REPORT ON PRELIMINARY DESIGN OF THE SATELLITE COMMUNICATION SYSTEM IN THE RWANDESE REPUBLIC

OCTOBER 1979

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

In response to the request of the Government of the Rwandese Republic, the Government of Japan decided to carry out a study necessary for the preparation of preliminary design for the satellite communication system project, and the Japan International Cooperation Agency conducted the study.

The Japan International Cooperation Agency, recognizing that the establishment of the satellite communication system which aims at remarkable improvement of the international telecommunication service will contribute very much to the development of Rwanda, dispatched a study team to Rwanda from June 19 to July 21, 1979 for the purpose of obtaining data necessary for preparing a preliminary design, discussing and exchanging views with Rwanda authorities concerned on the project.

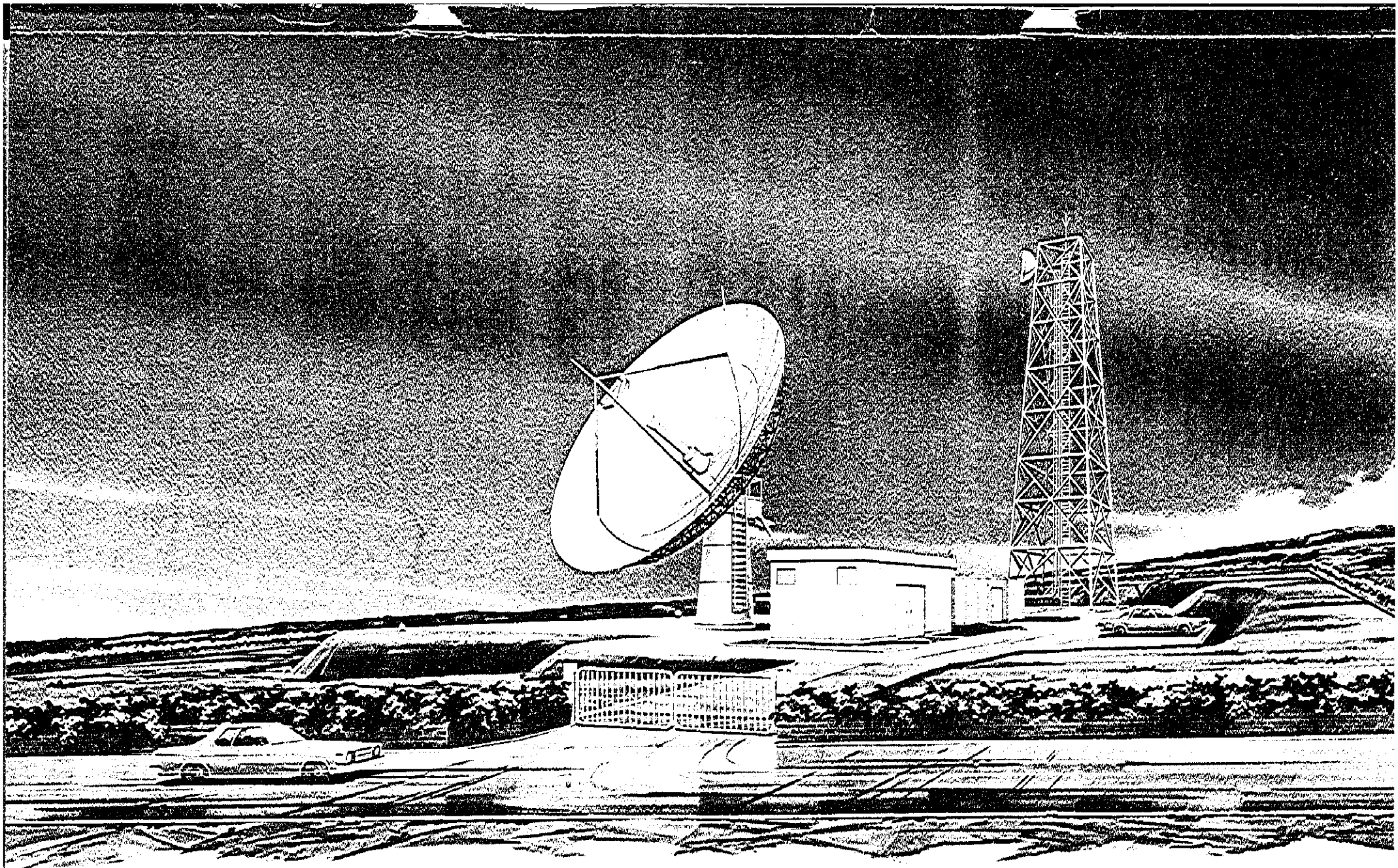
The field survey in Rwanda was carried out very smoothly with the extensive cooperation of the Ministry of Posts and Communications, and upon its return to Japan, the study team made further studies and analyses which have been complied in this report.

I hope that this report will contribute to the progress of the project and to the strengthening of the friendly relations now existing between our two countries.

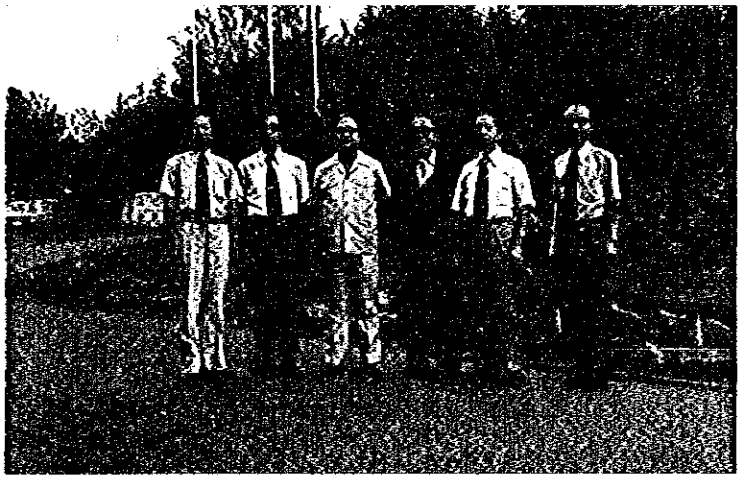
I express my heartfelt appreciation to the Government and people concerned of Rwanda for their close cooperation extended to the study team.

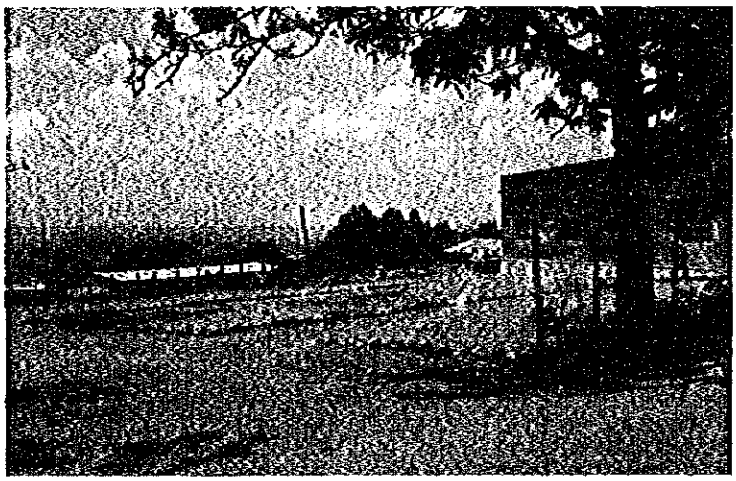
October, 1979

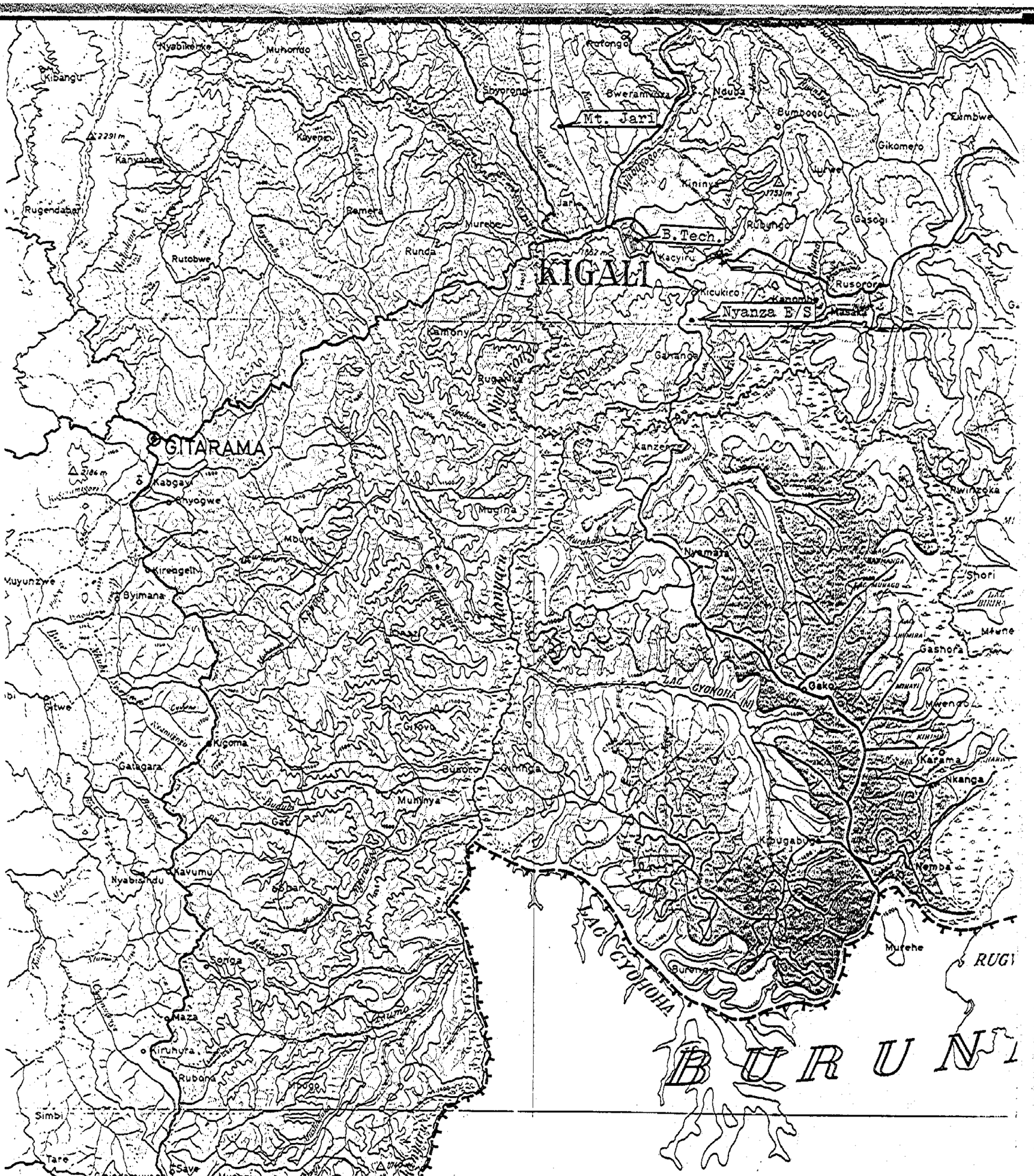
Shisaku Hogen
President
Japan International Cooperation Agency



KIGALI SATELLITE COMMUNICATION EARTH STATION







DISTANCES EN Km.

	Kigali	Butare	Byumba	Gitarama	Kibungo	Kibuye	Gisenyi	Gikongoro	Ruhengeri	Cyangugu
Kigali	0	135	75	53	112	144	187	164	118	293
Butare	135	0	210	82	247	129	237	29	190	158

0 5 10 15 20Km

KIGALI - GITARAMA - BUTARE (Rwanda)

CONTENTS

ATTACHED DRAWINGS

1. Site Plan of Earth Station, Nyanza

2. Floor Plan of the Existing Radio Repeater Building, Nyanza

3. Floor Plan of the Existing Power Building, Nyanza

4. Site Plan of Batiment Technique, Kigali

5. Floor Plan of the Existing Power Building, Bâtiment Technique, Kigali

6. Site Plan of Mt. Jari

7. Floor Plan of the Existing Radio Repeater Building, Mt. Jari

8. Floor Plan of the Existing Power Building, Mt. Jari

9. Site Plan of Tonga

10. Floor Plan of the Existing Radio Repeater Building, Tonga

11. Site Plan of Butare

12. Floor Plan of the Existing Exchange Building, Butare

CHAPTER 1

INTRODUCTION

Chapter 1 Introduction

1-1 Background and Purpose of Sending Study Team to Rwanda

The Government of the Rwanda Republic, based on the meeting held between the Ministre des Affaires Etrangeres et de la Cooperation who visited Japan in September 1978 and the Government authorities of Japan, officially requested the Japanese Ambassador residing in Kinshassa in November 1978 for the cooperation of the Japanese Government in connection with the International Communication Improvement Plan of Rwanda.

In response to this request, the Government of Japan dispatched a preliminary study team for a period of February 28 to March 22, 1979 for the purposes of the confirmation of the particulars of the request, field study of existing communication facilities, discussion on the proposed scope of detailed field survey, and collection of necessary study materials.

The preliminary study team, stressing the importance of a rapid development of the international communication network in the country for smooth collection of information on world-wide economic trends under such disadvantageous geographical circumstances in economic and social activities that the country is located nearly at the center of the African Continent and thus is obliged to pass a third country to reach the coast of either Atrantic or Indian Ocean, recommended for the Japanese Government to make positive cooperation to the country in both technical and economic fields.

Through examination of this recommendation the Japanese Government sent a study team to Rwanda for the preliminary design of the project in consideration of the possibility of granting an aid without compensation.

1-2 Organization of Study Team

The study team consisted of the following six members headed by Mr. Shigeru Fukuda, Special Advisor for International Cooperation, Minister's Secretariat, Ministry of Posts and Telecommunications.

Member	In Charge of	Affiliation
Shigeru FUKUDA	Summarization (Leader)	Special Advisor for International Cooperation, Minister's Secretariat, Ministry of Posts and Telecommunications (MPT)
Shizuma YAMAMOTO	Radio Engineering	Enginner, Technical Investigation Division, Radio Regulatory Bureau, MPT
Tsutomu KABEYA	Satellite Communication	Assistant to Manager, International Cooperation Offices, Kokusai Denshin Denwa Co., Ltd. (KDD)
Takeshi SHIMIZU	International Exchange	Assistant Chief, 2nd Telex Maintenance Section, Tokyo International Telecommunications Techincal Operation and Maintenance Office, KDD

(Continued)

Member	In Charge of	Affiliation
Mitsunao MORIZANE	Structural Design	Senior Architect, Nippon Sogo Architects' & Engineers' Office, Corporation Ltd. (NSK)
Adio ITOH (Coordinator)	General Coordination	Special Assistant to Director, Social Development Cooperation Department, Japan International Cooperation Agency (JICA)

1-3 Itinerary of Study Team

The itinerary of the study team members is given in Table 1.

Table 1 Itinerary of Study Team

Date	Place	Particulars
June 19	Lv. Tokyo (21:30 LH651)	
20	Ar. Frankfurt (07:50) Lv. Frankfurt (09:05) Ar. Paris (11:15)	∘ Visit Ambassada du Japon, Rep Française ∘ Request for application for entry visas into Rwanda
21	Paris	∘ Receive entry visas
22	Lv. Paris (10:00 AF489) Ar. Kigali (20:05)	∘ Check in at Hôtel des Mille Collines
23	Kigali	∘ Meeting with le Directeur Général des Télécommunications, MPC on survey schedule.

(Continued)

Date	Place	Particulars
June 24	Kigali	∘ Preliminary survey of proposed satellite communication earth station site and Mt. Jari Radio Repeater Station
25	Kigali	∘ Arrange for provision of locally procurable survey equipment and materials. ∘ Commence land surveying at proposed satellite communication earth station site in Nynza Transmitting Station
26	Kigali	∘ Land surveying of proposed satellite communication earth station site and measurement of skyline ∘ Visibility (line-of-sight) test between this site and Kigali Central Office
27	Kigali	∘ Selection and survey at proposed antenna site in Mt. Jari Repeater Station ∘ Meeting on international exchange system
28	Kigali	∘ Land surveying for expansion of Kigali Central Office building and surveying at proposed antenna site ∘ Meeting on proposed antenna site at Mt. Jari Radio Repeater Station
29	Kigali - Butare	Selection and land surveying of proposed antenna sites at Tonga Radio Repeater Station and Butare Telegraph and Telephone Office
30	Butare - Kigali	

(Continued)

Date	Place	Particulars
July 1	Kigali - Nyanza - Gabiro - Kigali	∘ Inspect local telegraph and telephone offices
2	Kigali	∘ Additional land surveying of proposed satellite communication earth station site and Mt. Jari Radio Repeater Station
3	Kigali	∘ Meeting with the Ministere des Travux Publics et L'equipment ∘ Inspect construction site of the Central Bank ∘ Meeting on Tonga Radio Repeater Station and Butare Telegraph and Telephone Office systems
4	Kigali	∘ Meeting with the Ministre des MPC on outline of survey the results
5	Kigali	∘ Participate in the Fête de la Paix et de l' Unité nationale
6	Kigali (Team Head FUKUDA leaves Kigali to Japan, 10:00 SN494)	∘ Meeting with Le Directeur Général des Télécommunications just returned from Washington on satellite communication and others.
7	Kigali	∘ Filing and summarization of survey results
8	Kigali	∘ Same as above.

(Continued)

Date	Place	Particulars
July 9	Kigali	◦ Meeting with the Direction Technique on details of survey results ◦ Procure maps of respective sites
10	Kigali	◦ Meeting with Le Directeur General des Télécommunications
11	Kigali	◦ Preparation of interim report
12	Kigali	◦ Submit and explain interim report to Le Directeur Général des Télécommunications ◦ Report to the Ministre des MPC (in the presence of Ambassadeur M. Yamashita)
13	Kigali	◦ Retest visibility between proposed Nyanza satellite earth station and Kigali Central Office ◦ Inspect Ecole Nationale des Postes et Telecommunications
14	Kigali	◦ See Ambassadeu M. Yamashita off at Airport.
15	Kigali	◦ Inspect Ruhengari and Gisenyi Telephone Office facilities
16	Lv. Kigali (18:20 SN488) Ar. Nirobi (22:15)	◦ Pay visit of facilities courtesy to MPC upon leaving Rwanda

(Continued)

Date	Place	Particulars
July 17	Nirobi	◦ Preparation of interim report to Ambassade du Japon, Rep. du Zaiire
18	Lv. Nirobi (09:30 UY801) Ar. Kinshassa (12:10) Lv. Kinshassa (21:35 SN328)	◦ Submission of interim report to Ambassade du Japon, Rep. du Zaiire
19	Ar. Brussels (06:15) Lv. Brussels (08:20) Ar. Frandfurt (08:25)	
20	Lv. Frankfurt (10:05 LH658)	
21	Ar. Tokyo (08:20 at Narita)	

1-4 Results of Survey

The study team recommends through its site survey for preliminary design to adopt the following system for this project from both technical and economic standpoints.

1-4-1 Construction of Satellite Communication Earth Station

The study team recommends to construct a standard type B earth station for access to the Indian Ocean Satellite of the INTELSAT system by allotting a site of 4,900m^2 (70m x 70m) in the existing Nyanza HF transmitting station site located about 8km in due south of the center of Kigali (about 14km along the road). The antenna will be 13m in diameter and allow communication with the Indian Ocean Satellite at approximately 3° north

from the due east in azimuth and approximately 50° in elevation. The channel capacity will be 12 channels at the time of initial installation, which will be expansible to a maximum of 60 channels. Upon commencement of service in 1982 direct communication with France, Kenya, the United Kingdom, and Belgium (via Netherland) will be intended.

The Ministere des Postes et des Communications (hereinafter referred to as MPC) shall accomplish the leveling of the proposed earth station site, the construction of an office room of about 20m^2 and a storehouse of about 15m^2, the construction of the access road, the expansion of the power distribution board for allowing the common use of the engine generator, and the construction of the antenna foundation.

It is also necessary to negotiate and start necessary procedures with applicable foreign orgainzations for smooth completion of INTELSAT verification test and lineup test with associated countries.

1-4-2 International Telephone Switching System

A telephone office building with a space of at least 260m^2 is to be constructed in the existing Kigali Central Office site to accommodate an electronic switching system with the functions of CT-3. Operator positions will be provided to handle semi-automatic and manual cause at the initial stage and ISD (International Subscriber Dialling) calls in future by expansion of necessary facilities. For the CT-3, consideration will be given for the

addition of the functions of CTN (Center Transit National) so as to allow calls among domestic subscribers in future. The channel capacity will be 40 channels for international calls at the initial stage which will be expansible to a maximum of 200 channels. A total of 50 domestic circuits will be provided for Kigali and other local exchanges.

MPC shall accomplish the construction of the new office building and the expansion or modification of the existing exchange for the interface with the new exchange to be installed.

1-4-3 International Telex Switching System

An international electronic telex switching system will be installed in the office building to be constructed in the Kigali Central Office, which will be provided with operator positions to handle semi-automatic and manual telex calls. The channel capacity will be initially 64 channels and expansible to a maixmum of 120 channels. MPC shall provide necessary space for the telex switching system in the office building to be constructed newly and arrange the interface between the existing and new switching systems.

1-4-4 Radio Links

(1) Between Satellite Communication Earth Station and Kigali Central Office

A microwave radio link of a 6GHz band is to be constructed newly. For this purpose, a selfsupporting antenna steel tower of 22m^2 and

that of 32m will be constructed respectively at the Earth Station and Kigali Central Office and a parabolic antenna of 1.2m in diameter will be mounted on each steel tower. The channel capacity will be initially 24 channels and expansible to a maximum of 60 channels.

(2) Between Mt. Jari Radio Repeater Station and Kigali Central Office

For a measure against the deterioration of the existing cable link, a 60GHz-band microwave radio link will be constructed newly. For this purpose, a selfsupporting antenna steel tower of 47m will be erected on Mt. Jari and a parabolic antenna of 1.2m in diameter will be mounted at a height of 30m on the steel tower. On the Kigali Central Office side a parabolic antenna of 1.2m in diameter will be mounted on the above-mentioned new steel tower, directed to Mt. Jari. The channel capacity will be initially 120 channels and will be expansible to a maximum of 300 channels.

(3) Between Mt. Jari Radio Repeater Station and Tonga Radio Repeater Station

In order to improve the existing UHF 400Hz-band radio link, a parabolic antenna of 3m in diameter will be mounted in the direction to Tonga and at the position of 45m on the 47m steel tower to be constructed newly on Mt. Jari and a parabolic antenna of 3m in diameter wil be mounted in the direction to Mt. Jari at a position of 55m on a 57m selfsupporting antenna steel tower to be constructed at Tonga Radio Repeater Station. The existing radio equipment will be replaced with a new UHF 400MHz-band equipment with an initial

capacity of 12 channels and a maximum capacity of 24 channels.

(4) Between Tonga Radio Repeater Station and Butare Telephone Office

For a measure against deterioration of the existing intra-city cable link, a UHF 400MHz-band radio link will be constructed. For this purpose, a Yagi antenna will be mounted at a height of 20m on the 57m steel tower to be constructed newly on Tonga Radio Repeater Station and a Yagi antenna will be mounted on the 20m Panza mast to be erected at Butare Telephone Office. The capacity of the radio equipment will be initially 12 channels and will be expansible to a maximum of 24 channels.

1-4-5 Improvement of Emergency Engine Generators

For emergency engine generators to be employed in the event of failure of commercial power, the following improvement will be introduced. The existing engine generator of Kigali Central Office will be replaced with a 100KVA engine generator, and those of Mt. Jari and Tonga Radio Repeater Stations with 12.5KVA engine generators. Butare Telephone Office will be furnished with batteries.

1-4-6 Civil and Architectural Work

Design considerations, specifications, and data on materials, etc., in connection with the antenna steel tower foundation work, the expansion of Kigali

Central Office, the modification of the foundation for the installation of engine generators, the modification of the existing station/office buildings, etc., to be accomplished by MPC will be provided by the Japanese side.

1-4-7 Implementation of the Project

This project will be completed by 20 months —— from the effectuation of the contract to the commencement of service. Accordingly, it is necessary for MPC to close the contract by July 1st 1980 with such a contractor that can implement the whole project and complete the system entirely by the end of February 1982.

1-4-8 Estimated Construction Costs

The construction costs of this project will be roughly as follows.

- Foreign currency: 640,000,000 FRW
  (1,500,000,000 Yen for exchange rate of 1 FRW = ¥2.35)
- Domestic currency: 35,000,000 FRW*
  (80,000,000 Yen for exchange rate of 1 FRW = ¥2.35)

* When the switching system office building to be constructed at Kigali Central Office is to be two storied.

The following chapters describes the preliminary design of each system of this project on the basis of the results of site survey.

CHAPTER 2

EARTH STATION

Chapter 2 Earth Station

2-1 Summary

The study team recommends through the field survey to allot a site of 4,900m^2 (70m x 70m) in the Nyanza HF Transmitting Station site for the earth station site in consideration of the utilization of the existing office building and power facility. The proposed site in Kacyiru plateau, which was determined to be the most promising proposed site in the last study (March 1979) has been rejected because of the unsolved problem in city planning.

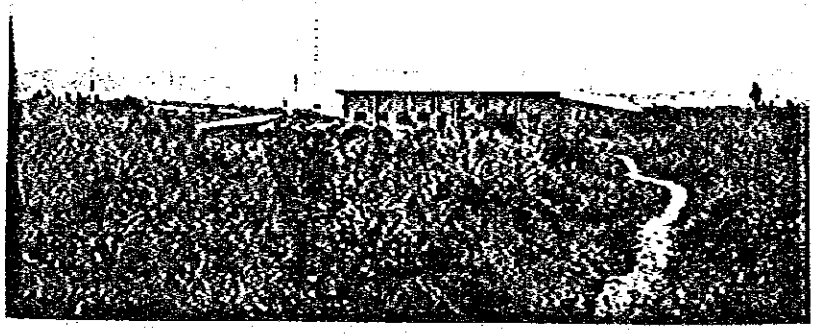
The study team recommends to construct an INTELSAT Standard B earth station with an antenna of 13m in diameter. The earh station will provide an initial capacity of 12 voice grade channels and a final capacity of 60 channels.

The procedures to be taken with INTELSAT, the procurement of the site, civil and architectural work, and the control and magenement of the earth station are to be conducted by MPC. In order to achieve smooth operation and maintenance, an example of earth station organization is given and recommendations are given for the assignment and training plan of technical personnel (13 engineers).

The earth station will gain access to the Indian Ocean Satellite on the basis of the new plan of MPC to ahcieve communication with France, Kenya, the United Kingdom, and Belgium (via Netherland).

2-2 Proposed Site of Earth Station and Site Condition

It is recommended to construct an earth station in the existing Nyanza HF Transmitting Station site located about 8km south of the center of Kigali (about 14km along the road). An antenna will be constructed at a location about 170m south of the existing station building and a site of 4,900m^2 (70m x 70m) around the antenna will be provided for exclusive use by the earth station.



Nyanza HF Transmitting Station
—— View from proposed earth station side

The major reasons for the recommendation of the site are as follows.

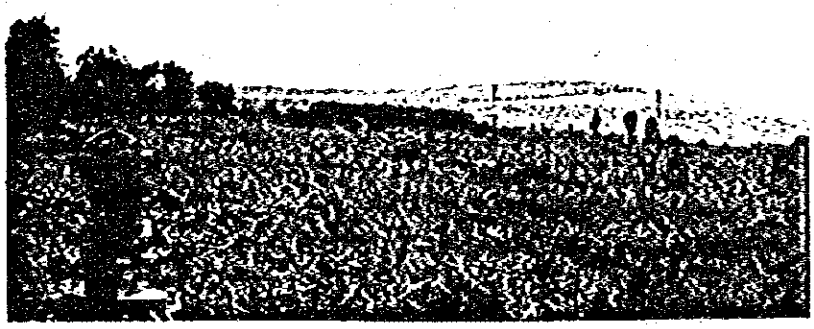
(1) The existing building and power source will be utilizable.

(2) Procurement of a new site is not necessary and expansion is easy.

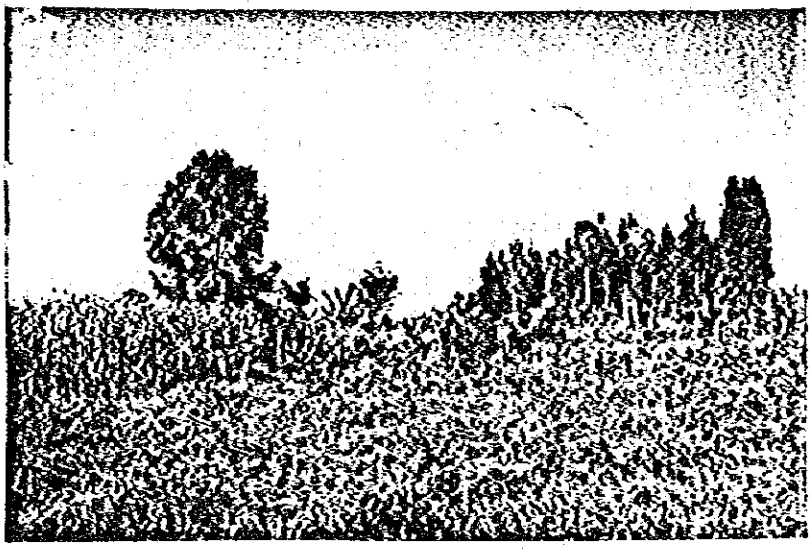
(3) The earth station can gain access to both Atlantic Ocean Satellite (AZ = 272°, EL = 18°) and Indian Ocean Satellite (AZ = 87°, EL = 50°).
See Fig. 2-1 "Skyline elevation angle of Kigali Earth Station (Nyanza)."

(4) There is no problem in both artificial noise and city planning.

(5) A good visibility is achieved with the communications center (Bâtiment Technique), facilitating the setting of a radio link for approach.



The direction of Atlantic Ocean Satellite from proposed earth station site



The direction of Idian Ocean Satellite
from proposed earth station site

The proposed site faces Umuganda in Kacyiru plateau (3km from the center of Kigali in straight line distance), which was determined to be the most promising proposed site by the last study (March 1979), is unsuitable because of the unsolved problem in city planning.

2-3 Essentials of Specifications for the Earth Station

It is recommended to construct the following INTELSAT Standard B earth station.

2-3-1 General

This paragraph specifies the requirements for the INTELSAT Standard B earth station to be constructed in Rwanda. Matters not specified herein should meet the required performance characteristics of

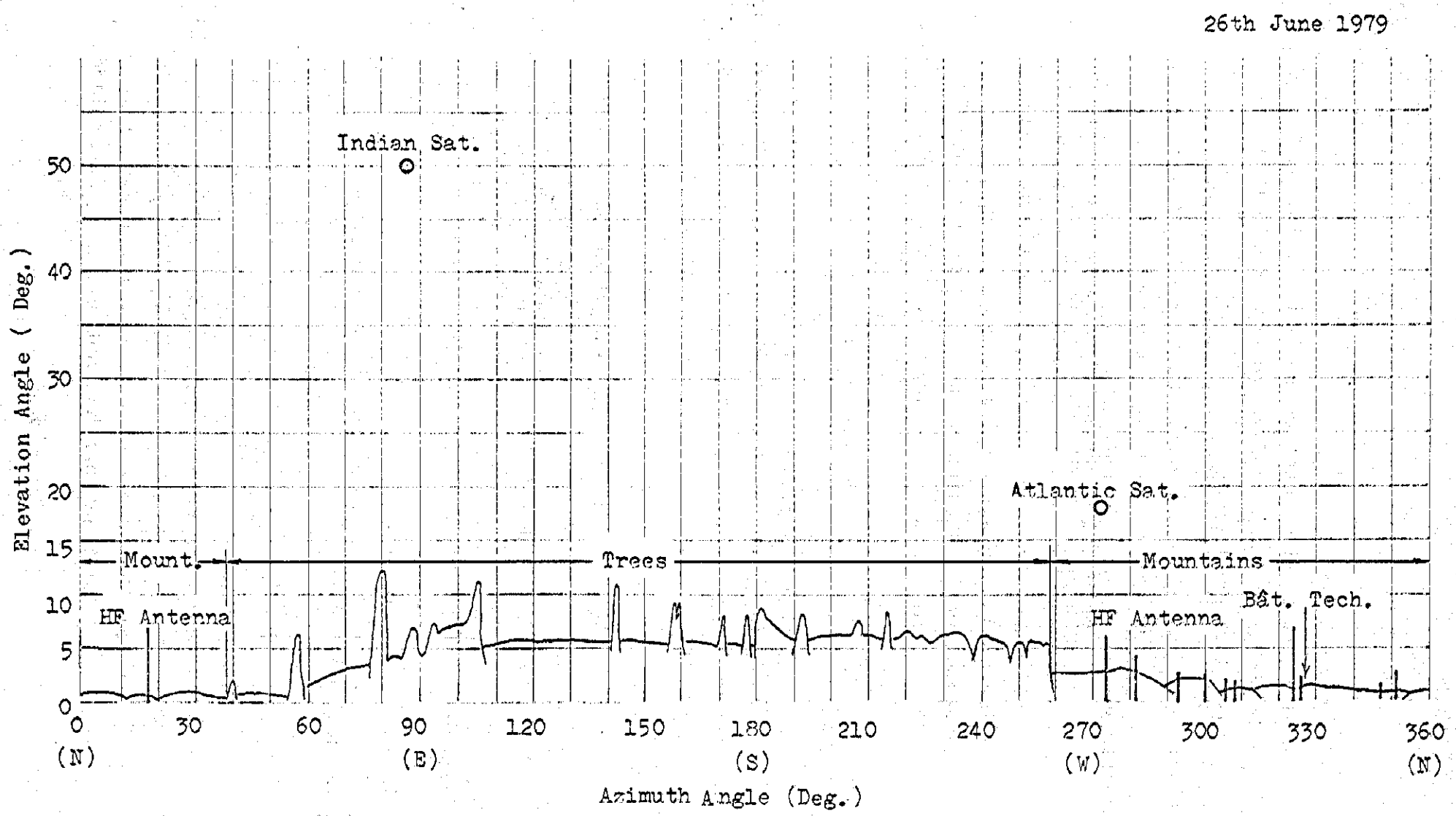


Fig 2-1 Skyline Elevation Angle of KIGALI E/S (NYANZA)

a Standard B earth station set out by INTELSAT (BG-28-74) and set confirm to applicable CCIR and CCITT Recommendations.

2-3-2 Configuration

The proposed earth station system consists of an antenna subsystem, a radio subsystem, a power supply subsystem and a communications center subsystem, as shown in the system diagram of Fig. 2-2. The proposed earth station site has an area of 4,900m^2 (70m x 70m), a layout of which is shown in Fig. 2-3.

2-3-3 Capacity

The initial installation capacity of this earth station is to be 14 channels (4 destinations) including 2 ESC channels, of which the breakdown is shown in Table 2-1. The final capacity is to be 60 channels.

Table 2-1 Initial Installation Capacity

Country	Earth Station	Telephone Channel	Voice Channel for VFTG	Total
France	Pleumeur-Bodou-4	CH	CH	CH
Kenya	Longonot-1			
Netherlands	Burum-2			
U.K.	Madley			
ESC		(TP + TG)		2
Total				14

Note: The number of channels for respective destinations has not yet been determined.

2-3-4 Safety

Consideration should be given for the safety of operating and maintenance personnel. In particular, high-voltage equipment should have protective circuits to assure personnel safety against hazard.
Proper protective means should be provided on all mechanically movable sections in the system.

2-3-5 Operating Conditions

Each equipment shall meet the following requirements in continuous operation.

(1) Temperature and humidity

	Indoor	Outdoor
Ambient temperature	5 ∿ 35°C	-10 ∿ 45°C
Ambient humidity	10 ∿ 90%	0 ∿ 100%

(2) Wind velocity

Average	up to 20m/s
In gust:	up to 27m/s

(3) Power requirements

Supply voltage:	3 phases/4 wires, 380V ± 10%
Frequency:	50Hz ± 1Hz

Required power capacity shall be specified in the proposal.

(4) Satellite to be used

IS-IVA satellite system in Atlantic or Indian Ocean region. Consideration shall be given to access to the IS-V satellite system.

2-3-6 Overall Performance Characteristics

(1) Figure of merit: $G/T \geq 31.7$dB (at 10° EL)

(2) Reliability: more than 99.8%

(3) Required level stability and frequency stability should be specified in the proposal.

(4) Design life: more than 15 years under normal operation and maintenance

2-3-7 Antenna Subsystem

The diameter of the main reflector shall be 13m and the tracking system shall be an AZ-EL type autotracking system.
Dual polarization shall be used for the feeder system.

2-3-8 Low-Noise Amplifier Subsystem

An in-service/stand-by low-noise amplifier subsystem using two parametric amplifiers each having a noise temperature of less than 45°K shall be employed.

2-3-9 High-Power Amplifier Subsystem

An in-service/stand-by high-power amplifier subsystem using two klystron amplifiers each with an output of 1.5kW shall be used.

2-3-10 Frequency Converter Subsystem

An in-service/stand-by frequency converter subsystem using two up converters and two down converters shall be employed.

2-3-11 SCPC Terminal Equipment

SCPC terminal equipment shall provide an initial capacity of 14 channels including 2 channels for ESC and expandable to a maximum of 60 channels. Carrier frequency will be specified later.

2-3-12 ESC Equipment

Shall provide 2 telephone circuits incorporating 2 teletypewriters.

2-3-13 Control and Monitor System

The control and monitoring system and items to be controlled or monitored shall be specified in the proposal.

2-3-14 Electric Power Supply Subsystem

A 35KVA non-break power equipment shall be installed. The power supply interface point shall be on the output terminals of the distributor in the existing power building.

2-3-15 Communications Center Subsystem

The earth station associated facilities to be installed in the communication center are as follows and shall included in this project.

(1) Echo suppressor shall be composed of 8 units.

(2) VFTG equipment shall have a capacity of 4 voice channels (24 telegraph channels).
The signal speeds will be specified later.

2-3-16 Shelter

All subsystems to be installed in the earth station except the power supply subsystem shall be housed in a shelter with an airconditioner. The shelter including the airconditioner shall be included in the project. The shelter shall accommodate also the carrier terminal equipment of which the specifications are shall be set out separately.

2-3-17 Test Equipment

Test equipment necessary for tests specified in the INTELSAT Satellite System Operation Guide (SSOG) should be provided. A list of the test equipment shall be given in the proposal.

2-3-18 Attachment

Accessories, spares for two years, special tools, manuals (in English), drawings, and test data shall be attached. A list of these attachments shall be given in the proposal.

2-3-19 Assistance in Operation and Maintenance

A technical staff shall be sent to the site for giving assistance in the lineup test of the satellite communication links, the operation and maintenance of the earth station subsystems and the radio transmission equipment to be provided on separate specifications, and guidance in OJT (on the job training).

2-3-20 Factory Training

Factory training should be given to two technical personnel of the earth station for a period of two months. Expenses for the stay of the trainees during the period of factory training and their round-trip airway fare should be paid by the contractor. The curriculum of the factory training should be specified in the proposal.

2-3-21 Others

The contract of the project should include the following items as well.

(1) Site survey

(2) Construction and installation (including supply and transportation of construction materials)

(3) Factory inspection, adjustment and test at site, and INTELSAT Verification Test (test items should be specified in the proposal)

(4) Supply of technical data necessary for foundation work of antenna and shelter, grounding, and construction of power building (with ventilator)

(5) Supply of techincal data on floor area, etc., necessary for communications center subsystem

(6) Construction of antenna aviation obstruction light

2-4 Obligations of MPC

MPC is responsible for the following items.

2-4-1 Negotiations and procedures with INTELSAT, related foreign administrations and foreign communication

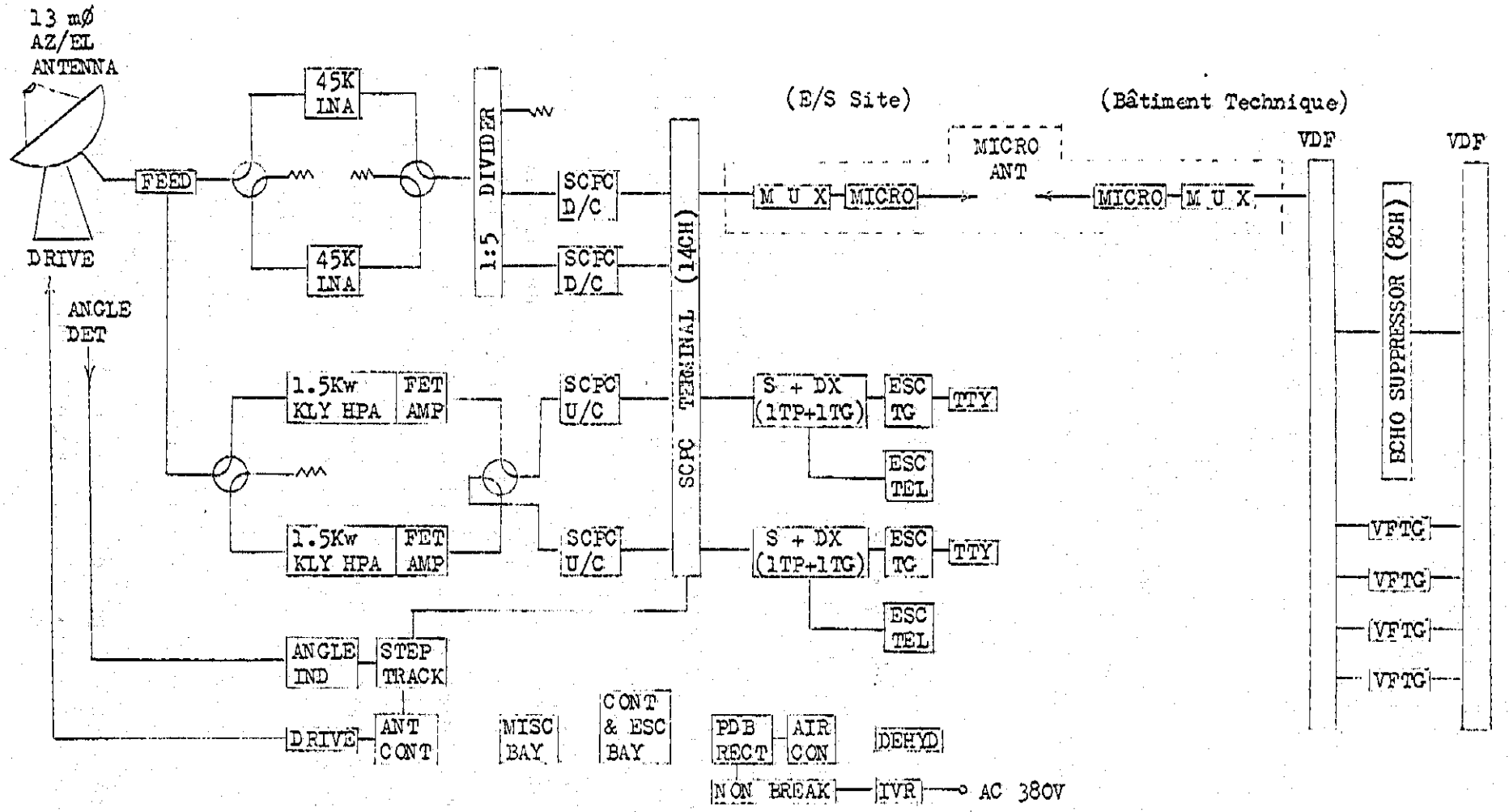


Fig 2-2 System Block Diagram for a STD-B Earth Station

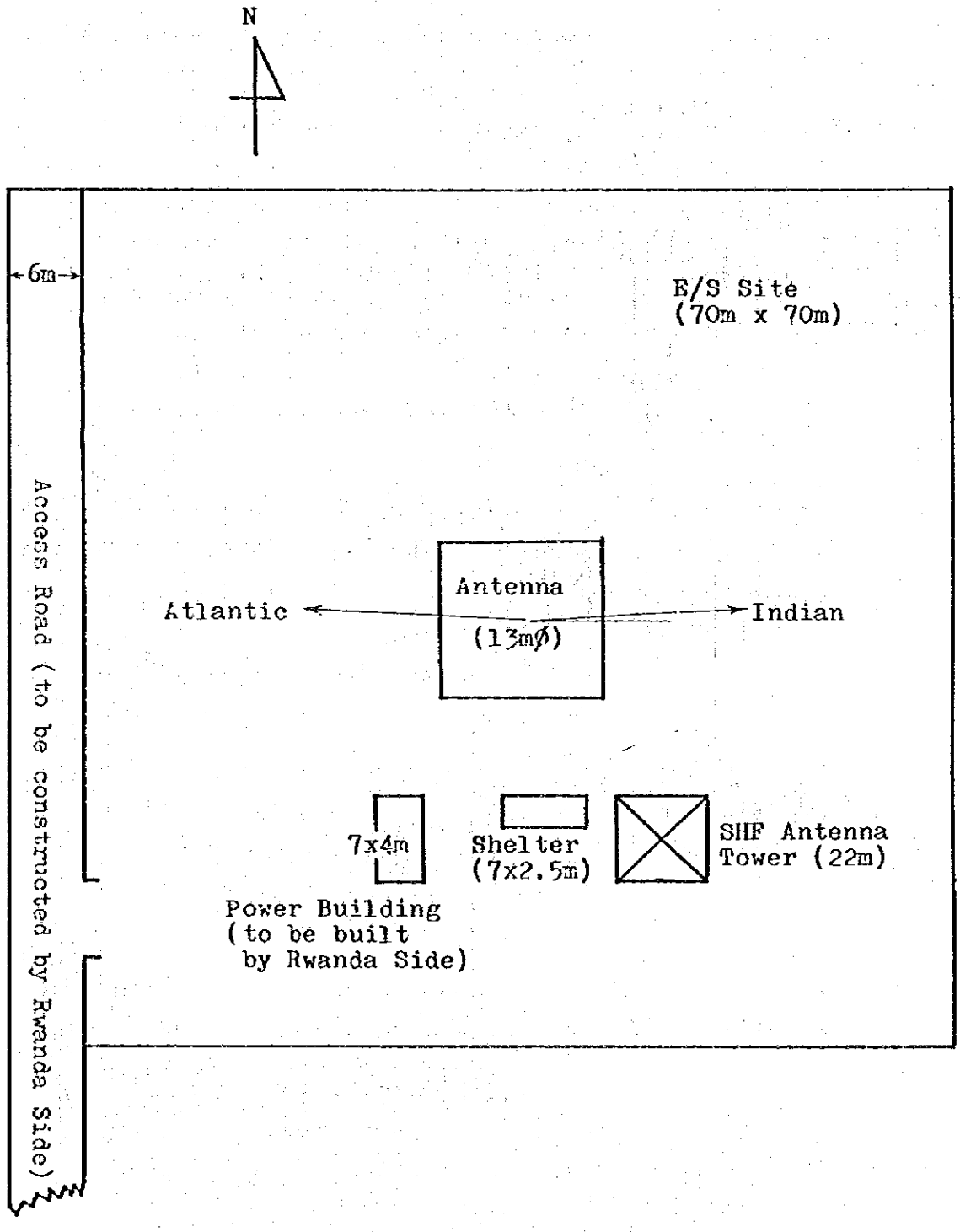


Fig 2-3 An Example of Layout of the Earth Station

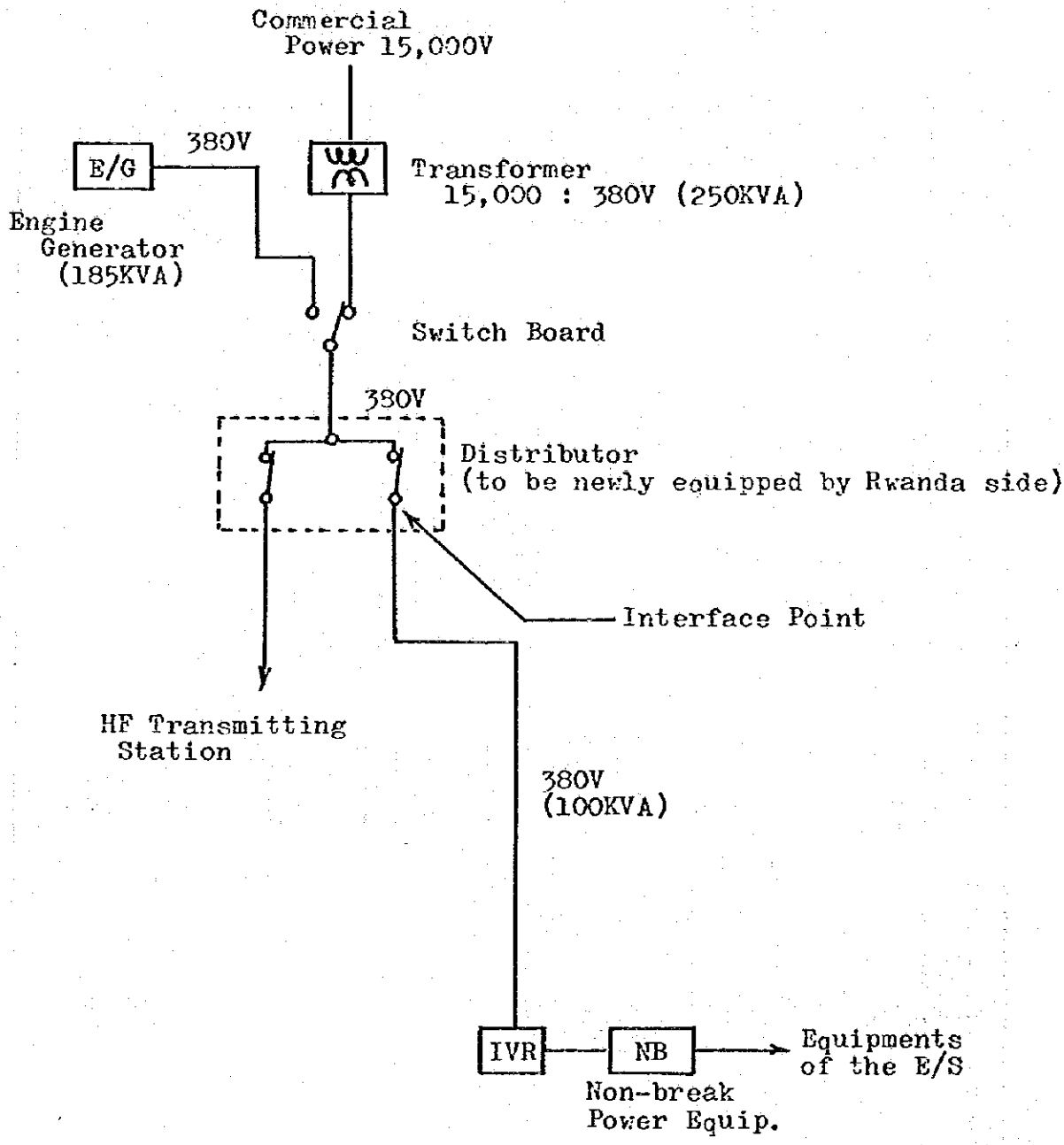


Fig 2-4 Interface of Power Source for the Earth Station

entities concerned, in connection with the establishment of the earth station.

(1) Negotiations and procedures based on the INTELSAT document, "Procedures governing application, approval, varification and operation of earth station in the INTELSAT system"

(2) Negotiations and procedures related to the opening and closing of international circuits with related foreign administrations and foreign communications entities

2-4-2 Preparation of coordination documents and negotiations

Documents necessary for coordination with neighboring countries should be prepared and negotiations should be conducted with Administrations concerned, on the basis of the ITU Radio Regulations.

2-4-3 Provision of the earth station site of 4,900m^2 (70m x 70m) in the existing Nyanza HF Transmitting Station. After decision of the site, the site should be leveled promptly without admitting any right of farming.

2-4-4 Construction of access road of a 6m width in a length of 250m to south on the west side of the site (see Fig. 2-3).

2-4-5 Grounding and foundation work of antenna and shelter

2-4-6 Foundation work of antenna aviation obstruction light and construction of related trench

2-4-7 Construction of earth station office of about 20m^2 and storehouse of about 15m^2 in the existing HF Transmitting Station building

2-4-8 Provision of floor area for earth station associated equipment to be installed in Bâtiment Technique

2-4-9 Provision of interface distributor with the distributor output terminals being power supply interface point as shown in Fig. 2-4. The required power on the earth station side should be 3 phases/4 wires, 380V, 50Hz, 100KVA.

2-4-10 Construction of power building (with ventilator) of 7m x 4m or so as shown in Fig. 2-3 and construction of trench for laying power cable between existing power building and new power building (about 150m) and between new power building and shelter (about 30m) (excluding cable laying).

2-4-11 Measures for prohibition of airplanes' passing over the earth station after completion of the earth station.

2-4-12 Provision of construction office, storehouse or place for safe-keeping construction materials, vehicles for transportation of construction materials (including drivers and fuel) and unskilled labours and nomination of counterpart among MPC staff,

2-4-13 Provision of earth station operation and maintenance personnel, arrangement of training, and smooth growth of technical personnel.

2-4-14 Self-active management of operation and maintenance of the earth station.

Study team members and local labourers under site survey

The proposed earth station site which is currently kaoliang or green pea field

2-5 Organization of Earth Station and Training Plan for Operation and Maintenance Personnel

For the organization of the earth station and training plan for smooth operation and maintenance of the earth station, the study team recommends as follows.

2-5-1 Such an organization as shown in Table 2-2 should be set up in the earth station for smooth operation and maintenance. The duties of the respective personnel are given in Table 2-3.

2-5-2 The earth station will be operated by a total of 13 MPC personnel plus one contractor's engineer to be sent to stay at a site for a period of one year from the service-in of the earth station.

2-5-3 An example of training plans is given in Table 2-4.

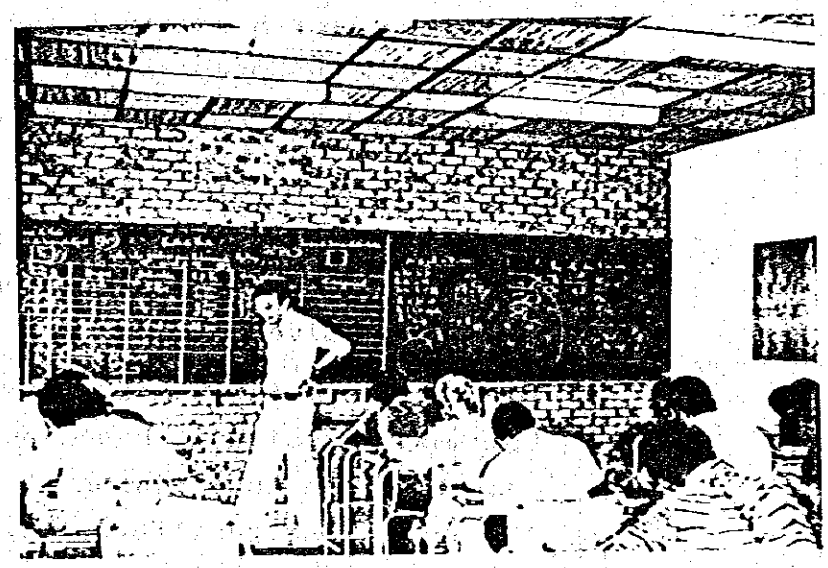
2-5-4 Two types of training are to be provided in Japan: group training by the Japanese Government and factory training by the contractor.

2-5-5 After the commencement of the service of the earth station, all technical personnel shall participate in OJT (On-the-Job Training) to develop their technical level. Instructors in OJT will be the technical personnel to be sent by the contractor, those engineers to attend the group training or factory training, and engineers specialized in their respective fields.

2-5-6 The group training by the Japanese Government in satellite communication engineering will be conducted in two courses, regular course and advanced course. One person from each country will in principle participate in each course so that it is desirable for MPC to send each one personnel to attend these courses. Participants of the advanced course should have the experience of INTELSAT satellite communication service for at least 3 years.

2-5-7 The factory training to be arranged by the contractor will be conducted for a period of about 2 months.

2-5-8 It is desirable to provide a ragular satellite communication engineering course in the Ecale Nationale des Postes et Télécommunications for continued training of new technical personnel.



A lecture at Ecole Nationale des Postes et Télécommunications

Table 2-2 Proposed Organization for Operation and Maintenance of Standard B Earth Station

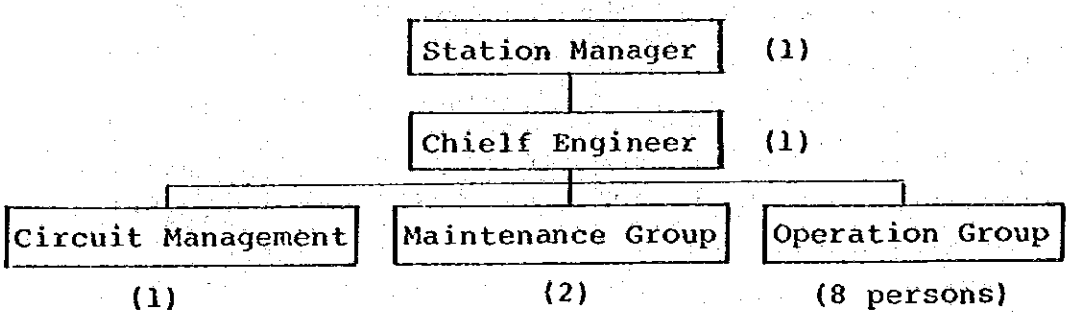


Table 2-3 Duties of the Technical Personnel in the Earth Station

Section	Number of Persons to Be Assigned	Duty
Station Manager	1	Responsible for general affairs of the earth station.
Chief Engineer	1	Administrative and engineering control of the earth station.
Circuit Management	1	Preparation of transmission circuit operation programs based on SSOG, negotiation with other earth stations and ITMCs concerned, and preparation and management of training and technical data.
Maintenance Group	2	Maintenance and repair of facilities, establishment and adjustment of facilities based on SSOP, and preparation of various reports involved.
Operation Group	8	Testing and maintenance of satellite transmission circuit based on SSOG, operation and supervision of satellite communications facilities involved, and preparation of various reports. (Work in shift: 2 persons x 4 groups)
Total	13	

Table 2-4 An Example of Training Plans

	No. of Persons to Be Assigned	Year		
		1980	1981 ~ 1983	In And After 1984
Station Manager	1			
Chief Engineer	1	Group training course (Regular)		
Circuit Management	1	Two-month factory training by contractor (Assign 2 persons out of 11 persons)	Group training course (Regular) (Assign one persons out of 11 persons)	Assign each one person for both group training courses (Regular & Advanced) every year
Maintenance Group	2			
Operation Group	8			
Total	13		All technical personnel should attend OJT after service-in	

2-6 Satellite to Be used and Destinations of Communication

MPC has determined to employ the primary satellite in the Indian Ocean region on the basis of its new plan in consideration of rapid increase in commercial traffic, Kenya's access to the Indian Ocean region satellite, increase in traffic with Asia particularly Japan, China, and India, and the capability of establishing direct links in future.

The destinations of direct satellite communication in the initial stage of 1982 will be France, Kenya, the United Kingdom, and Belgium (via Netherland) and the total number of channels will be 12 voice channels or less at the time of the commencement of the serivce. Communication with West African counties will be made via France and communication with East African countries via Kenya. The Rwanda-U.K. link will be used for communication with other English-spoken countries.

2-7 Operating Cost of the Earth Station

The estimated amount of total annual operating cost is about ¥45,000,000 including the rent of the satellite (for 12 channels in 1982), personnel expense for 13 technical personnel, electric fee (100KVA), expenses for components and parts for maintenance of equipment and facilities, and office supplies.

CHAPTER 3

INTERNATIONAL TELEPHONE SWITCHING

Chapter 3 International Telephone Switching System

3-1 General

An electronic switching system using a stored program control system will be installed as the CT3 stage at Bâtiment Technique. At the initial stage semi-automatic and manual calls will be handled at operator positions but the system will facilitate the addition of the function of ISD (International Subscriber Dialling) in future. The function of CTN (Center Transit National) desired by MPC in the preliminary survey will be achievable after completion of the arrangement of the domestic network. Accordingly, the following calls will be handled at the initial stage.

(1) Originating international calls	Manual (both demand and delay) basis
(2) Terminating international calls	Automatic and manual basis
(3) International transit calls	Manual transit basis

For the capacity, 40 circuits will be provided which will be expansible to a maximum of 200 circuits at the final stage. Fifty (50) circuits will be assignable. MPC shall accomplish office building expansion and equipment expansion or modification of the existing switching system for the achievement of interface with the new system to be introduced.

3-2 Outline of System

3-2-1 General Requirements

(1) An international telephone switching system of

the CT3 stage shall be installed at Bâtiment Technique

(2) This international telephone switching system shall be an electronic switching system using a stored program control system.

(3) This system will handle mainly manual calls through operator opsitions at the initial stage but shall facilitate the addition of the function of ISD (International Subscriber Dialling) call in future.

(4) Shall provide detailed billing facility.

(5) Shall use highly reliable integrated electronic component parts.

(6) Shall have a modular construction to assure ease of expansion.

(7) Shall employ a duplicated central processor and automatic reconfiguration facility.

(8) Shall assure ease of maintenance, diagonosis, and testing.

(9) Shall facilitate the addition of the CTN (Center Transit National) function after arrangement of the domestic network.

3-2-2 Basic Configuration

Fig. 3-1 shows a basic configuration of the proposed system.

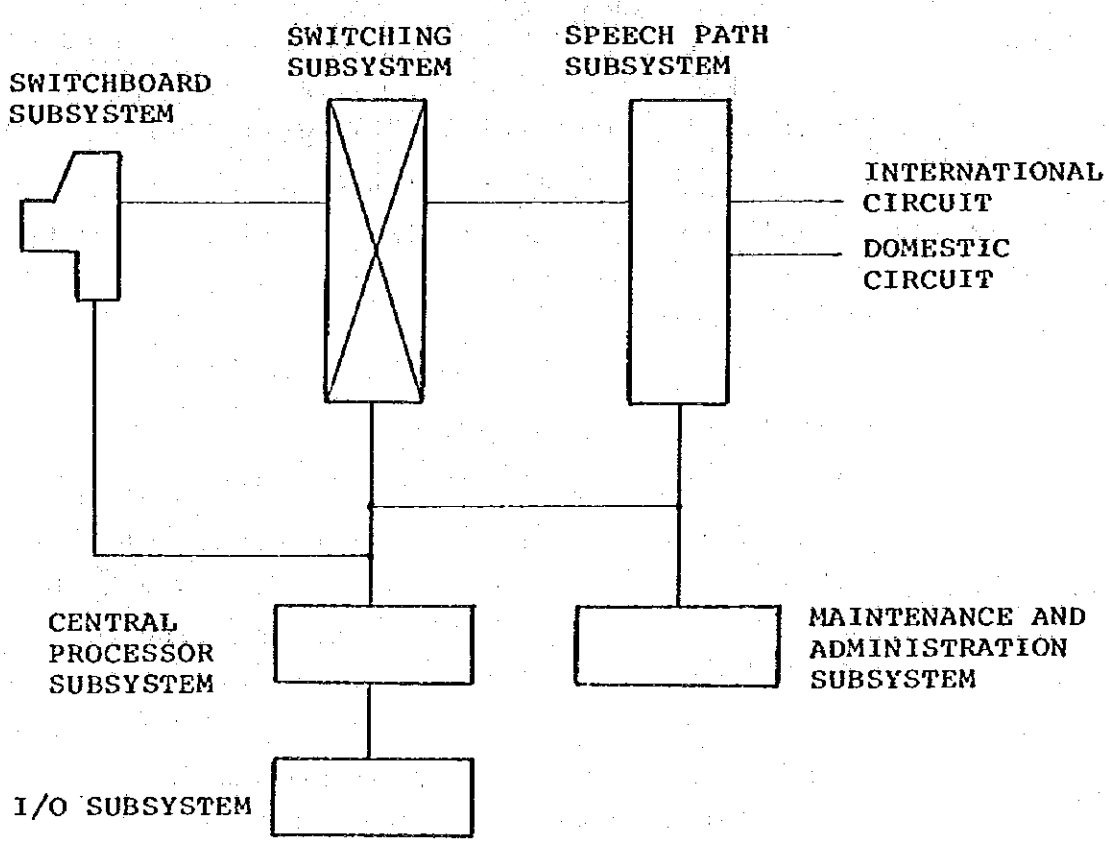


Fig. 3-1 Basic Configuration

3-3 Basic Scheme

3-3-1 Classification of Calls

(1) Originating international calls

Manual (both demand and delay) basis and ISD calls in future

(2) Terminating international calls

Atuomatic and manual basis

(3) International transit calls

Will not be handled in principle although will be able to be handled through operator when the occasion demands.

(4) Domestic mutual calls (CTN function) in future

Addition of the function of CTN will be allowed after completion of the arrangement of the domestic network.

3-3-2 Network Plan

(1) Number of international circuits

1) Initial stage	40 circuits. Of these circuits, 12 circuits are to be of CCITT No.5 signalling system and 28 circuits of CCITT R2 signalling system.
2) Final stage	200 circuits. Assignment to CCITT No.5 and R2 signalling systems is not yet determined.

(2) Number of domestic circuits

50 circuits in total. 15 circuits for Kigali local exchange and the remaining 35 circuits for other local exchanges.

(3) Network

The proposed switching network to be adopted upon introducing this system is shown in Fig. 3-2.

3-3-3 Numbering Plan

The international numbering plan to be employed in this system shall conform to the CCITT Recommendation, that is, each international number consists of a maximum of 12 digits except prefix. Discriminating digit "0" in full-automatic originating calls and the language code in semi-automatic originating calls should be inserted automatically in this system. The domestic numbering plan shall basically conform to the existing numbering plan.

3-3-4 Trunking

(1) Outgoing selection

a) Sequential selection shall be adopted for both way operation routes and random selection for one way operation routes.

b) Alternative routing shall be provided..

(2) Barring condition

Temporary barring shall be achievable for any destination route.

(3) Overload Countermeasures

a) Overload condition shall be detected by supervising the system operation at all times.

b) The system shall allow necessary restriction either automatically or manually in the event of overload condition.

3-3-5 Charging System

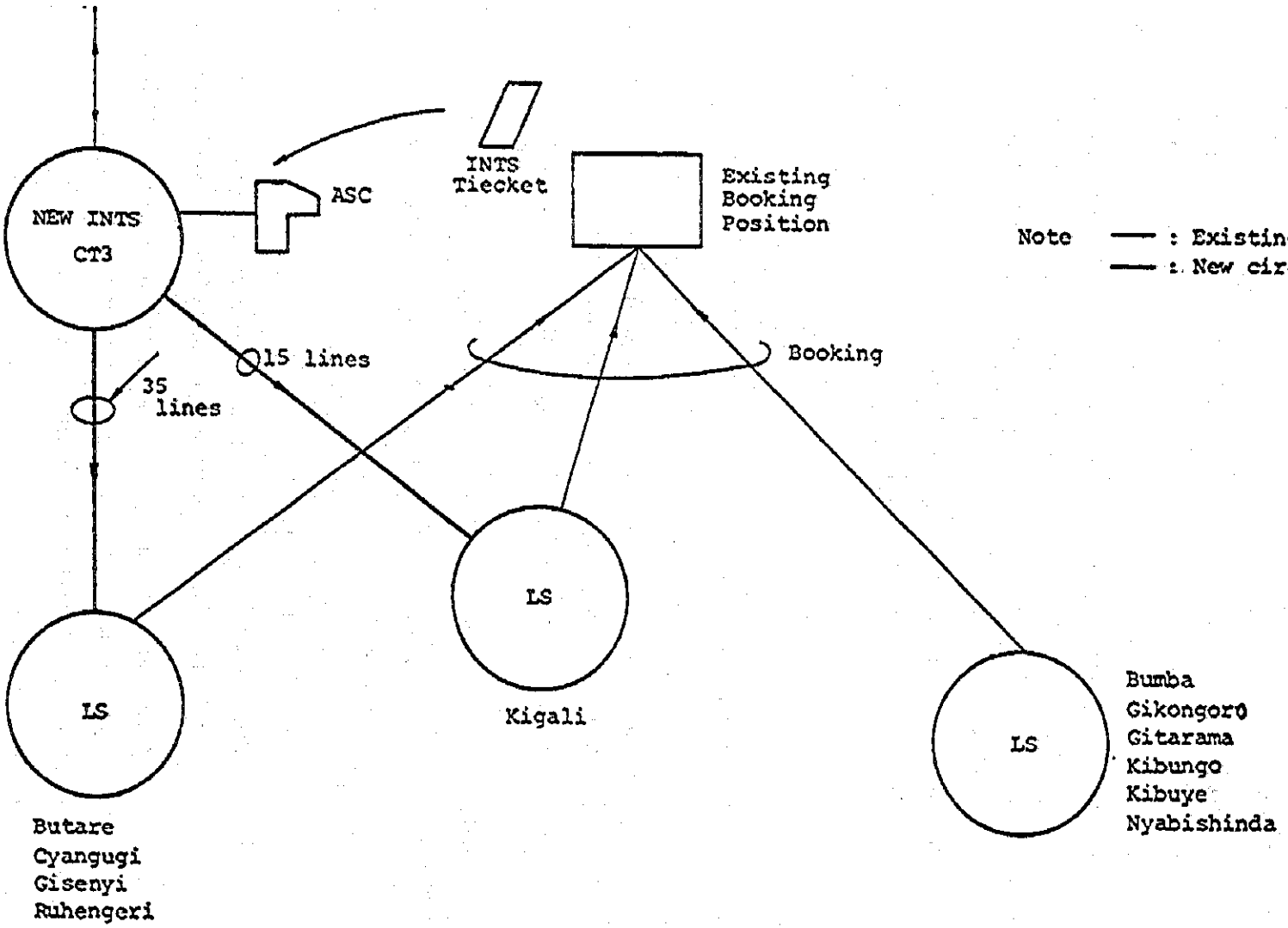


Fig. 3-2 SWITCHING NETWORK PLAN

(1) Charging

All international calls shall be charged by the detailed charging system as s route. When the function of CTN is introduced in future, CTN calls will be charged by detailed charging system or multi-metering pulse system.

(2) Charging information

The following information shall be recorded.

a) Calling subscriber number
b) Called subscriber number
c) Answer time and duration of conversation
d) Outgoing trunk route
e) Class of connection and subscriber category

(3) Call required to inform the charge

The duration of conversation time shall be printed out on teletypewriter, depending on the class of originating subscriber.

3-3-6 Signalling System

(1) International circuits

CCITT Recommendation No.5 and R2 signalling system. If any other signalling system is desired, further discussion shall be made for agreement.

(2) Domestic circuits

The continuous out-band system using 3825Hz signal to be employed for loop signalling, E & M signalling system for signalling with

carrier terminal equipment, and the dial pulse system for resistor signalling.

3-3-7 Maintenance and Test

(1) General requirements

Automatic supervision, test, and diagnosis shall be achievable by both hardware and software. Such functions as location of faulty equipment, reconfiguration of the system, repair of faulty package, preventing maintenance, inspection, and expansion and modification of circuits shall be provided.

(2) Supervision

The following functions shall be provided.

a) Lamp indication and audible alarm indication functions for faulty equipment

b) Print-out of fault condition on teletypewriter

c) Lamp indication of system operating condition

(3) Maintenance test and diagnosis

The following items shall be provided.

a) Diagnosis by test and diagnosis programs

b) Manual test and inspection by maintenance personnel

c) Connection test by designating circuit and equipment

3-3-8 Traffic Control

Traffic shall be supervised continuously and

following traffic data shall be printed out on teletypewriter or recorded on magnetic tape.

(1) For each trunk group

a) Total number of seizures
b) Total number of effective calls
c) Total number of ineffective calls
d) Total number of calls accepted by console
e) Total number of calls completed by console

(2) For each sender and receiver

a) Number of senders and receivers seized
b) Number of congestions

(3) For switchboard

a) Number of consoles attended by operators

(4) For each operator

a) Number of calls handled by operator

(5) For main processor

a) Occupancy

3-3-9 System Operation Conditions

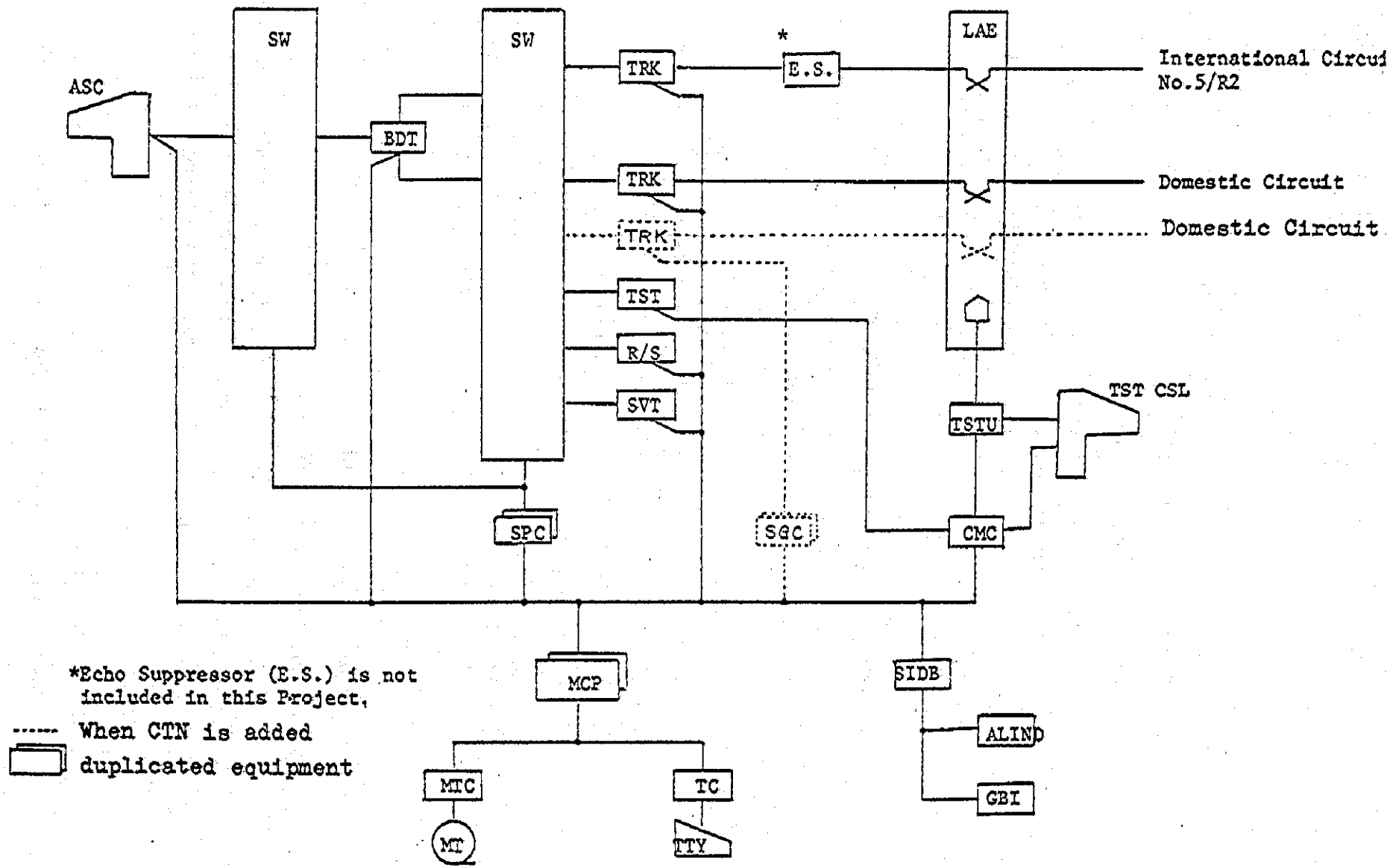
(1) Guaranty for final capacity

The central processor in this system shall be able to process the loaded traffic when the number of international circuits is expanded to 200.

(2) Reliability

The system shall be designed to assure such

FIG 3-3 SYSTEM COMPOSITION FOR RWANDA INTS



a high reliability that its system down time shall be less than one hour for 20 years.

(3) Environmental conditions

a) Normal operating condition

Ambient temperature:	23°C ± 5°C
Humidity:	60% ± 10%

b) Serviceable range

Ambient temperature:	0°C ∿ 40°C
Humidity:	10% ∿ 90%

3-4 System Configuration

3-4-1 System Configuration

Fig. 3-3 shows a diagram of system configuration. Equipment abbreviations are listed in Table 3-1.

(1) Switching subsystem

The switching subsystem consists of switch network and speech path controller to set up speech paths.

(2) Speech path subsystem

The speech path subsystem consists of various kinds of trunk and signalling equipment for handling telephone signals.

(3) Central processor subsystem

The central processor subsystem consists of a main central processor.

Table 3-1 List of Abbreviations

Abbreviation	Explanation
ALIND	Alarm Indicator
ASC	Assistance Service Console
BDT	Board Trunk
CMC	Circuit Maintenance Controller
E.S.	Echo Suppressor
GBI	Group Busy Indicator
LAE	Line Access Equipment
MCP	Main Central Processor
MT	Magnetic Tape
MTC	Magnetic Tape Controller
R/S	Receiver/Sender
SGC	Signal Controller
SIDB	System Information Display Board
SPC	Speech Path Controller
SVT	Service Trunk
SW	Switching Network
TC	Teletypewriter Controller
TRK	Trunk
TST	Test Trunk
TST CSL	Test Console
TSTU	Test Unit
TTY	Teletypewriter

(4) I/O subsystem

The I/O subsystem consists of I/O equipment such as teletypewriter, magnetic tape and I/O controller

(5) Position subsystem

The position subsystem consists of a switch board and a board trunk for handling manual calls.

(6) Maintenance and administration subsystem

The maintenance and administration subsystem consists of a test console and an alarm indication panel.

3-4-2 Traffic Conditions

(1) Destinations of international circuits

Table 3-2 gives expected destinations, the number of circuits, and traffic.

Table 3-2

Signaling System	Destination	Operating Mode	Number of Circuits	Traffic (Erl)*
CCITT No.5	Paris	Both-way	4	0.87
	Kenya	do.	2	0.15
	Brussels	do.	2	0.15
	London	do.	2	0.15
	Spare	do.	2	0.15
CCITT R2	Bujumbura	do.	8	3.13
	Kampala	do.	8	3.13
	Kinshassa	do.	8	3.13
	Spare	do.	4	0.87
Total			40	11.73

* Loss probability: 1/100

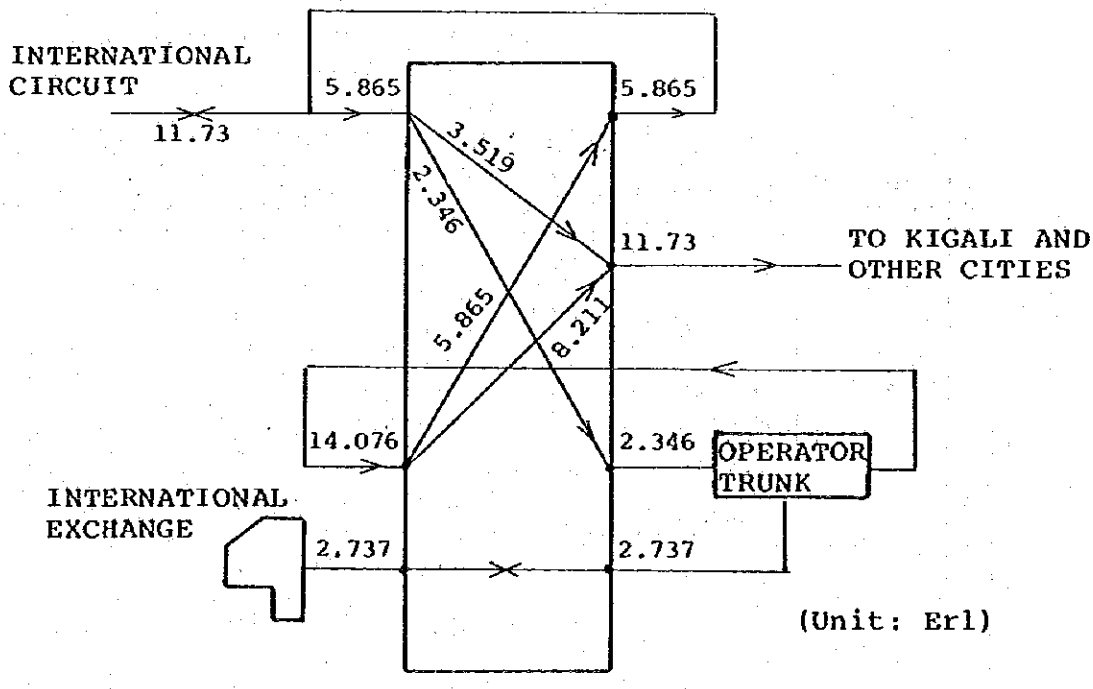
(2) General requirements

In this system, the traffic condition is supposed to be as follows.

a)	Originating calls	Manual calls: 100%
b)	Terminating calls	Automatic terminating calls: 60%
		Manual calls: 40%
c)	Average holding time:	180 sec
d)	Average operator processing time:	60 sec
e)	Average operator processing efficiency:	70%
f)	Number of originating calls to number of terminating calls:	50:50

(3) Traffic flow

Traffic flow obtained as per (1) and (2) is shown in Fig. 3-4.



Traffic flow is 22.678 Erl for both incoming and outgoing calls.

Fig. 3-4 Traffic Flow

3-4-3 List of Equipment

The following items of equipment shall be installed as per paragraphs 3-4-1 and 3-4-2 above.

(1) Major equipment

	Equipment	Q'ty
a)	Switch Frame	1
b)	speech Path Control Frame	1
c)	Trunk Frame	3
d)	Miscellaneous Frame	1
e)	Control Processor Frame	1
f)	System Bus Control Frame	1
g)	Operator Trunk Frame	1
h)	Circuit Maintenance Control Frame	1
i)	System Information Display Board	1
j)	Alarm Indication Panel	1
k)	Circuit Interruption Equipment Bay	1
l)	Circuit Test Bench	1
m)	Operator's Exchange	5
n)	Line Access Equipment Frame	1
o)	Group Busy Indicator	1
p)	Magnetic Tape Equipment	3
q)	Teletypewriter	2

(2) Power equipment

a)	-48V Power Equipment (including rectifier and bateries) Power can be provided for 4 hours by the initial capacity upon power failure	1 lot

(3) Installation materials and tools 1 lot

(4) Spare parts for 2 years 1 lot

(5) Maintenance test equipment and tools 1 lot

3-4-4 Software Configuration

The following programs will be provided for efficient operation of the systems.

(1) Execution control program (EP)

EP controls the execution of all application programs and input/output operations.

(2) Fault processing program (FP)

FP analyzes faults, reconfigurates the system depending on the fault, and restarts switching processing.

(3) Call processing program (CP)

CP executes a series of processing ranging from the setting up to clearing of telephone calls.

(4) Administration program (AP)

AP executes commands inputted by maintenance personnel in traffic control and other administrative jobs.

(5) Diagnosis program (DP)

DP executes test for faulty package and locate the fault.

3-4-5 Floor Layout Plan

Refer to the paragraph on the floor layout plan.

3-5 Scope of Work

3-5-1 Works to Be Performed by the Contractor

The contractor shall be responsible for the following works.

(1) Supply of equipment and materials for new facilities (both hardware and software), installation, and testing

(2) Technical documenation

The contractor shall submit manuals, instuctions, drawings, etc., written in English, which shall contain sufficient information for maintenance personnel to operate and maintain the system as required.

(3) Training

The contractor shall provide the following kinds of training to engineers assigned by MPC. Training programmes shall be proposed by the contractor and determined by mutual agreement between MPC and the contractor.

a) Factory training

A training for a period of 2.5 months shall be given to 3 trainees by the contractor.

b) On the job training (OJT)

The contractor shall provide OJT at the site for 10 ∿ 20 technical personnel including engineers and operators.

c) Language

All training shall be conducted in English.

d) Textbooks

The contractor shall provide all necessary textbooks for all trainees.

e) Expenses

All expenses including round-trip air fare and living expenses shall be paid by the contractor.

(4) Assistance in operation and maintenance

Contractor shall provide supervision and engineering support services in operation and maintenance by one engineer sent from the contractor for a period of 12 months after the service-in of the system.

3-5-2 Works to Be Performed by MPC

MPC shall be responsible for the following works.

(1) Expansion of building (equipment room, operator room and power equipment room) including grounding work and provision of cable holes, lighting and utility power, power distributor, etc.

(2) Expansion or modification of the existing domestic exchange for provision of new circuits with new international switching system

(3) Cable laying and wiring of the existing switching system to the distribution frame of the new international switching system

3-5-3 Cabling Diagram

Fig. 3-5 shows the relation and cabling between the main switching equipment and power equipment.

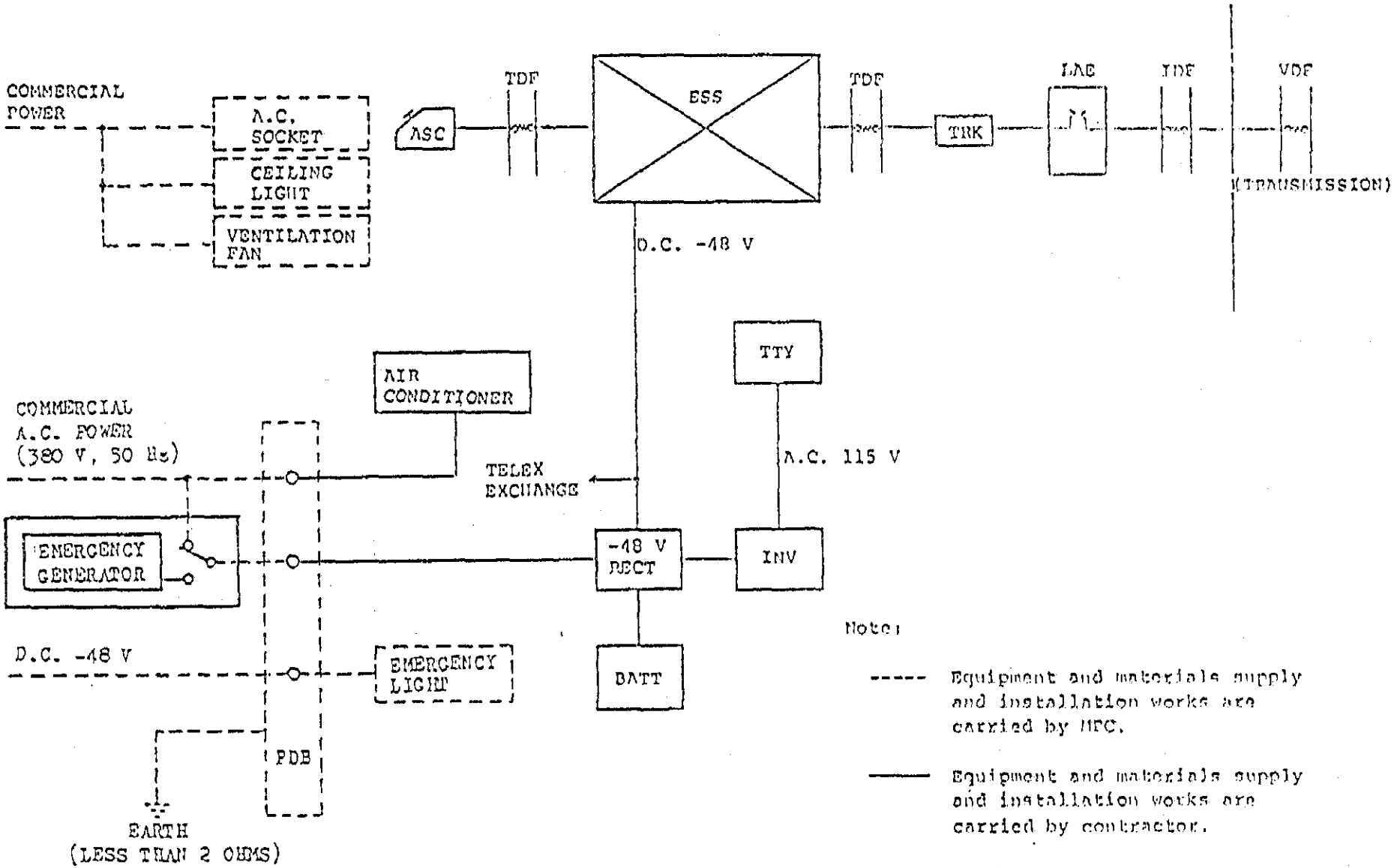


Fig. 3-5 Cabling Diagram

CHAPTER 4

INTERNATIONAL TELEX SWITCHING SYSTEM

Chapter 4 International Telex Switching System

4-1 General

An electronic international telex switching system using a stored program control system will be installed at Bâtiment Technique. Full-automatic operation will be introduced in principle and operator positions will be provided for handling semi-automatic and manual calls as well. The following calls will be handled.

(1) Originating calls	Automatic, semi-automatic and manual calls
(2) Terminating calls	Automatic and manual terminating calls
(3) International transit calls	Automatic and manual transit calls
(4) Originating and terminating calls through position	

In capacity, 64 circuits including both international and domestic circuits will be provided at the initial state.
MPC shall be responsible for the provision of necessary space in the building to be expanded and arrangement of the existing switching system for interface with the new switching system to be introduced.

4-2 Outline of System

4-2-1 General Requirements

(1) An international telex switching system shall be installed at Bâtiment Technique.

(2) The system shall be a fully electronic switching system using a stored program control system

(3) The system shall provide necessary position equipment for handling semi-automatic and manual calls as well.

(4) Shall provide detailed billing facility.

(5) Shall employ time division circuit switching technique

(6) Shall use high-reliability integrated electronic component parts.

(7) Shall employ modular construction to assure ease of expansion.

(8) The central processor shall be duplicated and the function of automatic system reconfiguration shall be provided.

(9) Shall facilitate maintenance, diagnosis, and testing.

4-2-2 Basic Configuration

The basic configuration of the proposed system is shown in Fig. 4-1. The proposed system consists mainly of three subsystems, switching subsystem, maintenance and control subsystem, and position subsystem.