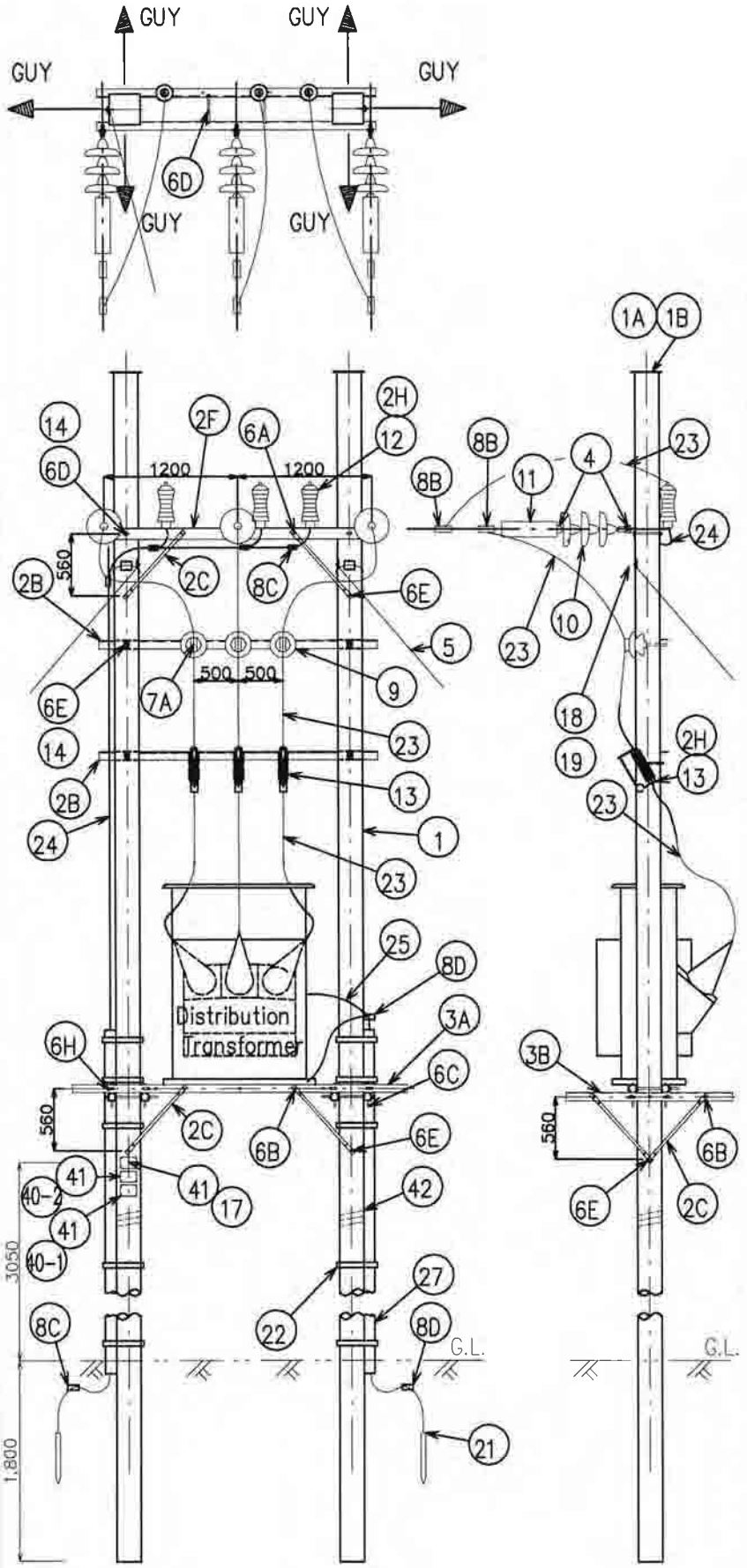
PART.NO.	DESCRIPTION	Q'TY	項 目
1	Wooden Pole (12m)	2	木柱 (12m)
1A	Pole Cap	2	電柱保護キャップ
1B	Pole Cap Nails	4	キャップ固定釘
2A	Crossarm L100X75X7-2500	2	腕金 L100x75x7-2500
2C	Crossarm Brace	4	腕金用ブレス
2H	Support for Bracket	3	ブラケットサポート
4	Anchor Shackle	6	アンカーシャックル
4	Ball Clevis	6	ボールクレビス
4	Socket Eye	6	ソケットアイ
5A	Strain Plate	6	耐張プレート
5B	Dead End Grip for Pole	6	巻付グリップポール用
5C	Dead End Grip for Thimber	6	巻付グリップ
5D	Dead End Grip for Insulator	12	巻付グリップ碍子用
5E	Stay Wire 45sqmm (15m)	6	支線 45sqmm (15m)
5F	Stay Insulator 33kV	6	支線碍子
5G	Stay Rod	6	支線ロット
5H-1	Stay Plate	6	支線プレート
5H-2	Stay Anchor	6	支線アンカー
5I	Turnbuckle	6	ターンバックル
5J	Ivy Protection	6	ツタ防止
6A	Bolt & Nut M16x50(Crossarm/Brace)	8	ボルトナット M16x50
6D	Bolt & Nut M16x350(Crossarm/Pole)	8	ボルトナット M16x350
6E	Bolt & Nut M16x400(Pole/Brace)	4	ボルトナット M16x450
8A	Conector (AI 100/AI 100)	6	コネクター
8B	Conector (AI 100/AI 50)	3	コネクター
8C	Conector (CU14/CU14)	2	コネクター
10	Disc Insulator	18	耐張碍子
11-1	Dead End Clamp	6	引留めクランプ
11-2	Adapter for Dead End Clamp	6	引留めクランプ用ホルダー
12	33kV Lightning Arrester	3	33kV 避雷器
14	Square Washer	4	角座金
17	Number Plate	1	プレート
18	Nail	24	引留材(釘)
19	Staple	24	ステップル
21	Ground rod	2	接地棒
22	IBT band	8	バンド
23	Drop Wire (AAAC 50sqmm)	10m	リード線
24	Ground Wire(IV 14sqmm)	30m	接地線 IV 14sqmm
27	PVC Protection Pipe L=4m	2	PVC保護パイプ L=4m
31	Load Break Switch Assembly	1	負荷開閉器
40-1	Danger Plate	1	危険表示
40-2	ODA Plate	1	ODAマーク
41	Nail (for Plate)	12	釘 (プレート用)
42	Anti Climbing Barbed Wire(7m)	2	昇柱防止用有刺鉄線(7m)
43	Conductor (AAAC 100sqmm)	10m	電線

SCALE	1/60
SCALE	DRG.NO.
TYPE H LOAD BREAK SWITCH POLE 線路開閉器柱	T-08



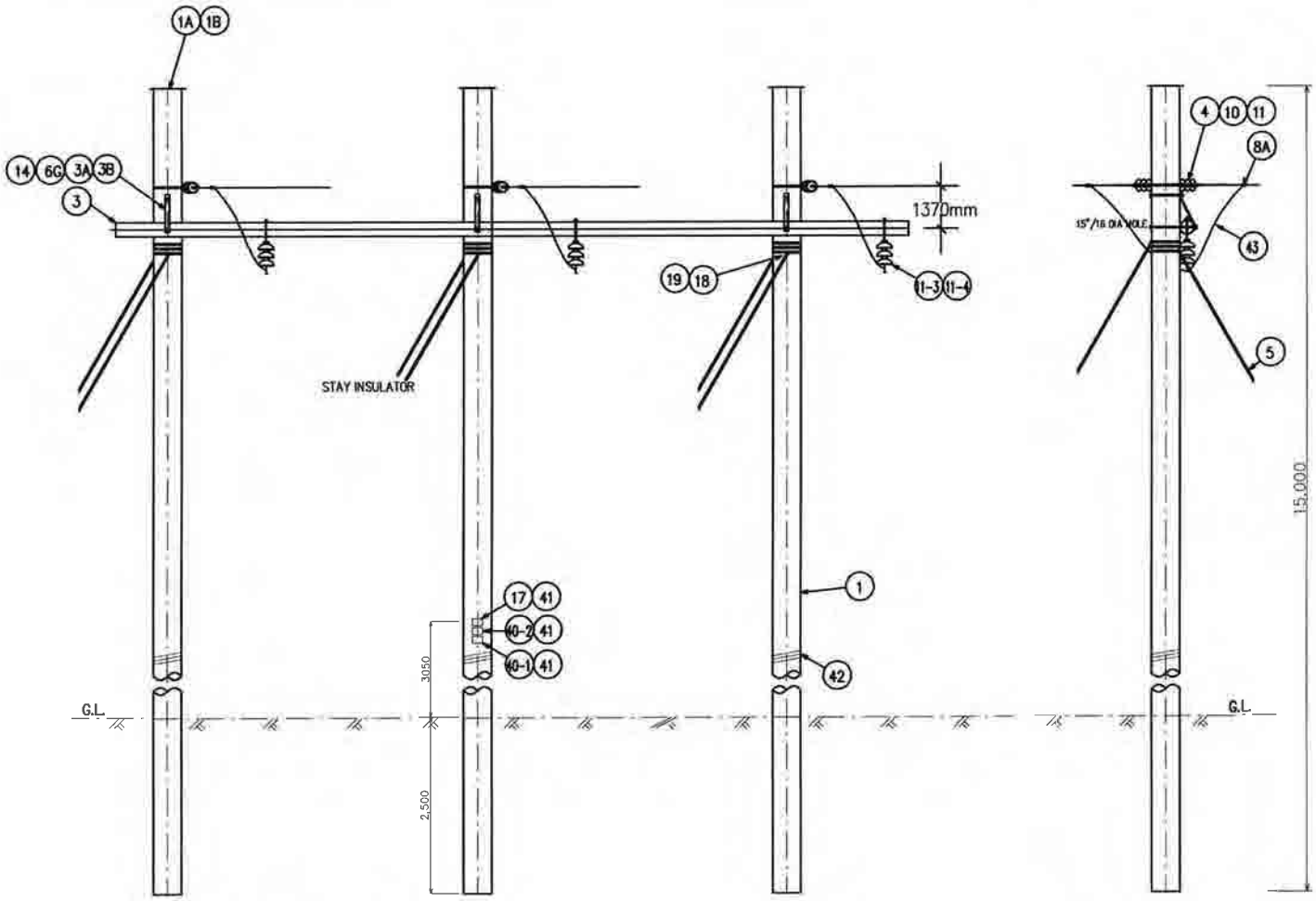
PART.NO.	DESCRIPTION	Q'TY	項 目
1	Wooden Pole (11,12m)	2	木柱 (11,12m)
1A	Pole Cap	2	電柱防護キャップ
1B	Pole Cap Nails	2	キャップ固定用釘
2A	Crossarm L100X75X7-2500	1	腕金 L100X75X7-2500
2C	Crossarm Brace	6	腕金用ブレス
2A	Crossarm L100X100X10-2500	2	腕金 L100X100X10-2500
4	Anchor Shackle	3	アンカーシャックル
4	Ball Clevis	3	ボールクレビス
4	Socket Eye	3	ソケットアイ
5A	Strain Plate	2	耐張プレート
5B	Dead End Grip for Pole	2	巻付グリップポール用
5C	Dead End Grip for Thimber	2	巻付グリップ
5D	Dead End Grip for Insulator	4	巻付グリップ碍子用
5E	Stay Wire 45sqmm (15m)	2	支線
5F	Stay Insulator 33kV	2	支線碍子
5G	Stay Rod	2	支線ロット
5H-1	Stay Plate	2	支線プレート
5H-2	Stay Anchor	2	支線アンカー
5I	Turnbackle	2	ターンバックル
5J	Ivy Protection	2	ツタ防止
6A	Bolt & Nut M16x50(Crossarm/Brace)	6	ボルトナット M16x50
6D	Bolt & Nut M16x350(Crossarm/Pole)	5	ボルトナット M16x350
6E	Bolt & Nut M16x400(Pole/Brace)	3	ボルトナット M16x400
7A	Preformed Top Tie	3	頂部タイ
8A	Conector (AI100/AI100)	6	コネクター
9	33kV Pin Insulator	3	33kV ピン碍子
10	Disc Insulator	9	耐張碍子
11-1	Dead End Clamp	3	引留めクランプ
11-2	Adapter for Dead End Clamp	3	引留めクランプ用ホルダー
14	Square Washer	8	角座金
17	Number Plate	1	プレート
18	Nail	8	引留材(釘)
19	Staple	8	ステップル
40-1	Danger Plate	1	危険表示
40-2	ODA Plate	1	ODAマーク
41	Nail (for Plate)	12	釘(プレート用)
42	Anti Climbing Barbed Wire(7m)	2	昇柱防止用有刺鉄線(7m)
43	Conductor (AAAC 100sqmm)	10m	電線

SCALE	1/60	
TITLE TYPE J T-OFF POLE 分岐柱		DRG.NO. T-09



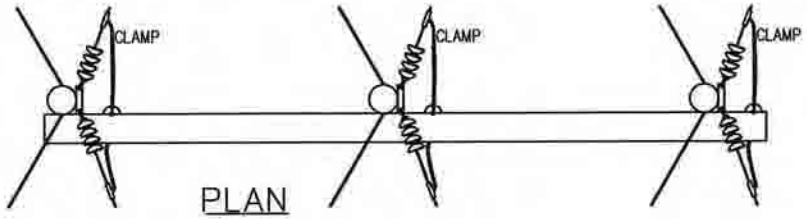
PART.NO.	DESCRIPTION	Q'TY	摘 要
1	Wooden Pole (12m)	2	木柱 (12m)
1A	Pole Cap	2	電柱防腐キャップ
1B	Pole Cap Nails	4	キャップ固定用釘
2B	Crossarm for Pin Support and Fuse	2	ピンサポート,ヒューズ用腕金
2C	Crossarm Brace	16	腕金用ブレス
2F	Crossarm L100X100X10-2500	2	腕金 L100X100X10-2500
2H	Support for Bracket	6	ブラケットサポート
3A	Tr. Support(A) 75x75x3.2-3000	2	変圧器用サポート(A)
3B	Tr. Support(B) 75x75x3.2-1500	4	変圧器用サポート(B)
4	Anchor Shackle	3	アンカーシャックル
4	Ball Clevis	3	ボールクレビス
4	Socket Eye	3	ソケットアイ
5A	Strain Plate	6	耐張プレート
5B	Dead End Grip for Pole	6	巻付グリップポール用
5C	Dead End Grip for Thimber	6	巻付グリップ
5D	Dead End Grip for Insulator	12	巻付グリップ碍子用
5E	Stay Wire 45sqmm (15m)	6	支線 45sqmm (15m)
5F	Stay Insulator 33kV	6	支線碍子
5G	Stay Rod	6	支線ロット
5H-1	Stay Plate	6	支線プレート
5H-2	Stay Anchor	6	支線アンカー
5I	Turnbackle	6	ターンバックル
5J	Ivy Protection	6	ツタ防止
6A	Bolt & Nut M16x50(Crossarm/Brace)	4	ボルトナット M16x50
6B	Bolt & Nut M16x150(Tr. Support/Brace)	12	ボルトナット M16x150
6C	Bolt & Nut M16x200(Tr. Support A/B)	8	ボルトナット M16x200
6D	Bolt & Nut M16x350(Crossarm/Pole)	6	ボルトナット M16x350
6E	Bolt & Nut M16x400(Pole/Brace)	12	ボルトナット M16x400
6H	Bolt & Nut M16x500(Tr. Support /Pole)	8	ボルトナット M16x500
7A	Preformed Top Tie	3	頂部タイ
8B	Conector (AI100/AI50)	6	コネクター
8C	Conector (CU14/CU14)	5	コネクター
8D	Conector (CU38/CU38)	2	コネクター
9	33kV Pin Insulator	3	33kV ピン碍子
10	Disc Insulator	9	耐張碍子
11-1	Dead End Clamp	3	引留めクランプ
11-2	Adapter for Dead End Clamp	3	引留めクランプ用ホルダー
12	33kV Lightning Arrester	3	33kV 避雷器
13	33kV Fuse Cutout	3	33kV ヒューズカットアウト
14	Square Washer	16	角座金
17	Number Plate	1	プレート
18	Nail	24	引留材(釘)
19	Staple	24	ステップル
21	Ground rod	2	接地棒
22	IBT band	24	バンド
23	Drop Wire (AAAC 50sqmm)	30m	リード線
24	Ground Wire(IV 14sqmm)	30m	接地線 IV 14sqmm
25	Tr. Grounding Wire (IV38sqmm)	10m	変圧器用接地線 IV38sqmm
27	PVC Protection Pipe L=4m	2	PVC保護パイプ L=4m
40-1	Danger Plate	1	危険表示
40-2	ODA Plate	1	ODAマーク
41	Nail (for Plate)	12	釘(プレート用)
42	Anti Climbing Barbed Wire(7m)	2	昇降防止用有刺鉄線(7m)

SCALE	1/60	
TITLE TYPE K TRANSFORMER POLE 変圧器柱(終端用)		DRG.NO. T-10



FRONT ELEVATION

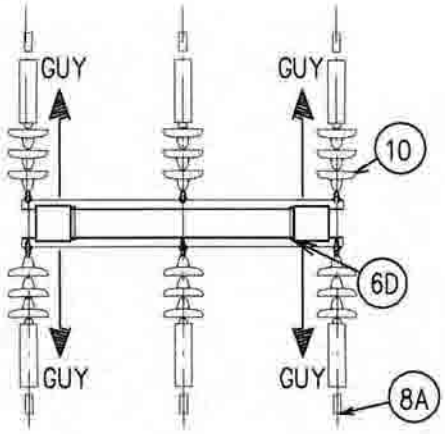
VIEW ON X-X

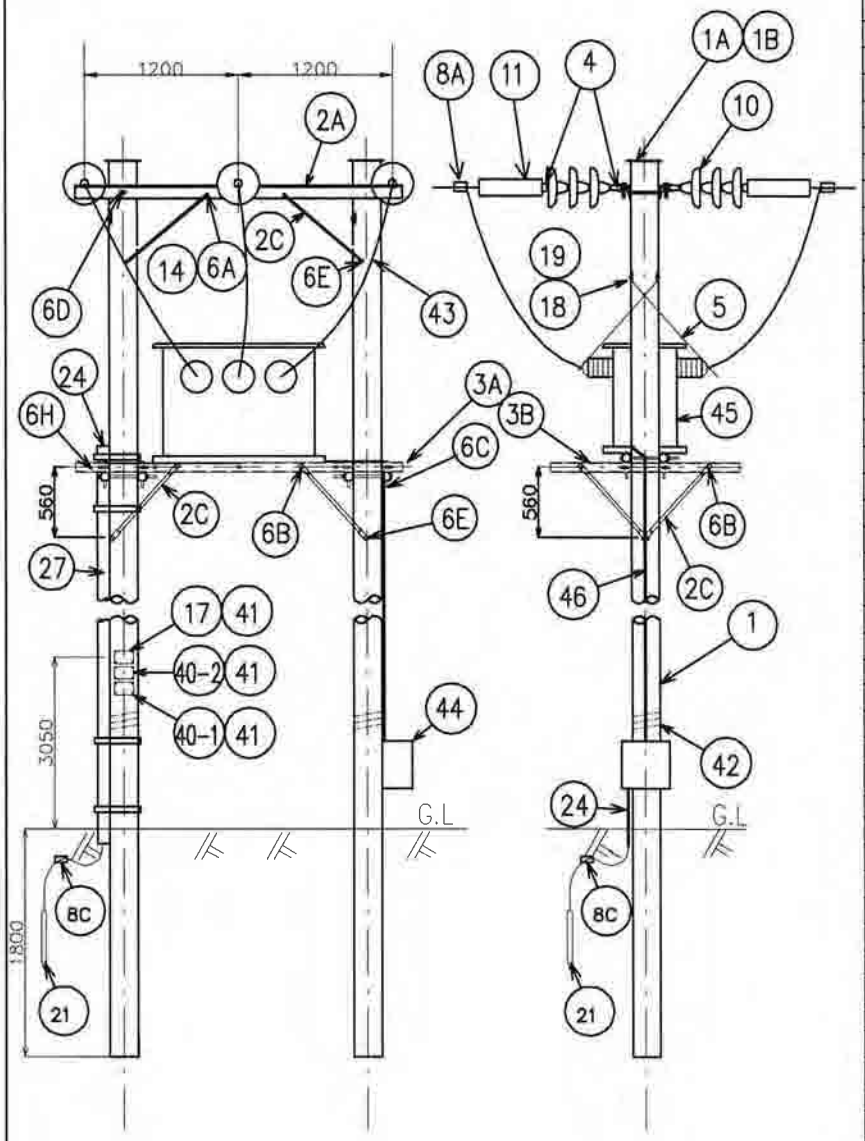


PLAN

PART.NO.	DESCRIPTION	Q'TY	項 目
1	Wooden Pole (15m)	3	木柱 (15m)
1A	Pole Cap	3	電柱防護キャップ
1B	Pole Cap Nails	6	キャップ固定用釘
3	Wooden Crossarm (11m Wooden pole)	1	腕木(11m木柱)
3A	Crossarm Tie Straps	3	腕木タイストラップ
3B	Strap Washes	3	ストラップワッシャ
4	Anchor Shackle	9	アンカーシャックル
4	Ball Clevis	9	ボールクレビス
4	Socket Eye	9	ソケットアイ
5A	Strain Plate	6	耐張プレート
5B	Dead End Grip for Pole	6	巻付グリップポール用
5C	Dead End Grip for Thimber	6	巻付グリップ
5D	Dead End Grip for Insulator	12	巻付グリップ碍子用
5E	Stay Wire 45sqmm (15m)	6	支線
5F	Stay Insulator 33kV	6	支線碍子
5G	Stay Rod	6	支線ロット
5H-1	Stay Plate	6	支線プレート
5H-2	Stay Anchor	6	支線アンカー
5I	Turnbackle	6	ターンバックル
5J	Ivy Protection	6	ツタ防止
6G	Bolt & Nut M20x400(Crossarm/Pole)	6	ボルトナット M20x400
8A	Conector (Al 100/Al 100)	6	コネクター
10	Disc Insulator	27	耐張碍子
11-1	Dead End Clamp	6	引留めクランプ
11-2	Adapter for Dead End Clamp	6	引留めクランプ用ホルダー
11-3	Suspension Clamp	3	懸垂クランプ
11-4	Eye Bolt & Nut M20x350	3	アイボルトナット M20x350
14	Square Washer	6	角座金
17	Number Plate	1	プレート
18	Nail	24	引留材(釘)
19	Staple	24	ステップル
40-1	Danger Plate	1	危険表示
40-2	ODA Plate	1	ODAマーク
41	Nail (for Plate)	12	釘(プレート用)
42	Anti Climbing Barbed Wire(7m)	3	昇柱防止用有刺鉄線(7m)
43	Conductor (AAAC 100sqmm)	10m	電線

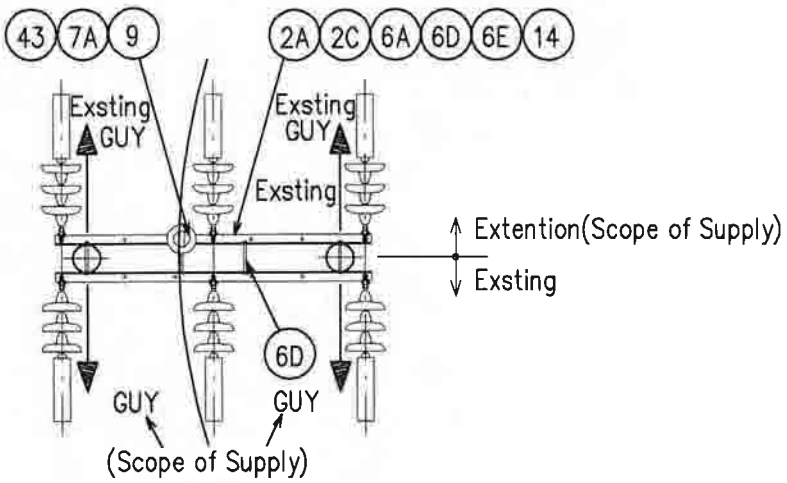
SCALE	1/100
TITLE	TYPE L 3 MEMBER POLE 3本柱
DRG.NO.	T-11

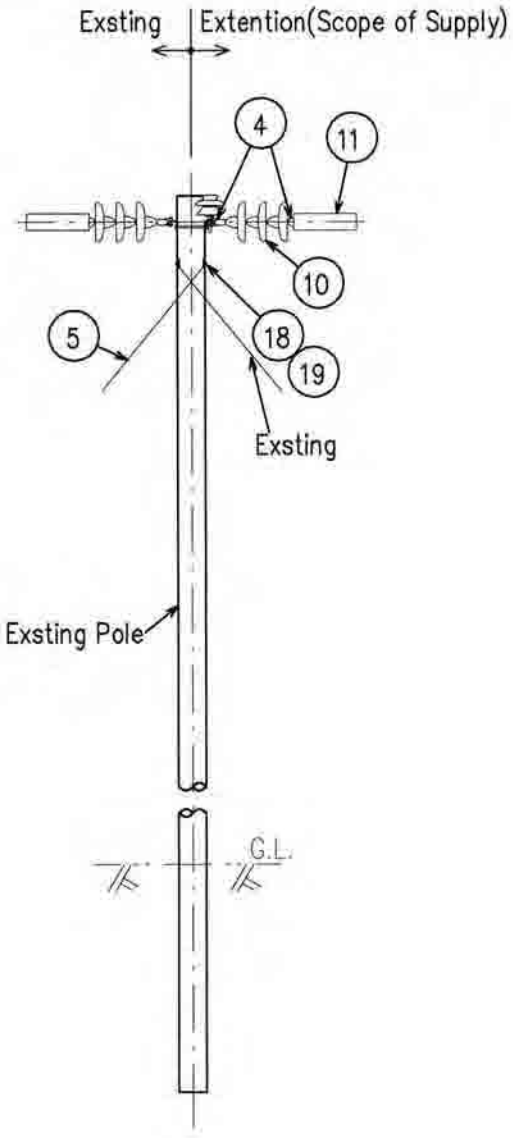




PART.NO.	DESCRIPTION	Q'TY	項 目
1	Wooden Pole (12m)	2	木柱 (12m)
1A	Pole Cap	2	電柱防護キャップ
1B	Pole Cap Nails	4	キャップ固定用釘
2A	Crossarm L100X75X7-2500	2	腕金 L100X75X7-2500
2C	Crossarm Brace	4	腕金用ブレス
3A	Tr. Support(A)	2	変圧器用サポート (A)
3B	Tr. Support(B)	4	変圧器用サポート (B)
4	Anchor Shackle	6	アンカーシャックル
4	Ball Clevis	6	ボールクレビス
4	Socket Eye	6	ソケットアイ
5A	Strain Plate	4	耐張プレート
5B	Dead End Grip for Pole	4	巻付グリップポール用
5C	Dead End Grip for Thimber	4	巻付グリップ
5D	Dead End Grip for Insulator	8	巻付グリップ碍子用
5E	Stay Wire 45sqmm (15m)	4	支線
5F	Stay Insulator 33kV	4	支線碍子
5G	Stay Rod	4	支線ロット
5H-1	Stay Plate	4	支線プレート
5H-2	Stay Anchor	4	支線アンカー
5I	Turnbuckle	4	ターンバックル
5J	Ivy Protection	4	ツタ防止
6A	Bolt & Nut M16x50(Crossarm/Brace)	4	ボルトナット M16x50
6B	Bolt & Nut M16x150(Tr.Support/Branc)	12	ボルトナット M16x150
6C	Bolt & Nut M16x200(Tr.Support A/B)	8	ボルトナット M16x200
6D	Bolt & Nut M16x350(Crossarm/Pole)	4	ボルトナット M16x350
6E	Bolt & Nut M16x400(Pole/Brace)	2	ボルトナット M16x400
6H	Bolt & Nut M16x500(Tr.Support Pole)	8	ボルトナット M16x500
8A	Conector (Al 100/Al 100)	6	コネクター
8C	Conector (CU 14/CU 14)	3	コネクター
10	Disc Insulator	18	懸垂碍子
11-1	Dead End Clamp	6	引留めクランプ
11-2	Adapter for Dead End Clamp	6	引留めクランプ用ホルダー
14	Square Washer	4	角座金
17	Number Plate	1	プレート
18	Nail	8	引留材(釘)
19	Staple	8	ステップル
21	Ground rod	2	接地棒
22	IBT Band	6	バンド
24	Ground Wire CIV(IV 14sqmm)	20m	グランドワイヤー
27	PVC Protection Pipe	4m	PVC保護パイプ
40-1	Danger Plate	1	危険表示
40-2	ODA Plate	1	ODAマーク
41	Nail (for Plate)	12	釘 (プレート用)
42	Anti Climbing Barbed Wire(7m)	2	昇柱防止用有刺鉄線(7m)
43	Conductor (AAAC 100sqmm)	10m	電線
44	BULK METERING BOX	1	電力量計収納箱
45	VT/CT	1	計器用変成器
46	Control Cable(min2.5sqmm 7C)	10m	制御ケーブル

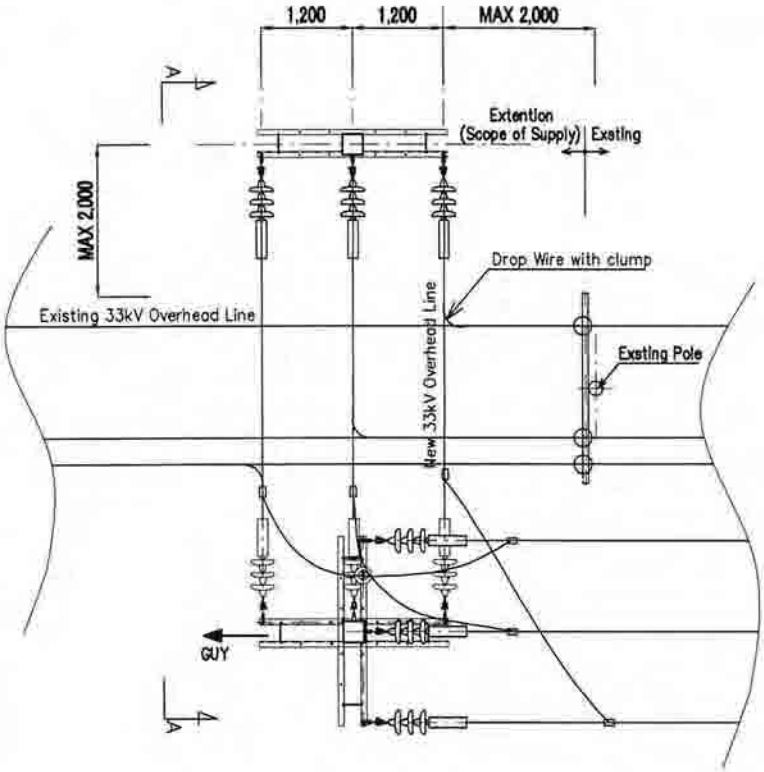
SCALE	1/60
TITLE TYPE M BULK METERING UNIT POLE 電力量計柱	DRG.NO. T-12

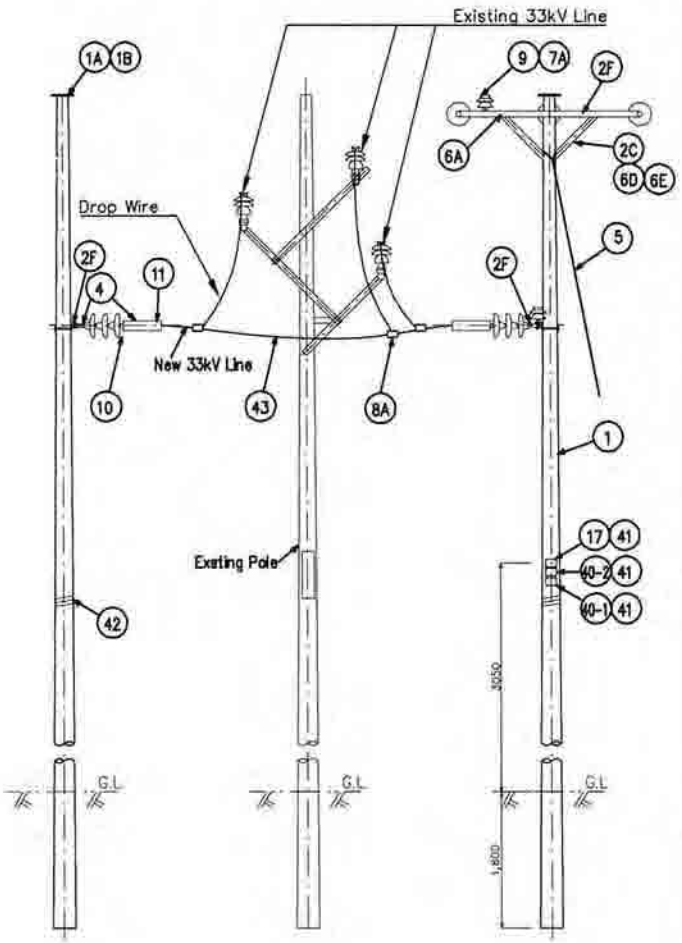




PART.NO.	DESCRIPTION	Q'TY	備 考
2A	Crossarm L100X75X7-2500	1	腕金 L100x75x7-2500
2C	Crossarm Brace	2	腕金用ブレス
4	Anchor Shackle	3	アンカーシャックル
4	Ball Clevis	3	ボールクレビス
4	Socket Eye	3	ソケットアイ
5A	Strain Plate	2	耐張プレート
5B	Dead End Grip for Pole	2	巻付グリップポール用
5C	Dead End Grip for Thimber	2	巻付グリップ
5D	Dead End Grip for Insulator	4	巻付グリップ碍子用
5E	Stay Wire 45sqmm (15m)	2	支線
5F	Stay Insulator 33kV	2	支線碍子
5G	Stay Rod	2	支線ロット
5H-1	Stay Plate	2	支線プレート
5H-2	Stay Anchor	2	支線アンカー
5I	Turnbackle	2	ターンバックル
5J	Ivy Protection	2	ツタ防止
6A	Bolt & Nut M16x50(Crossarm/Brace)	2	ボルトナット M16x50
6D	Bolt & Nut M16x350(Crossarm/Pole)	1	ボルトナット M16x350
6E	Bolt & Nut M16x400(Pole/Brace)	1	ボルトナット M16x400
7A	Preformed Top Tie	1	頂部タイ
8A	Conector(Al100/Al100)	6	コネクター
9	33kV Pin Insulator	1	33kV ピン碍子
10	Disc Insulator	9	耐張碍子
11-1	Dead End Clamp	3	引留めクランプ
11-2	Adapter for Dead End Clamp	3	引留めクランプ用ホルダー
14	Square Washer	2	角座金
17	Number Plate	1	プレート
18	Nail	16	引留材(釘)
19	Staple	16	ステップル
43	Conductor(AAAC 100sqmm)	10m	電線

SCALE	1/60	
TITLE TYPE N1 CONNECTION PLAN TO THE EXISTING LINE 既設延伸接続用図 (EXTENSION TYPE)		DRG.NO. T-13

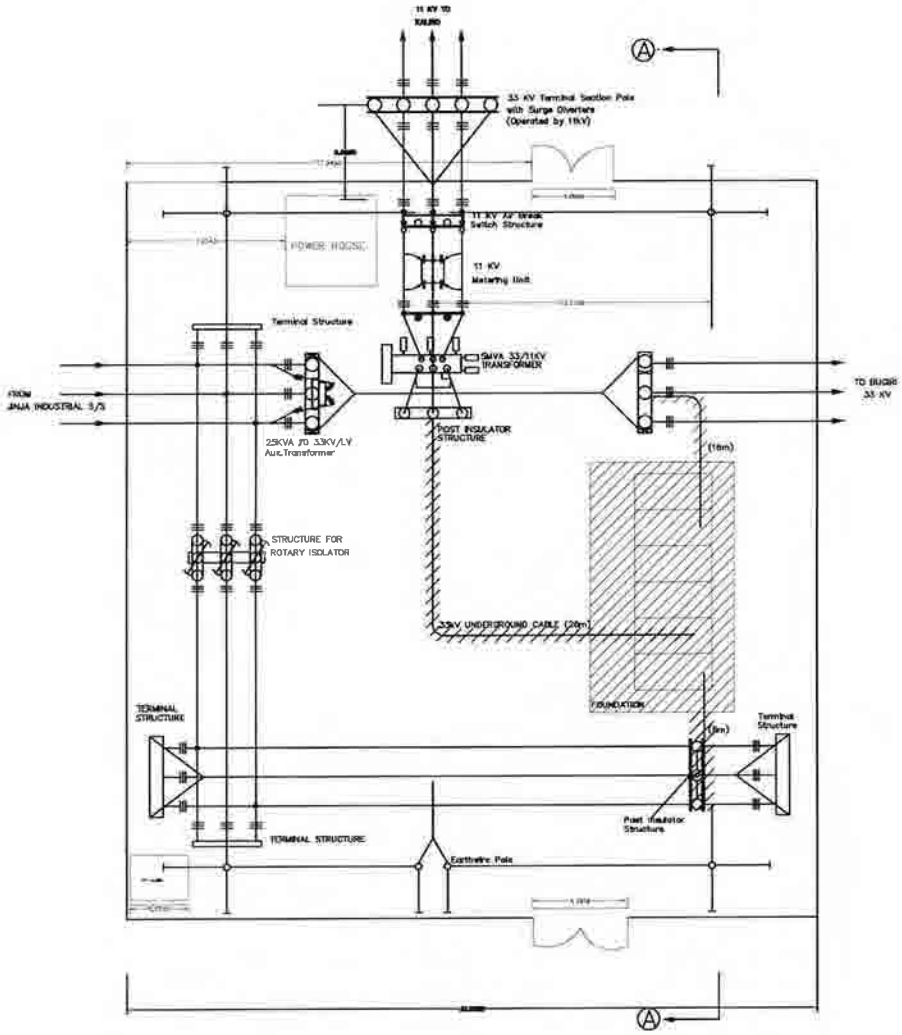


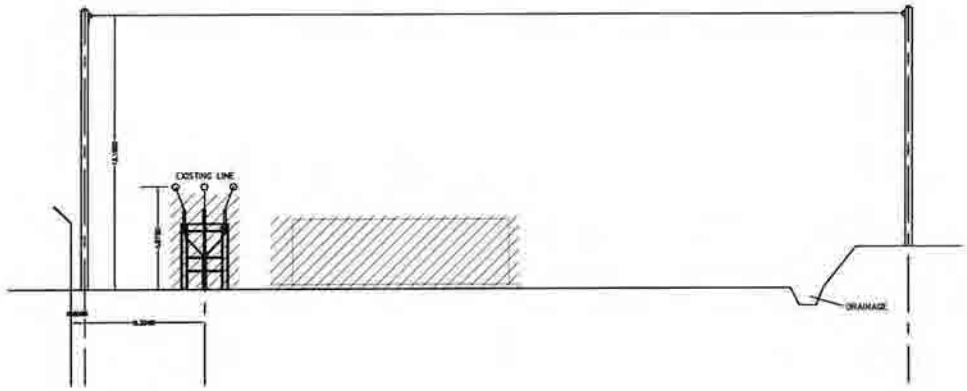


SECTION A–A

PART.NO.	DESCRIPTION	Q'TY	項 目
1	Wooden Pole (12m)	2	木柱 (12m)
1A	Pole Cap	2	電柱頭部キャップ
1B	Pole Cap Nails	4	キャップ固定用釘
2C	Crossarm Brace	12	腕金用ブレス
2F	Crossarm L100X100X10–2500	6	腕金 L100X100X10–2500
4	Anchor Shackle	9	アンカーシャックル
4	Ball Clevis	9	ボールクレビス
4	Socket Eye	9	ソケットアイ
5A	Strain Plate	1	耐張プレート
5B	Dead End Grip for Pole	1	巻付グリップポール用
5C	Dead End Grip for Thimber	1	巻付グリップ
5D	Dead End Grip for Insulator	2	巻付グリップ碍子用
5E	Stay Wire 45sqmm (15m)	1	支線
5F	Stay Insulator 33kV	1	支線碍子
5G	Stay Rod	1	支線ロット
5H–1	Stay Plate	1	支線プレート
5H–2	Stay Anchor	1	支線アンカー
5I	Turnbackle	1	ターンバックル
5J	Ivy Protection	1	ツタ防止
6A	Bolt & Nut M16x50(Crossarm/Brace)	12	ボルトナット M16x50
6D	Bolt & Nut M16x350(Crossarm/Pole)	6	ボルトナット M16x350
6E	Bolt & Nut M16x400(Pole/Brace)	6	ボルトナット M16x400
7A	Preformed Top Tie	2	頂部タイ
8A	Conector (Al 100/Al 100)	12	コネクター
9	33kV Pin Insulator	2	33kV ピン碍子
10	Disc Insulator	27	耐張碍子
11–1	Dead End Clamp	9	引留めクランプ
11–2	Adapter for Dead End Clamp	9	引留めクランプ用ホルダー
14	Square Washer	6	角座金
17	Number Plate	1	プレート
18	Nail	16	引留材(釘)
19	Staple	16	ステップル
40–1	Danger Plate	1	危険表示
40–2	ODA Plate	1	ODAマーク
41	Nail (for Plate)	12	釘 (プレート用)
42	Anti Climbing Barbed Wire(14m)	1	昇降防止用有刺鉄線(14m)
43	Conductor (AAAC 100sqmm)	50m	電線

SCALE	1/100
TITLE	TYPE N2 CONNECTION PLAN TO THE EXISTING LINE (CROSS TYPE) 既設延伸接続用図
DRG.NO.	T–14





SECTION A－A

: This Project (SCOPE OF SUPPLY)

DWG No.L－01 LAYOUT PLAN OF IGANGA SUBSTATION
イガンガ変電所配置計画図