IV. INTERIM REPORT

ON

PRELIMINARY DESIGN STUDY

FOR

THE SATELLITE

COMMUNICATION SYSTEM PROJECT

IN

THE RWANDESE REPUBLIC

JULY 1979

JAPAN
INTERNATIONAL
COOPERATION
AGENCY

PREFACE

In response to the request of the Government of the Rwandese Republic, the Government of Japan gas decided to conduct the preliminary design study for the satellite communication system project as a part of its technical cooperation programmes to foreign countries.

Based on this decision, the Japan International Cooperation Agency (JICA), the official agency responsible for the implementation of the cooperation programmes has organized and despatched a team to the Rwandese Republic to carry out the study.

The team consists of six experts headed by Mr. Fukuda, Special Advisor for International Cooperation, Minister's Secretariat, Ministry of Posts and Telecommunications (MPT), as shown in the following member list.

The team successfully executed the study necessary for preparing the preliminary design of the proposed satellite communication system project in close cooperation with Ministry of Posts and Communications (MPC), the Rwandese Republic from June 22 to July 15.

This is an interim report which was prepared in Kigali, the Rwandese Republic after the completion of study work to inform the Government of the Rwandese Republic of summarized result of the study.

The team will examine the result of study more carefully after return to Japan and prepare a draft final report which is expected to complete towards the middle of coming October.

All of the team members should like to express the heartfelt thanks to the MPC staff concerned for their kind cooperation given to the team throughout the study work.

Finally, the Team do hope that international communication service in the Rwandese Republic will be much improved in the near future by implementing this project as planned in close cooperation with both countries.

July 1979

The Japanese Preliminary Design Study Team For the Satellite Communication System Project in the the Rwandese Republic

CONTENTS

DRAWINGS

NO.1 Allocation Drawing of the Site of E/S, Nyanza

NO.2 Floor Allocation Plan of the Radio Repeater Building (Existing), Nyanza

NO.3 Floor Allocation Plan of the Power Building (Existing), Nyanza

NO.4 Allocation Drawing of the Site of Batiment Technique

NO.5 Floor Allocation Plan of the Power Building (Existing), Batiment Technique

NO.6 Allocation Drawing of the Site of Mt. Jari

NO.7 Floor Allocation Plan of the Radio Repeater Building (Existing), Mt. Jari

NO.8 Floor Allocation Plan of the Power Building (Existing), Mt. Jari

NO.9 Allocation Drawing of the Site of Tonga

NO.10 Floor Allocation Plan of the Radio Repeater Building (Existing), Tonga

NO.11 Allocation Drawing of the Site of Butare

NO.12 Floor Allocation Plan of the Exchange Building (Existing), Butare

A. Earth Station

1. Summarized result of the study

The study team recommends to allot 4,900m^2 (70m x 70m) of land in the Nyanza HF transmitting atation site for the proposed earth station site, where is confirmed as the most suitable place to set up an earth station through the field survey.

Meanwhile, an area faced to Umuganda street Cacyiru plateau which was considered as the first grade of the proposed sith at the last study (March 1979) is unsuitable for an earth station site, because problem on city planning has not been cleared.

As for the scale of the earth station, the study team recommends to construct the INTELSAT Standard B earth station based on international traffic demand forecast, and initial capacity will be 12 voice grade channels, the final capacity will be 60 channels.

The earth station will be able to access the IS-IV A Primary Satellite in the Indian Ocean Region, and will also be able to access the INTELSAT V satellite system in the future.

2. Proposed site of earth station and site condition

The study team recommends that the earth station will be constructed in the Nyanza HF transmitting station, the antenna will be constructed at some 170m position to South from the existing building, and 4,900m^2 (70m x 70) area around the antenna will be provided for exclusive use in accordance with the result of the site survey.

(1) Existing building and power source will be able to utilize.

(2) It is not necessary to procure a site.

(3) There is no problem on skyline data as shown Fig. A-1.

(4) The place is about 8Km (along the road about 14Km) away from the center of Kigali, therefore, there is not influenced by artificial noises and icty planning.

(5) There is no problem of distance by adopting a radio link to the Bâtiment Technique.

The following items should be obligations of Rwanda side to construct the earth station in the site.

(1) To provide an office room (about $20m^2$) and a sooreroom for spare parts (about $15m^2$) of the earth station in the existing building.

(2) To use existing commercial power facilities and 185KVA emergency Diesel engine generator for the earth station together with existing HF transmitting station.

An interface distributor should be newly equipped by Rwanda side.

The interface point of power supply will be output terminal of the distributor as shown Fig. A-2.

The necessary power source for the earth station will be AC 380V, 50Hz, 3 phase 4 wire and 100KVA.

(3) To construct 6m access road through 250m to South from the site.

(4) The site has been selected on condition that is off regular air routes, but an air liner flew over the head during the site survey, therefore it is necessary to prohibit passing of any aircraft over the earth station after completion of the earth station.

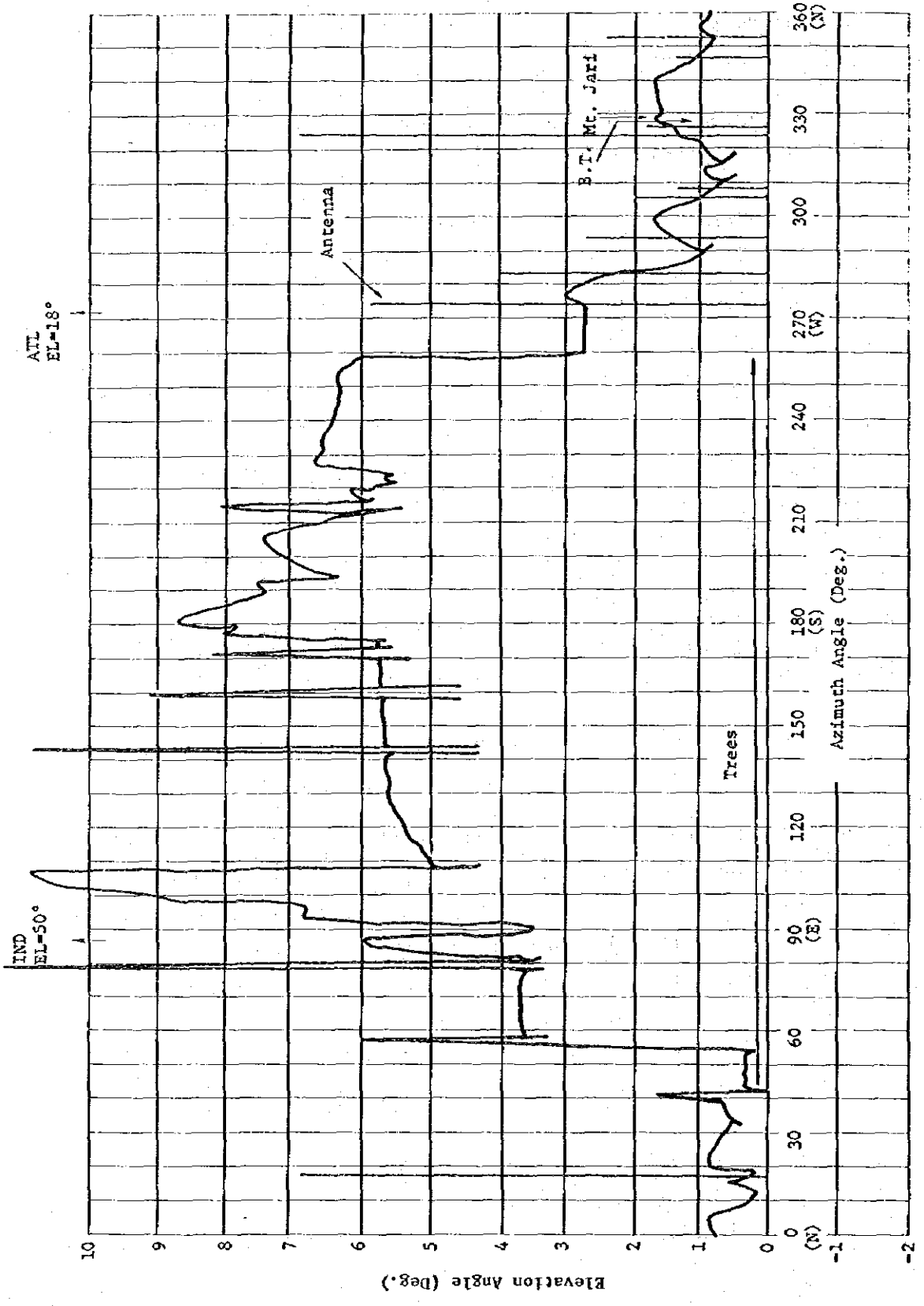


Fig. A-1 Skyline Elevation Angle of KIGALI E/S (KICUKIRO)

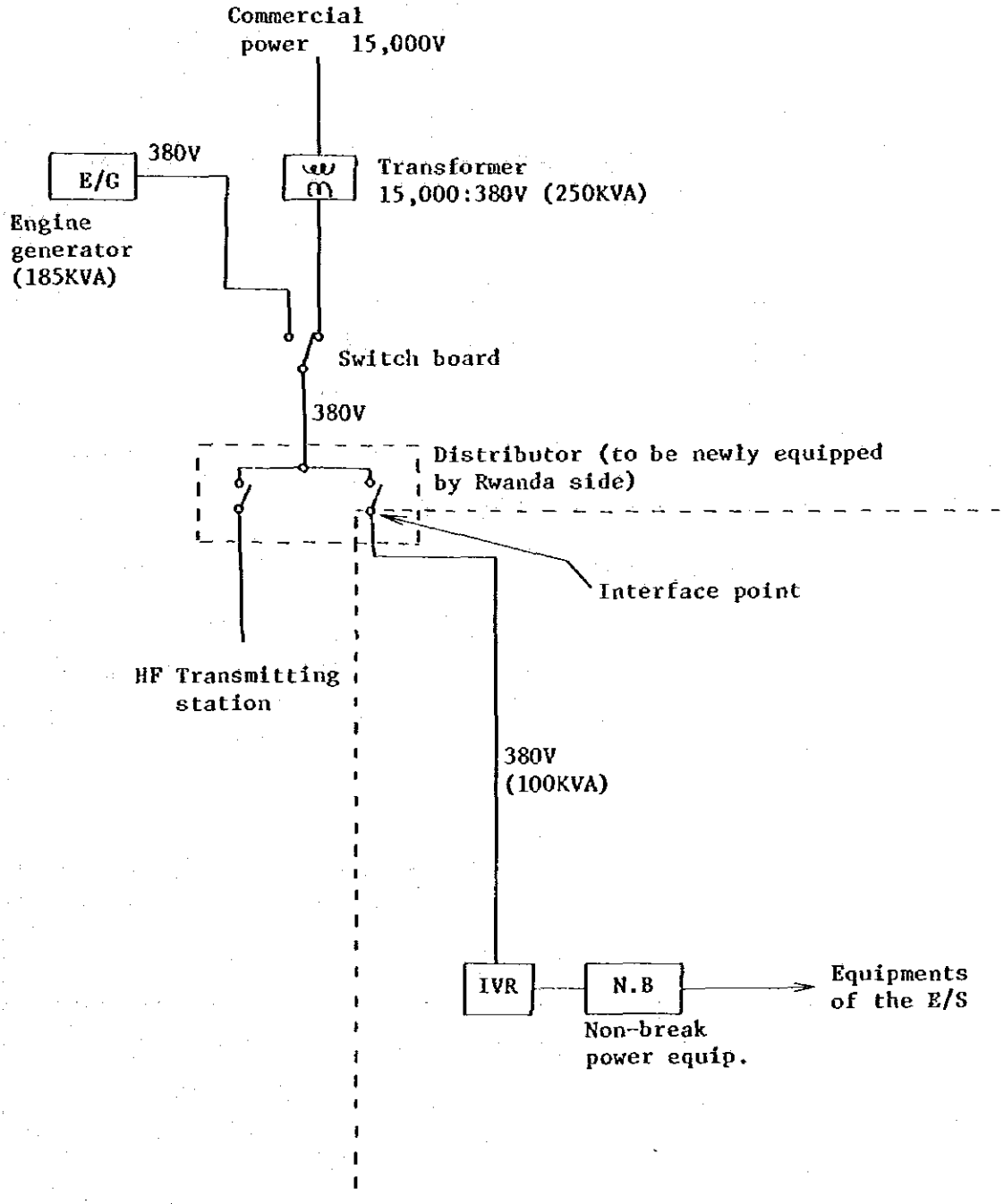


Fig. A-2 Interface of Power Source for the Earth Station

(5) At present, green pease and such like are farmed in the site (70m x 70m), but all rights to farming should not be permitted after decision of the site.

Then, leveling of the site should be necessary as soon as possible. An example of layout in the site is shown Fig. A-3.

3. Proposed system for satellite communications

The study team recommends construction of the INTELSAT Standard B earth station as shown in the essentials of specifications (Annex A-1).

An outline of the earth station is as foolws, however, details are stated in the essentials of specifications.

Antenna Diameter	:	11 - 13m
Feed system	:	for Dual Polarization
Noise temperature of LNA	:	less than 45°K
Output Power of HPA	:	higher than 1.5KW
Initial Installation Capacity	:	12 voice grade channels
Final Capacity	:	60 voice grade channels
Figure of Merit	:	G/T = 31.7^{dB} (at 10° EL Angle)
Reliability	:	not less than 99.8%

"OPERATIONS MEMORANDOUM" by INTELSAT offered by the study team at the last time (March) should be referred to study in details of performance characteristics of standard B earth station.

The obligations of the Rwandese Government in connection with implementation of the project are as shown Annex A-2.

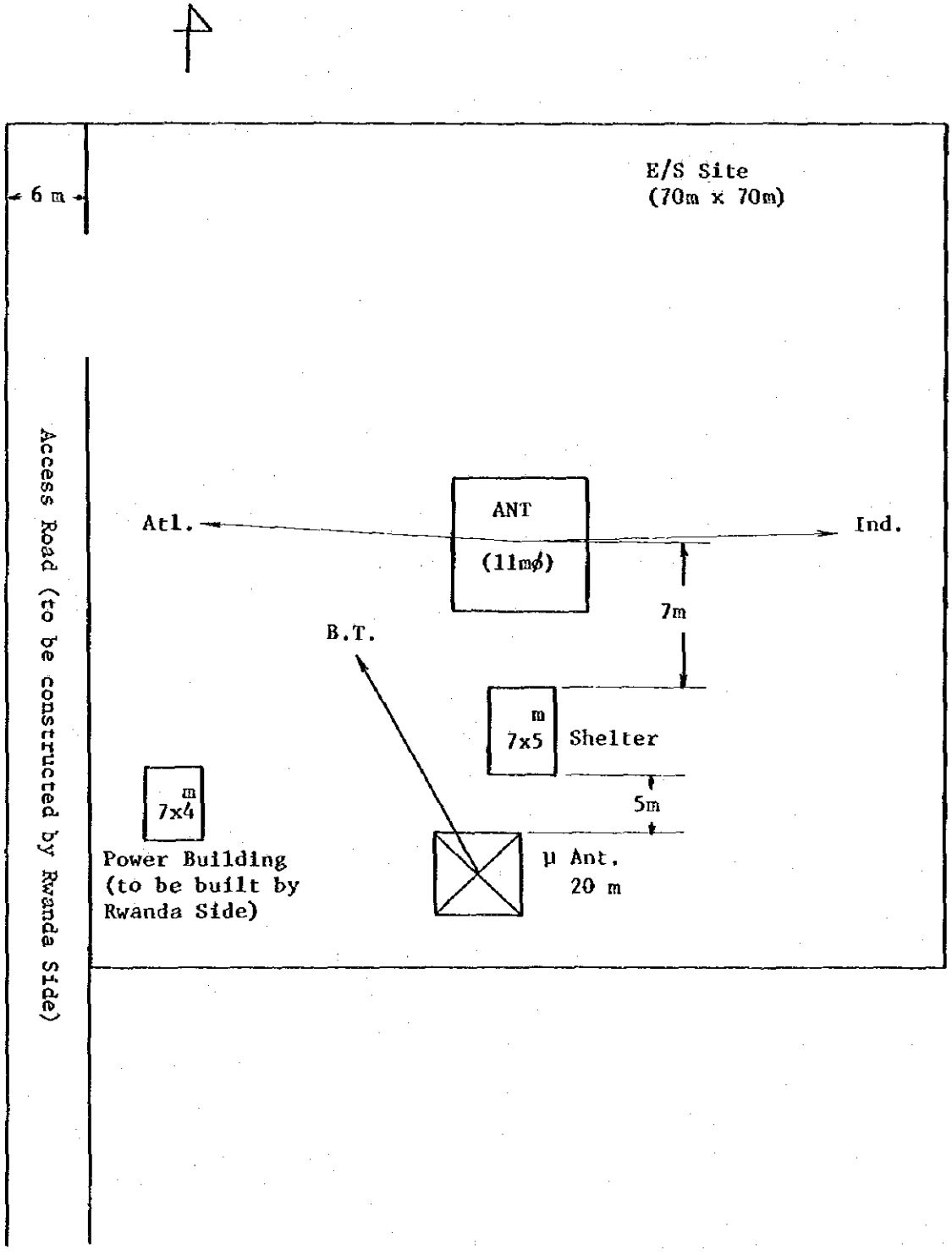


Fig. A-3 An Example of Layout of the Earth Station

4. Proposed organization for operation and maintenance of satellite communication system.

The study team recommends to provide the organization, as shown Table A-2, in the earth station in order to perform smooth operation and maintenance.

The duties of the technical staff in the earth station are as shown in Table A-3.

The training plan for the technical staff is as shown in Annex A-3.

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

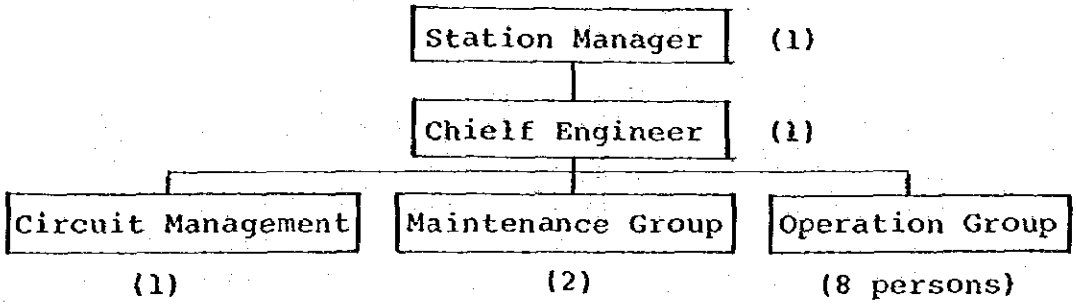


Table A-3 Duties of the Technical Personnel in the Earth Station

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	

Annex A-1

Essentials of Specifications for Project of The Kigali Earth Station in The Rwandese Republic

1. General

In this document, requirements for an INTELSAT standard B earth station to be constructed in Rwanda are defined.

The matters which are not defined in this document should satisfy the performance characteristics of the standard B earth station defined by INTELSAT (BG-28-74) and should conform to the CCIR and CCITT Recommendations.

2. Confituration

Configuration of this system consists of antenna subsystem, radio subsystem, power supply subsystem and communications center subsystem, and is shown in a schematic representation of Fig. A-4.

3. Capacity

Initial installation capacity of tbe earth station should be 14 channels including 2 ESC channels.

The itemized installation is as shown in Table A-1 below.

The final capacity should be 60 channels.

Table 1-1 Initial Installation Capacity

Country	Earth Station	Telephone Channel	Voice Channel for VFTG	Total
France	Pleumeur-Bodou-4	CH	CH	CH
Kenya	Longonot-1			
Nother-lands				
U. K.	Madley-1			
E S C		(TP + TG)		2
Total				14

4. Safety

Arrangements for safety should be provided in the interset of operational and maintenance staff.

Especially, high power equipment should have protective circuits against danger.

And appropriate protective measures should be provided to all mechanically movable sections in the system.

5. Operating Conditions

Each equipment item should satisfy the specifications when operated conditions by under the following conditions.

(a) Temperature and Humidity

	(Indoor)	(Outdoor)
Ambient Temperature:	5 to 35°C	-10 to 45°C
Ambient Humidity:	10 to 90%	0 to 100%

(b) Wind Velocity

Average: up to 20m/s

In Gust: up to 27m/s

(c) Power Supply

Voltage: 3 Phase/4 Wire 380 Volts $\pm$ 10%

Frequency: 50 Hz $\pm$ 1 Hz

The required power capacity should be stated in the proposal.

(d) Satellite to be Used

The IS-IVA satellite system in the Atlantic or Indian Ocean Region will be accessed. Should be considered to be able also access the IS-V satellite system.

6. Overall Performance Characteristics

(a) Figure of Merit: G/T $\geq$ 31.7 dB (at 10° EL Angle)

(b) Reliability: not less than 99.8%

(c) Stability of level and frequency should be statet in the proposal.

(d) Design Life
15 years or longer under normal operation and maintenance.

7. Antenna Subsystem

The diameter of the main reflector should be about 11 meters, and the tracking system should be autotracking by AZ-EL type and the feed system should be for dual polarization.

8. Low Noise Amplifier Subsystem

Should be made up of two routes of operation and standby by two parametric amplifiers, the noise temperature of which is lower than 45°K.

9. High power Amplifier Subsystem

Should be made up of two routes of operation and standby by two Klystron amplifiers, the output power of which is higher than 1.5kW.

10. Frequency Converter Section

Should be made up of two routes of operation and standby by two up-converters and two down-converters.

11. SCPC Terminal Equipment

Should have 14 initial channels including 2 channels for ESC, maximum of 60 channels.

The carrier frequencies will be specified later on.

12. ESC Equipment

Should have two telephone circuits including two teletypewriters.

13. Control and Monitor System

How and to what extent this system will function should be stated in the proposal.

14. Electric Power Supply Subsystem

A 35 KVA non-break power equipment should be equipped.

The interface point of power supply will be output terminal of distributor in the existing power source building.

15. Communications Center Subsystem

The earth station associated facilities to be installed in the communications center are as follows, and they should be included in this project.

(a) Echo Supperssor

Should be composed of 8 units.

(b) VFTG Equipment

Should have a capacity of 4 voice channels.
(24 telegraph channels).

The signal speeds will be specified later on.

16. Shelter

All subsystems to be installed in the earth station excepting the electric power supply subsystem should be taken in a shelter with an air conditioner, the shelter including the air conditioner should be included in the project.

And carrier terminal equipment and microwave equipment on separate specifications should be also taken in the shelter.

17. Test Equipment

Test equipment required for the tests specified in the INTELSAT Satellite System Operation Guide (SSOG) should be provided, and a list of equipment should be given in the proposal.

18. Attachments

Accessories, spares for two years, special tools, manuals (in English), deawings and test data should be attached and a list of attachments should be given in the proposal.

19. Assistance in Operation and Maintenance

A technical staff member should be provided to give assistance in the operation and maintenance work for one year after the commissioning of the earth station.

20. Factory Training

Factory training should be given to two persons of the technical staff of the earth station for two months.

The staying expenses for the period of the training and the return air traveling expenses should be paid by the contractor, and the curriculum should be stated in the proposal.

21. Others

The following items should also be included in the contract of the project.

(a) Site Survey

(b) Construction and Installation (including supply of construction materials and transportation)

(c) Factory Inspection, Adjustment & Test, INTELSAT Varification Test and Line-up Test (each test item should be stated in the proposal)

(d) Offer of data required for foundations of the antenna and the shelter

(e) Offer of data such as floor area, etc. required for construction of communications center subsystem

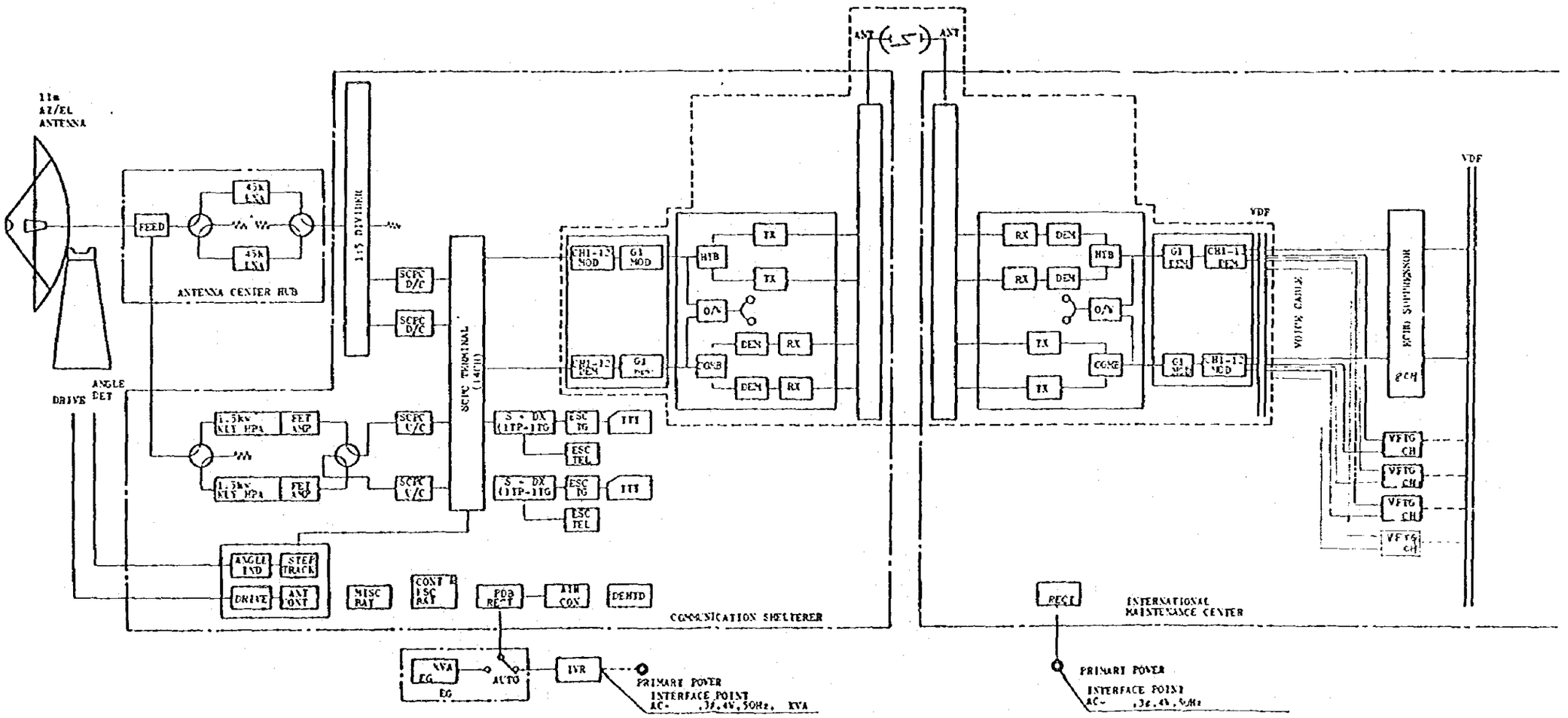


Fig. A-4 System Block Diagram for a STD-B Earth Station

Annex A-2

Obligations of Rwandese Government in Connection with Implementation of The Earth Station Project

1. Matters related to negotiations and procedures with INTELSAT, administrations and communication entities concerned, in connection with the establishment of the earth station.

   (a) Matters related to negotiations and procedures based on the INTELSAT document, "Procedures governing application, approval, varification and operation of earth station in the INTELSAT system"

   (b) Negotiations and procedures related to the opening and closing of international circuits with related Administrations and communications entities

2. Preparation of coordination documents, and regotiations

   Based on the ITU Radio Regulations, documents necessary for coordination with the adjacent countries should be prepared, and negotiations should be conducted with Administrations concerned.

3. To provide and leveling of the earth station site, construction of access road, and to provide commercial low-voltage power source, and to supply output power of emergency Diesel engine generator.

4. To provide office building & construction of the power source building with ventilator, grounding and foundation of the antenna & the shelter.

5. To provide floor area for installation of the relative facilities to the earth station in the communications center.

6. Offer of construction office, storehouse or safe-keeping place for construction materials, and transportation for construction materials with driver & fuel.

7. Nomination of PTT staff to counterpart, anf offer of unskilled labor.

8. To provide technical staff for operation and maintenance of the earth station, implementation of training, and to quickly bring up technical staff.

9. Independent management of operation and maintenance of the earth station.

Annex A-3

Training Plan for O/M Staff

1. Besides PTT staff of 13 persons, a technical staff member will be provided by project contractor for one year after opening of the E/S.

2. A example of training plan is shown in Table A-4.

3. As for training in Japan, there are group training by Japanese Government and factory training by project contractor.

4. After opening operation of the E/S, all technical staff members had better attend the OJT (on the job training) and will advance their technical level.

   For leader of the OJT, the technical staff member provided by the contractor, PTT staff completed the course of group training or factory training and the staff in charge of each sections take it.

5. As for group training course in satellite communication engineering by Japanese Government, there are two kind of courses; Regular and Advanced course, in principle the number of participant in each course is only one person from a country, so it is desirable that will attend one and one person for the both courses in every year, but participants for the Advanced course need to have experience of not less than three years in the field of INTELSAT communication services.

6. If a PTT staff member hopes to attend for the Regular course in 1980, Rwandese Government need to request putting reason for participation to the Japanese Embassy in Zaire not later than September this year (1979), then Japanese Government will make a decision the countries which will participate and send the informations to Rwandese Government not later than January 1980.

7. Outline and information of the both courses have been offered as for the others.

8. A period of factory training by project contractor is about two months, the stay expenses and the return air expenses for two persons are paid by Japan side.

9. PTT need to provide a satellite communication technical course and to train freshmen permanently in the PTT institute.

   And the PTT had better refer to "Satellite Communications Engineering" by Dr. MIYA offered by the study team at the last time (in March) when will prepare the curriculum or the text.

Table A-4 An Example of Training Plan

<table>
<tr><th rowspan="2"></th><th rowspan="2">No. of Persons Placed</th><th colspan="3"></th></tr>
<tr><th>1980</th><th>1981 - 1983</th><th>In and after 1984</th></tr>
<tr><td>Station Manager</td><td>1</td><td></td><td></td><td></td></tr>
<tr><td>Chief Engineer</td><td>1</td><td>Group training course (Regular)</td><td></td><td></td></tr>
<tr><td>Circuit Management</td><td>1</td><td rowspan="3">Two months training by contractor at factory (Choose 2 persons out of 11 persons)</td><td rowspan="3">Group training course (Regular) (Choose one persons out of 11 persons)</td><td rowspan="3">Apply one and one person for group training both course (Regular & Advanced) in every year</td></tr>
<tr><td>Maintenance Group</td><td>2</td></tr>
<tr><td>Operation Group</td><td>8</td></tr>
<tr><td>Total</td><td>13</td><td></td><td colspan="2">All staffs attend the OJT after opening the E/S</td></tr>
</table>

B. International Switching System

I. Telephone switching system

1. Outline of System

1.1 General requirement

(1) The international telephone switching system is installed in Kigali, as the CT3 stage.

(2) To be a fully electronic switching system employing a stored program control.

(3) To provide with necessary operator positions to handle semi-automatic and manual calls at the initial stage. In addition, the system shall be easily added to the facility of ISD (International Subscriber Dialling) calls in future.

(4) To provide with the detailed billing facility.

(5) To consist of highly reliable and integrated electronic parts requiring a minimum floor space.

(6) To adopt modular structure to permit a easy extension.

(7) Duplicated central processor and the automatic recondiguration facility shall be provided.

(8) Maintenance, test and diagnosis shall be able to performed easily.

(9) The system shall be easily added to the facility of CTN (Centre Transit National), after the domestic network plan shall be completed.

1.2 Basic configuration

Fig. (Figure) 1-1 shows the basic configuration of the proposed system.

This systemconsists of switching, speed path, switch-board, central processor, maintenance and administration and I/O subsystems.

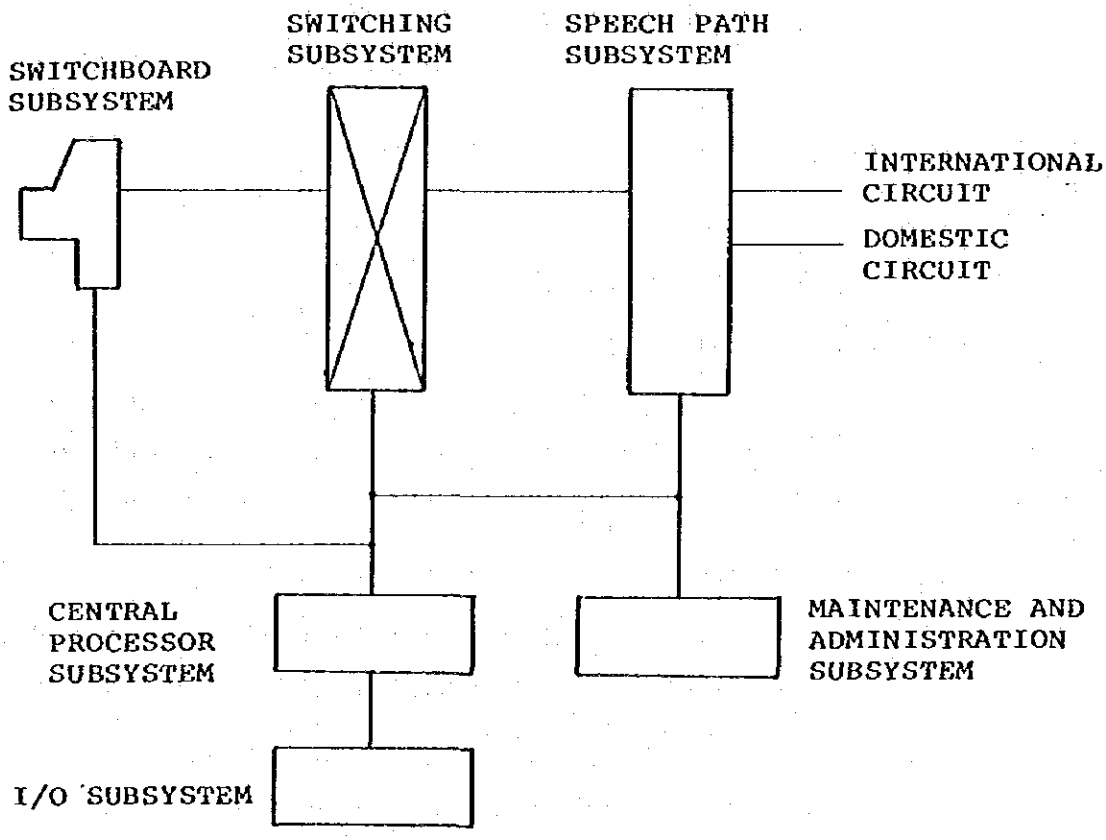


Fig. 1-1 Basic Configuration

2. Basic Scheme

2.1 Call classification

(1) Originating call;

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

(2) Terminating call;

Automatic and Manual basis

(3) International transit call;

No provision in principle, but it will be able to deal with it based on poerator's handling as occasion demands.

(4) Domestic mutual call in future

2.2 Network plan

2.2.1 Number of international circuit

(1) Initial stage;

40 circuits shall be provided, and 12 circuits are assigned for No.5 signalling system and 28 circuits for R2 signalling system of CCITT Recommendation.

(2) Final stage;

200 circuits shall be totally expected to accommodate in this system at the final stage, but the assignment for each signalling system is undecided.

2.2.2 Number of domestic circuit

As a total, 50 circuits shall be provided for the existing local exchanges. 15 circuits of them are assigned to Kigali local exchange and the rest 35 circuits are distributed to local exchanges.

2.2.3 Network

The expected switching network plan will be shown in Fig. 2-1.

2.3 Numbering plan

The international numbering plan in this system shall be conformed to CCITT Recommendation, namely, it can handle to maximum 12 digits except prefix, and the descriminating digit "0" and language digit shall be automatically produced in this system.
Besides, domestic numbering plan shall be conformed to the existing.

2.4 Trunking

2.4.1 Outgoing selection

(1) Sequential selection shall be adopted for both way operation routes, and random selection for one way operation routes.

(2) Alternative routing shall be also available.

2.4.2 Barring Condition

According to the condition of each destination route, a temporaly barringing facility shall be provided for each route.

2.4.3 Overload Countermeasure

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

(2) The system shall be possible to perform a necessary restriction automatically or manually in the case of overload condition.

2.5 Charging system

2.5.1 Charging as a rule, all international calls shall be charged with employing the detailed charging system.

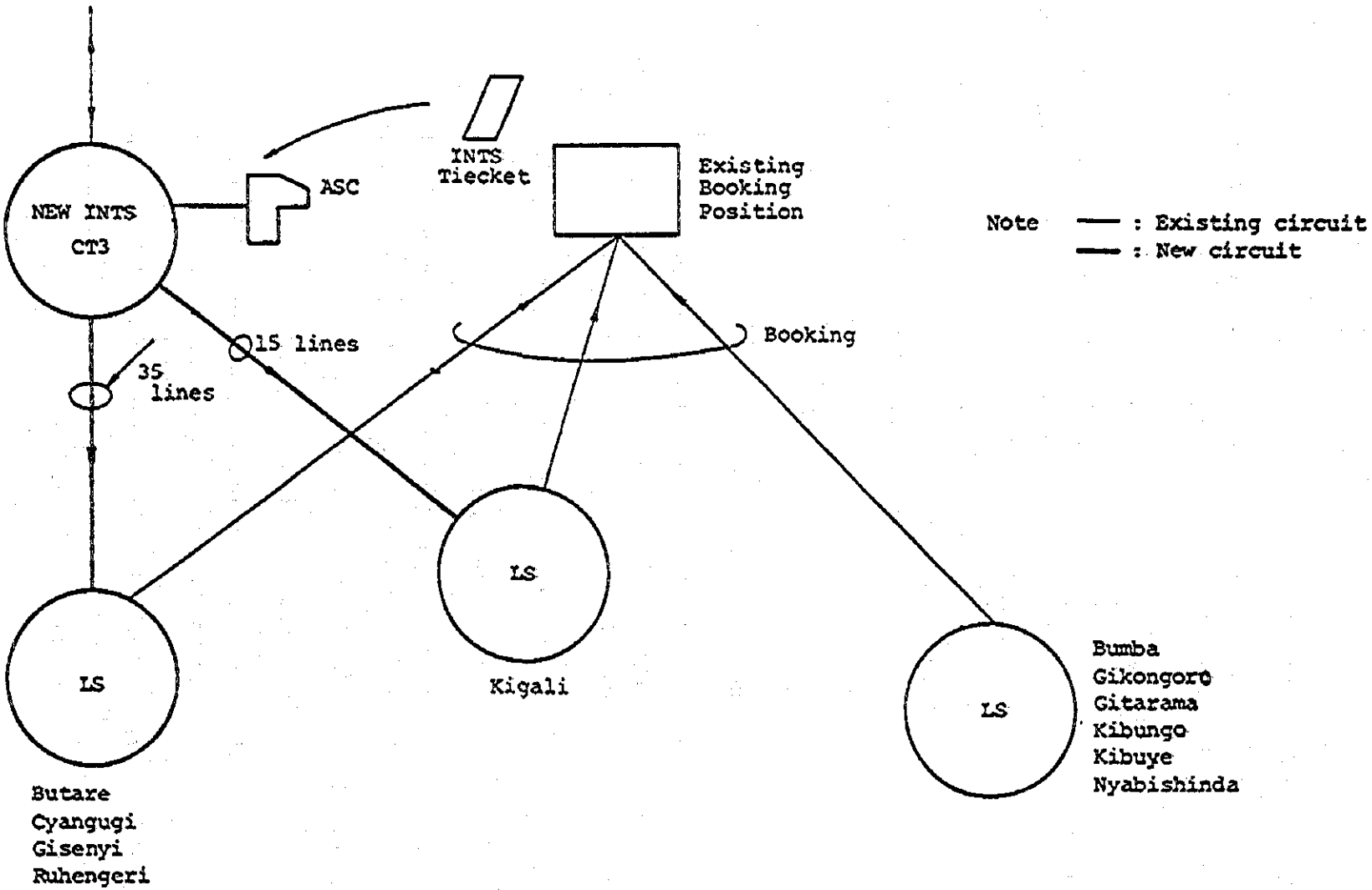


Fig. 2-1 SWITCHING NETWORK PLAN

2.5.2 Charging information

At least, the following information shall be recorded on magnetic tape for charging.

(1) Calling subscriber number

(2) Called subscriber number

(3) Answer time and duration of conversation

(4) Outgoing trunk route

(5) Class of connection and subscriber category

2.5.3 Call required to inform the charge

According to the class of originating subscriber, the duretion of conversation time shall be printed out on teletypewriter.

2.6 Signalling system

CCITT Recommendation No.5 and R2 signalling system are provided. If other signalling is required, it shall be the subject for further discussion.

For domestic circuit, loop signalling and out-band (3825 Hz) E & M signalling systems shall be adopted for Kigali and other existing LSs.

2.7 Maintenance and test

2.7.1 *General requirements*

Automatic supervision, test and diagnosis shall be performed by both hardware and software.

The function such as detection of fault equipment, reconfiguration of system, repaire of faulty package, preventive maintenance, extension and modification of circuits shall be required.

2.7.2 Supervision

Following items shall be provided.

(1) Provision of facilities with lamp and audible alarm indication for fault equipment

(2) Provision of facility with printing out the trouble condition on teletypewriter.

(3) Provision of facility with lamp indication for system operating status.

2.7.3 Maintenance test and diagnosis

Following items shall be provided.

(1) Diagnostic program

(2) Manual test and check by a maintenance personnel

(3) Connection test designating trunk and equipment.

2.8 Traffic supervision and statistics

The system shall be provided with the facility to supervise the loaded traffic condition, continuously.

The following traffic data collected by central peocessor subsystem shall be printed on a teletypewriter or recorded on a magnetic tape.

(1) For each trunk group

i) Total number of seizure

ii) Total number of effective call

iii) Total number of ineffective call

iv) Total number of call accepted by console

v) Total number of call completed by console

(2) For each sender and receiver

i) Number of sender and receiver seized

ii) Number of congestion

(3) For switchboard

i) Number of console attended by operator

(4) For each operator

i) Number of call handled by operator

(5) For main processor

ii) Occupancy

2.9 Condition of system operation

(1) Guaranty for final capacity

The central processor in this system shall be able to process the loaded traffic when the international circuit will be extended up to 200 lines.

(2) Reliability

The system shall be designed to satisfy high reliability on which the system down time is less than one hour during 20 years.

(3) Environmental conditions

i) Normal operating condition

Room temperature : 23°C $\pm$ 5°C

Humidity : 60% $\pm$ 10%

ii) Operating condition

Room temperature : 0°C $\sim$ 40°C

Humidity : 10% $\sim$ 90%

3. System Configuration

3.1 Diagram of system constitution

Fig. 3-1 shows the diagram of system constitution, and the abbreviations are listed in Table 3-1.

Besides, the six subsystems as shown in Fig. 1-1 are explained as follows.

(1) Switching sybsystem;

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

(2) Speech path subsystem;

consists of various kinds of trunk and signalling equipment to handle the telephone signal.

(3) Central processor subsystem;

consists of main central processor to progress a call processing.

(4) I/O subsystem

sonsists of I/O equipments such as TTY, MT and these controller.

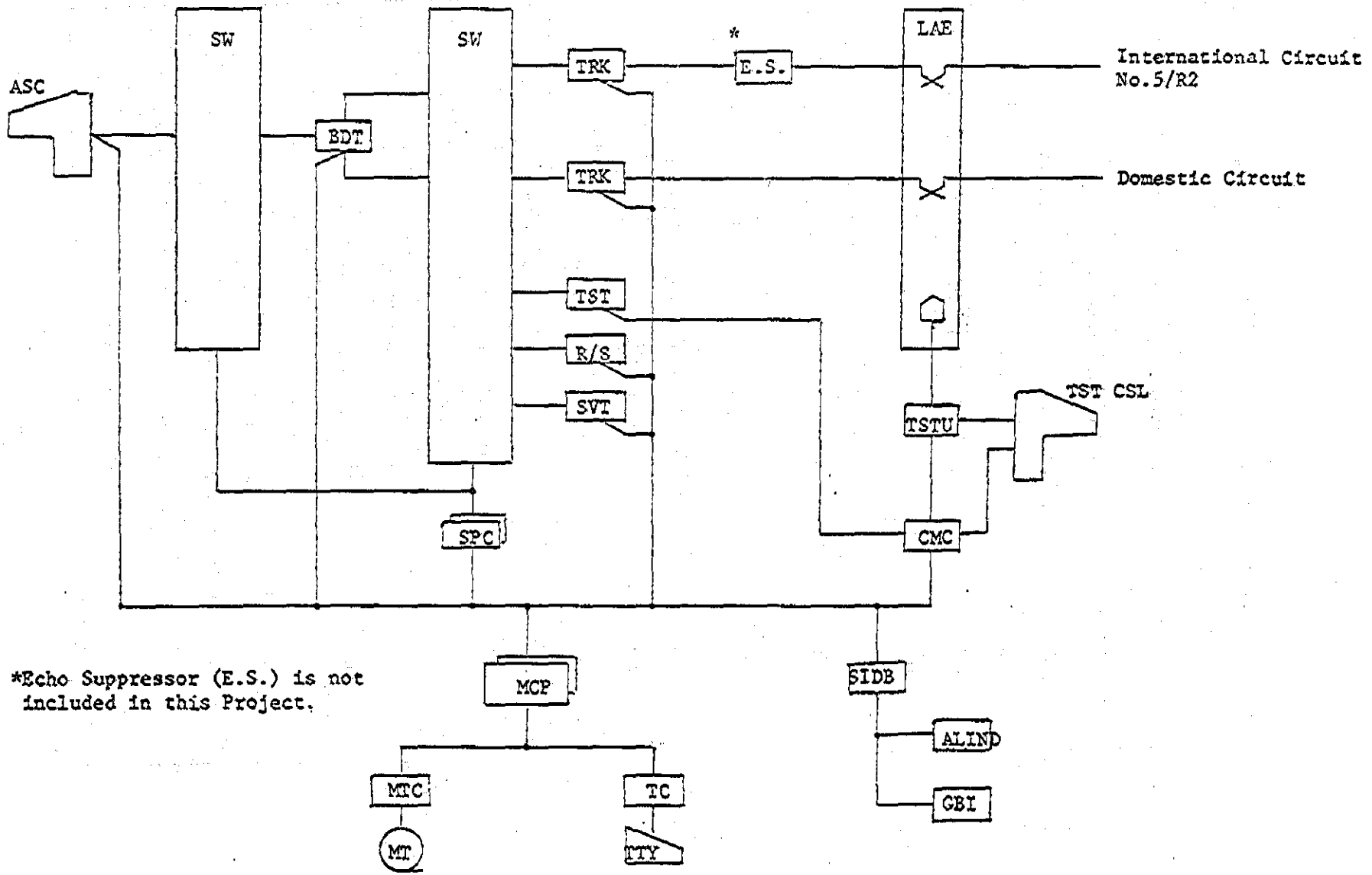
(5) Position subsystem

consists of switch board and board trunk to handle manual calls.

(6) Maintenance and administration subsystem

consists of test console and it's relative equipment to maintain the circuits.

FIG 3-1 SYSTEM COMPOSITION FOR RWANDA INTS



*Echo Suppressor (E.S.) is not included in this Project.

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

3.2 Equipment list

The following equipment shall be provided.

Item	Equipment	Q'ty
1.	Main Equipment	
1.1	Switch Frame	1
1.2	Speech Path Control Frame	1
1.3	Trunk Frame	3
1.4	Miscellaneous Frame	1
1.5	Control Processor Frame	1
1.6	System Bus Control Frame	1
1.7	Board Trunk Frame	1
1.8	Circuit Maintenance Control Frame	1
1.9	System Information Display Board	1
1.10	Alarm Indicator	1
1.11	Line Access Equipment Frame	1
1.12	Circuit Test Console	1
1.13	Assistance Service Console	5
1.14	Cable Turn Section	1
1.15	Group Busy Indicator	1
1.16	Magnetic Tape Equipment	3
1.17	Teletypewriter	2
2.	Power Equipment	
2.1	-48V Power Equipment (including RECT and BATT)	1 lot
3.	Installation Material and Tool	1 lot
4.	Spare Parts for 2 years	1 lot
5.	Maintenance test equipment and Tool	1 lot

3.3 Software Configuration

To make the efficient use of the system, following program will be provided.

(1) Execution Control Program (EP)

EP controls the execution of all application programs and Input-Output operations.

(2) Fault Processing Program (EP)

EP controls the hardware configuration of the system, performing fault recognition and system reconfiguration.

(3) Call Processing Program (CP)

CP executes the setting up and clearing of telephone calls.

(4) Administration Program (AP)

AP executes prepared commands for maintenance personnel to perform traffic control and other administrative jobs.

(5) Diagnostic Program (DP)

DP performs to identify the doubtful packages in a failed units.

3.4 Floor Layout Plan

Refer to Fig. 1 of explanation of the layout plan.

4. Implementation Schedule

4.1 Schedule'

Typical implementation plan will be given in the draft final report.

4.2 Scope of work

4.2.1 Works to be performed by the contractor

The contractor shall be responsible for the following works.

(1) The contractor shall provide the equipment and materials for new facilities and perform the installation.

Both of hardware and software shall be provided.

(2) Technical Documentation

The contractor shall submit manuals, descriptions and drawings to the customer, written in English, containing sufficient detail and clarity to enable the maintenance personnel to operate and maintain the system.

(3) Training

The contractor shall be responsible for necessary training of personnel designated by Rwandese Ministry of Posts and Communications (MPC).

The training program shall be proposed by the contractor and final decision shall be based on the agreement between MPC and the contractor.

i) Training at factory

3 trainees shall be accepted by the contractor for a period of 2.5 months.

ii) On the job training

The contractor shall accept 10 - 20 trainees and shall give them on-the job training at the site where installation work is in progress for a period of 1 month.

iii) Language

English shall be used.

iv) Text book

The contractor shall prepare all necessary text books for all trainees.

v) Cost

All expenses for trainees such as round trip air-fare, living expenses shall be covered by the contractor.

(4) Operation and Maintenance

The contractor shall provide supervision and engineering support services by one engineer for a period of 12 months for initial operation of the system.

4.2.2 Works to be performed by MPC

MPC should be responsible for the following works.

(1) To provide the following facilities

i) Building (Equipment Room, Operator Room and Power Equipment Room) including grounding, cable holes, lighting and utility power etc.

ii) Extension or modification of the existing domestic exchange, requiring for provision of new circuits with new international exchange.

iii) Provision of cabling and wiring from the existing system to the distribution frame of the new international telephone exchange.

4.2.3 Cabling diagram

Fig. 4.1 shows the relative and cabling between main switching equipment and power equipment.

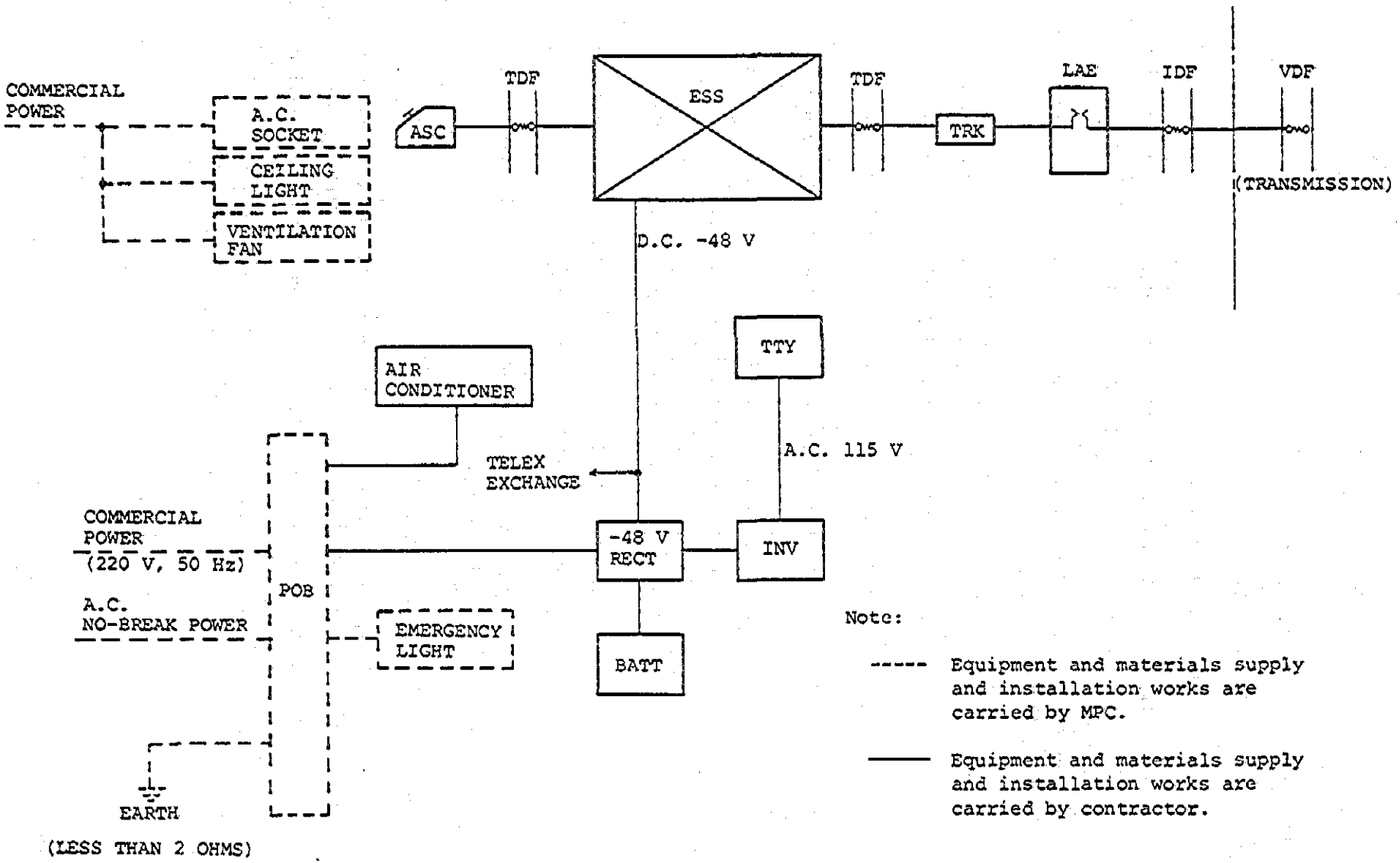


Fig. 4-1 Cabling Diagram

II. Telex switching system

1. Outline of System

1.1 General Requirements

(1) The international telex switching system is installed in the Bâtiment Technique in Kigali.

(2) To be a fully electronic switching system employing a stored program control.

(3) To provide with necessary operator positions in order to handle semi-automatic calls and manual calls.

(4) To provide with the detailed billing facility.

(5) To employ time division circuit switching technique.

(6) To consist of highly reliable and integrated electronic parts requiring a minimum floor space.

(7) To adopt modular structure to permit a easy extension.

(8) Duplicated central processor and the automatic system reconfiguration shall be provided.

(9) Maintenance, test and diagnosis shall be able to be performed easily.

1.2 Basic Configuration

The proposed system, as shown in Fig. 1.1, is basically composed of three subsystems such as switching subsystem, maintenance and administration subsystem and position subsystem.

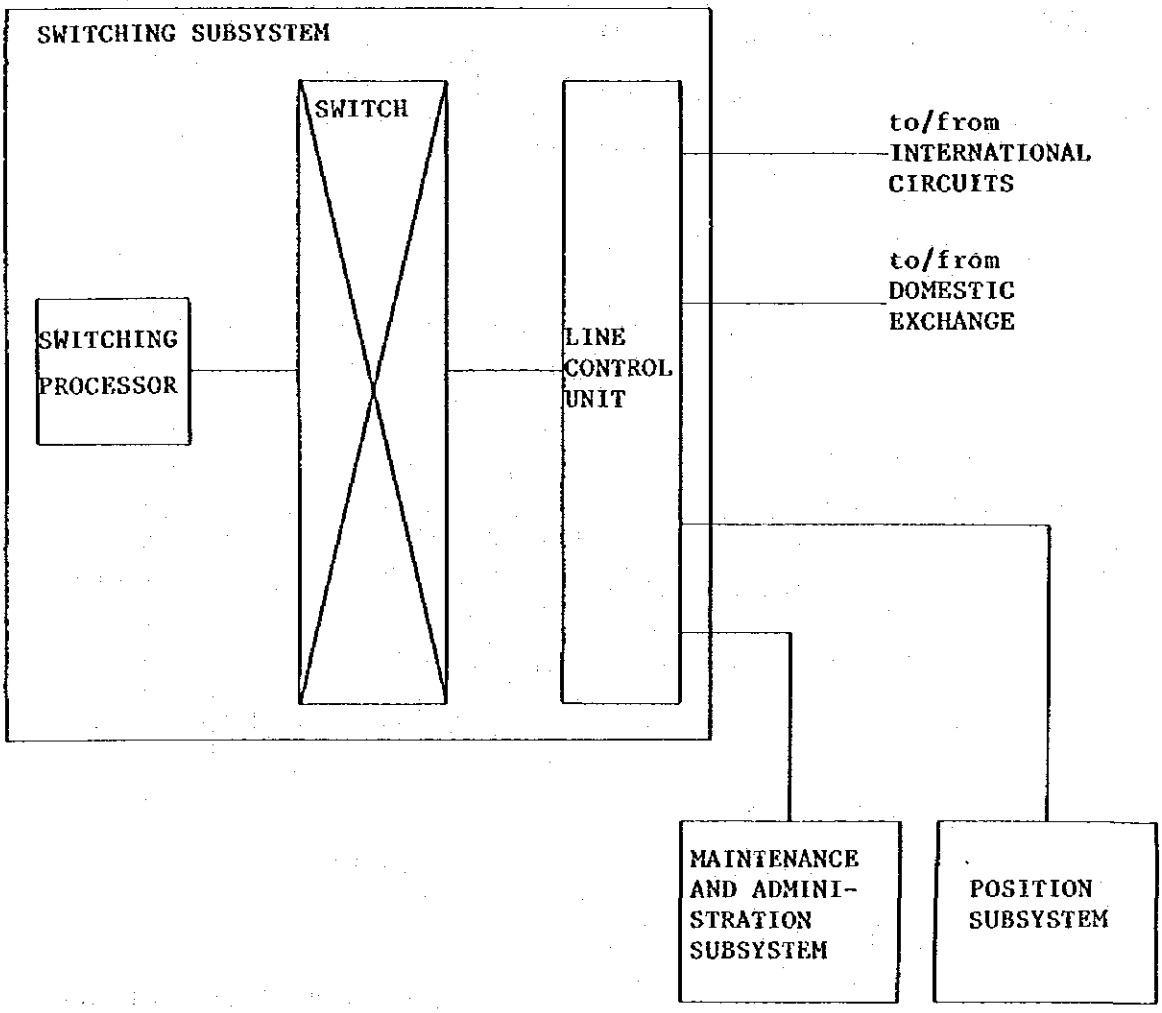


Fig. 1-1 Basic Configuration

2. Basic Scheme

2.1 Service Mode

2.1.1 Call Classification

(1) Originating Call

- Automatic call
- Semi-automatic call
- Manual call

(2) Terminating Call

- Automatic terminating call
- Manual terminating call

(3) International Transit Call

(This service will be provided if necessary)

(4) Originating Ca-l/Terminating Call from/to Position

2.1.2 Code and Speed of Signal

International Telegraph Alphabet (ITA) No.2 50 Bauds

2.2 Trunking

Fig. 2.1 shows a trunking diagram plan.

2.2.1 Outgoing Selection

(1) The circuit should be selected and seized both at random and in a predetermined order as required.

(2) Alternative routing will be also available.

2.2.2 Barring of connection:

According to the requirement of MPC, necessary barring for originating, terminating and transit calls will be provided.

2.2.3 Overload Countermeasure

(1) Overload condition will be detected by supervising the system operation at all times.

(2) It will be possible to perform the necessary restriction automatically or manually when the overload condition has occurred.

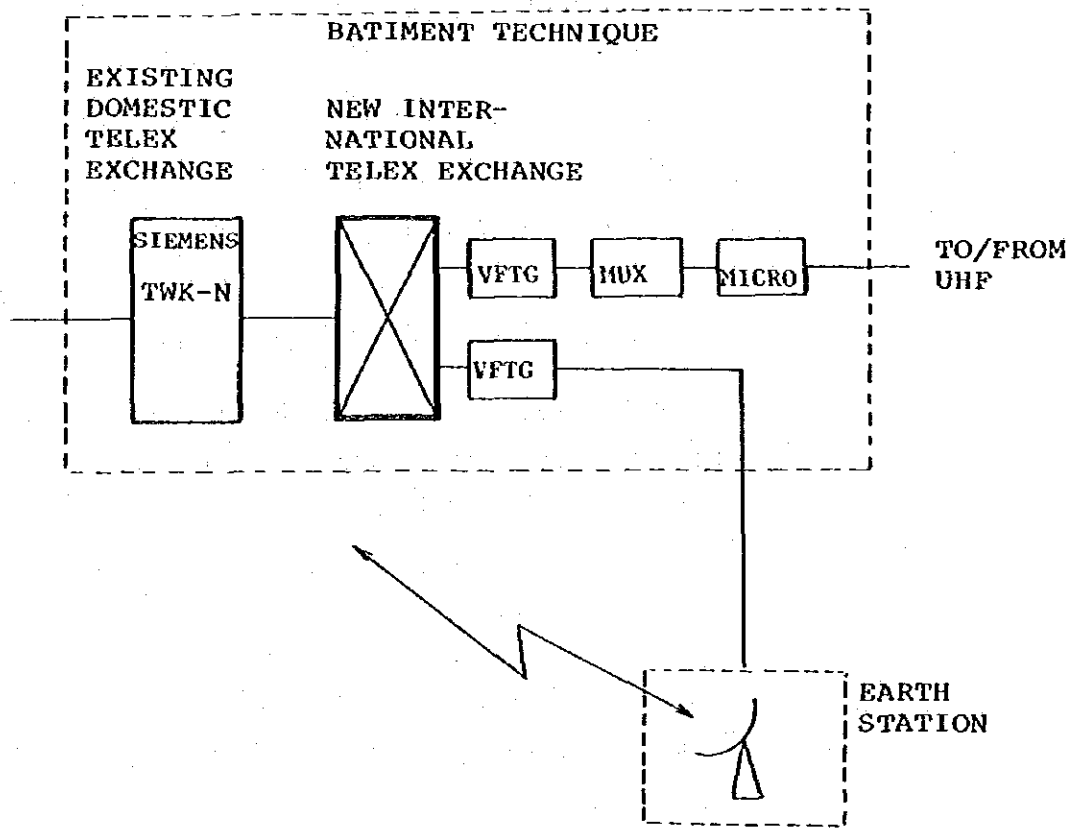


Fig. 4-2 Trunking Diagram

2.3 Operating Scheme

2.3.1 Operation of Subscriber

The detail of the operation will be decided at the discussion between MPC and the contractor.

2.3.2 Functions of Operator Position

Functions of operator position will be as follows.

(1) International Call Connection

Originating, terminating and transit calls are connected at the position by request of subscriber such as the call connection can not be performed on a full automatic base.

(2) Inquiry and Complaint

To also be available for the reception and processing of claim and inquiry from subscribers and other stations.

2.3.3 Service Code

Following service codes will be returned to the originating subscriber according to the cases conforming to CCITT recommendation F. 60.

OCC : Subscriber is engaged
DER : Out of order
NP : The called party is not, or is no longer a subscriber
NA : Correspondence with this subscriber is not admitted
NC : No circuits
NCH : Subscriber's number has been changed
MOM : Wait/Waiting

2.4 Call Record

2.4.1 Recorded Call

As a rule, all telex calls will be recorded in the form of detailed recording.

2.4.2 Contents of Record

All the call connection data compiled into Call Data will be recorded on the maintenance teletypewriter.

The following informations are contained in to call data.

(1) Record Number

(2) Type of Call (Originating/Terminating/Transit)

(3) Class of Service

(4) Starting Time of Communication

(5) Calling Subscriber Number or Answer-back Code
(In case of originating call in Rwands)

(6) Called Subscriber Number

(7) Incoming Trunk Group Number
(In case of terminating call or transit call)

(8) Outgoing Trunk Group Number
(In case of originating call or transit call)

(9) Chargeable Time

2.4.3 Chargeable Call Duration Notice

To advise of the chargeable time automatically to the calling subscriber at the end of call.

2.5 Signalling

2.5.1 International Signalling Condition

(1) The international telex signalling condition type A and type B specified in the CCITT Recommendations U1 are provided.

(2) If other signalling is required, it will be the subject for further discussion.

(3) Recommendation U20 (Radio circuit) is not taken into consideration.

2.5.2 Inter-unit Signalling

(1) From/to VFTG Equipment: Double Current, ±20mA/±60V

(2) From/to Domestic Telex Exchange: Double Current, ±20mA/±60V

2.6 Maintenance and Test

2.6.1 General

To operate the system without interruption, following functions are provided.

To perform automatic supervision, test and diagnosis by both hardware and software.

To easily perform trouble shooting work and a preventive maintenance work.

2.6.2 Supervision

To provide following functions.

(1) Lamp Indication and Audible Alarm:

System condition is indicated on the indication panel, visual and audible alarm are raised in case of trouble.

(2) Faulty message

Trouble message shall be printed out on the maintenance teletypewriter to show what kind of trouble has occurred.

(3) Indication of System Operating Status

Following items will be indicated with lamp, bell and/or print-out message.

i) Frame Fault Indication ----- · Power fault
· Fuse blown
· Fan fault
· Clock fault

ii) Faulty Equipment Indication ----- Trouble status for each unit

iii) Faulty Circuit Indication

iv) Traffic Overload Indication

(4) Supervision of International Trunk Circuit and Operator Positions.

Busy status of each route and the number of requests awaiting for operator positions will be displayed as well as the indications mentioned above.

2.6.3 Maintenance Test and Diagnosis

(1) Diagnosis by diagnostic program

(2) Manual test and check performed by a maintenance personnel

(3) Connection test of designated trunk circuit.

2.7 Traffic Supervision and Statistics

The traffic handling condition of the system is continuously supervised at various points during call processing and is reported to the maintenance personnel periodically or on his request.

The following items, mainly according to the CCITT Recommendation F.70, are taken for the purpose of observations on the grade of service.

(1) Total number of calls

(2) Number of effective calls of each call type

(3) Number of ineffective calls

(4) Utilization of each trunk group (route)

(5) Utilization of the central processor performance

3. System Specification

3.1 Basic Specifications

(1) Number of Trunk Lines

- initial 64 lines
- final 120 lines

The above number includes all of the international trunk circuits, positions, test terminals and so forth.

(2) Communication Speed

50 bauds

(3) Code

ITA (International Telegraph Alphabet) No.2, CCITT Recommendation F.1.

(4) Signalling

Type A and Type B, CCITT Recommendation U.1.

(5) Switching Method

Time Division Circuit Switching

(6) Control Method

Stored Program Control

(7) Receiving Distortion Margine

46%

(8) Reliability

The system shall be designed to satisfy high reliability.
Down time : Less than 1 hour/20 years

(9) Environmental Condition

The system shall be able to operate under following conditions.

i) Normal Operation Condition

Room Temperature : 23°C ± 5°C

Humidity : 60% ± 10%

ii) Operatable Condition

Room Temperature : 0°C ∿ 40°C

Humidity : 10% ∿ 90%

3.2 System Configuration

3.2.1 Hardware System

(1) Switching Subsystem

The switching subsystem performs telex switching. This subsystem consists of Switching Processor Frames which are the basic frame of the System.

The control processor for whole system, memories, time division switching unit, line control unit shall be included in this subsystem.

Two Switching Processor Frames shall be required to constitute duplicated system to assure the high reliability of operation.

(2) Maintenance and Administration Subsystem

This subsystem shall provide the facility for the personel to know the system operating status.

This subsystem is composed of Maintenance Teletypewriter which is used for man-machine interface and issuing charging data and Maintenance Console which provides various functions such as automatic change-over, supervision and printing out the trouble message.

Besides, test teleprinter which is used for a connection test shall be also included.

(3) Position Subsystem

This subsystem consists of Operator Positions provided with teleprinter and Route Busy Display which displays

busy status of each trunk group and number of requests awaiting in the queue.

3.2.2 Equipment List

The equipment required will be as follows.

Item	Description	Q'ty
1.	Main Equipment	
1.1	Switching Processor Frame	2
1.2	Maintenance Teletypewriter	3
1.3	Maintenance Console	1
1.4	Operator Position	2
1.5	Route Busy Display	1
1.6	Line Test Frame	1
1.7	Test Teleprinter	2
1.8	Intermediate Distribution Frame	1
2.	Power Supply Equipment*	
2.1	Inverter	1

* *The main power source equipment such as rectifiers* and batteries is not included in this system as using in common with the new international telephone switching system

3.	Installation Materials and Tools	1 lot
4.	Test Equipment and Tools	1 set
5.	Spare Parts	1 set

3.2.3 System Block Diagram

System block diagram of Rwanda international telex switching system will be as shown in Fig. 3.1.

3.3 Software Configuration

To make the efficient use of the system, following program will be provided.

(1) Execution Control Program (EP)

EP controls the execution of all application programs and Input-Output operations.

(2) Fault Processing Program (FP)

FP controls the hardware configuration of the system, performing fault recognition and system reconfiguration.

(3) Call Processing Program (CP)

CP executes the setting up and clearing of telex calls.

(4) Administration Program (AP)

AP executes prepared commands for maintenance personnel to perform traffic control and other administration jobs.

(5) Diagnostic Program (DP)

DP performs to select the suspectable packages in a failed unit.

3.4 Floor Layout

Refer to Fig.1 of explanation of the layout plan.

FLD : Floppy Disk Memory
HW : Highway Switch
IDF : Intermediate Distribution Frame
LCU : Line Control Unit
LTF : Line Test Frame
MCSL : Maintenance Console
MTTY : Maintenance Teletypewriter
MM : Main Memory
POS : Position
RBD : Route Busy Status Display
SPU : Switching Processor Unit
TTP : Test Teleprinter

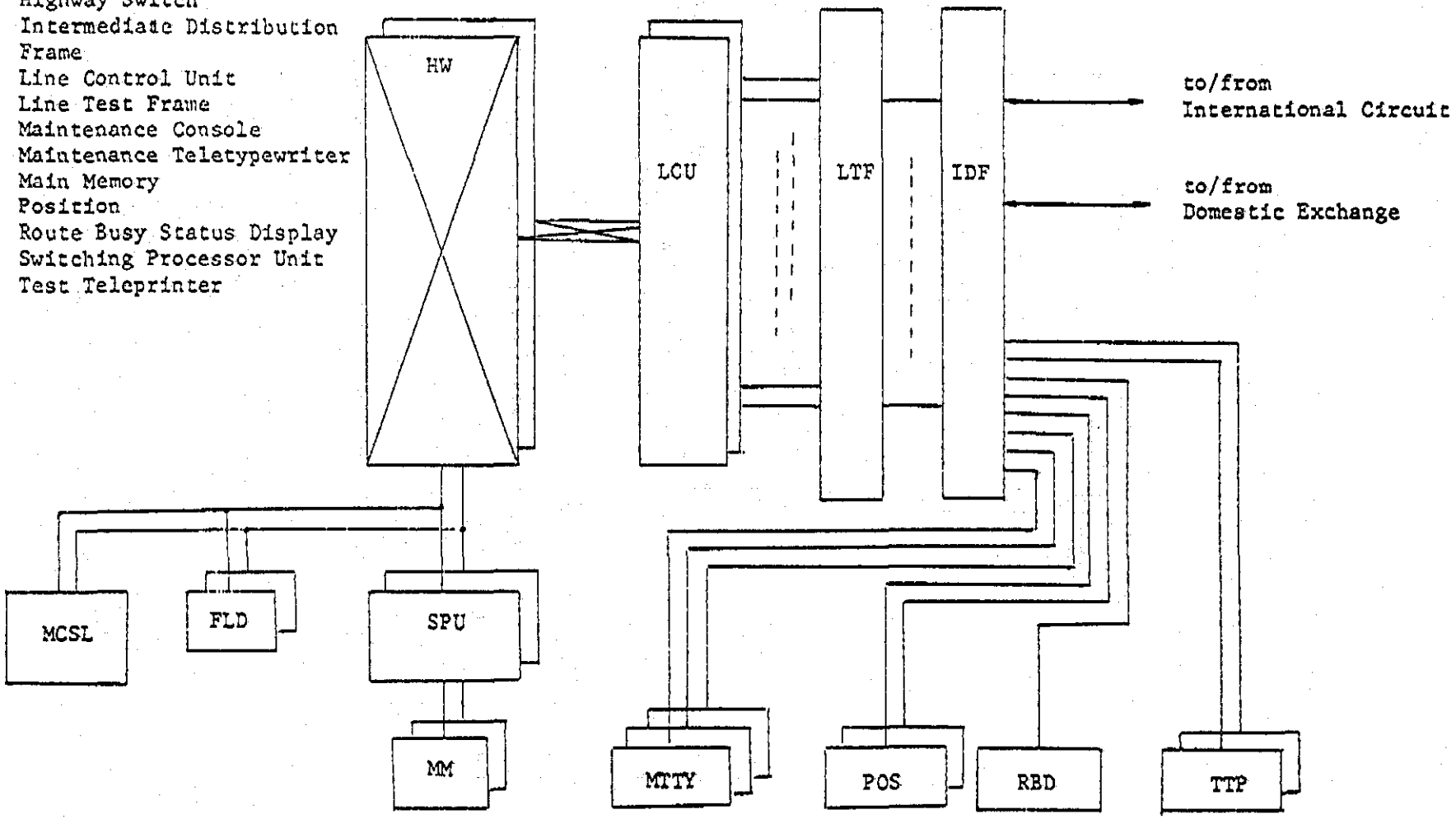


Fig. 4-3 System Block Diagram

4. Implementation Schedule

4.1 Schedule

Typical implementation plan will be given in the draft final report.

4.2 Scope of Work

4.2.1 Works to be performed by the Contractor

The contractor will be responsible for the following works.

(1) The contractor will provide the equipment and materials for new facilities and perform the installation.

Both of hardware and software will be provided.

(2) Technical Documentation

The contractor will submit manuals, descriptions and drawings to MPC, written in English, containing sufficient detail and clarity to enable the maintenance personnel to operate and to maintain the system.

(3) Training

The contractor shall be responsible for necessary training of personnel designated by MPC. The training program shall be proposed by the contractor and final decision shall be based on the agreement between MPC and the contractor.

i) Training at factory

2 trainees shall be accepted by the contractor for a period of 2.5 months.

ii) On the Job training

The contractor shall accept 10-20 trainees and shall give them on-the job training at the site where installation work is in progress for a period of 1 month.

iii) Language

English shall be used.

iv) Text book

The contractor shall prepare all necessary text books for all trainees.

v) Cost

Round trip air-fare for trainees and staying expenses shall be covered by the contractor.

(4) Operation and Maintenance

The contractor will provide supervision and engineering support services by one engineer for a period of 12 months for initial operation of the system.

4.2.2 Works to be performed by MPC

MPC should be responsible for the following works in order to have the contractor perform the work satisfactorily.

(1) To provide the following facilities.

i) Building (Equipment Room, Operator Room and Power Equipment Room) including grounding and shielding, cable holes and trenches, lighting, interior furniture, partitions utility power, etc.

ii) Necessary equipment and materials for interfacing with the new switching system.

iii) Provision of cabling and wiring from the existing system to the distribution frame of the new International telex exchange.

III. Layout plan and peripheral conditions

1. Layout plan

In case of this project, not only the switching room but also following rooms must be required.

1) operator's room

2) power supply room

3) air conditioner room

4) office room

1.1 Basic conditions

Special regard be paid to the fact are given as under.

1) to ensure the floor area of final equipments

2) to be under consideration to the final arrangement

3) to ensure the space for equipments carried in

4) to ensure the area to raise the efficiency of test and maintenance

5) to ensure the area of air conditioner in case of installation in same area

6) to ensure the length of cable connected to equipment to equipment be short as possible

1.2 Floor layout plan

A floor layout plan is shown in Fig. 1.

2. Power supply

The electric installation which must be of a first class quality, in 220 V 3 Phases. The electrical supply must be stable; a failure would lead to a sudden stop of the system and loss of the data recorded in the system.

3. Environmental conditions

On survey of the actual conditions, the problems to be solved are as follows.

1) dust-proof

2) temperature and humidity

The proposed switching system must be installed in the air-conditionned room which satisfies the following conditions.

temperature	18 - 28 °C
humidity	40 - 70 %
variation of temperature	less than 5 °C/hour

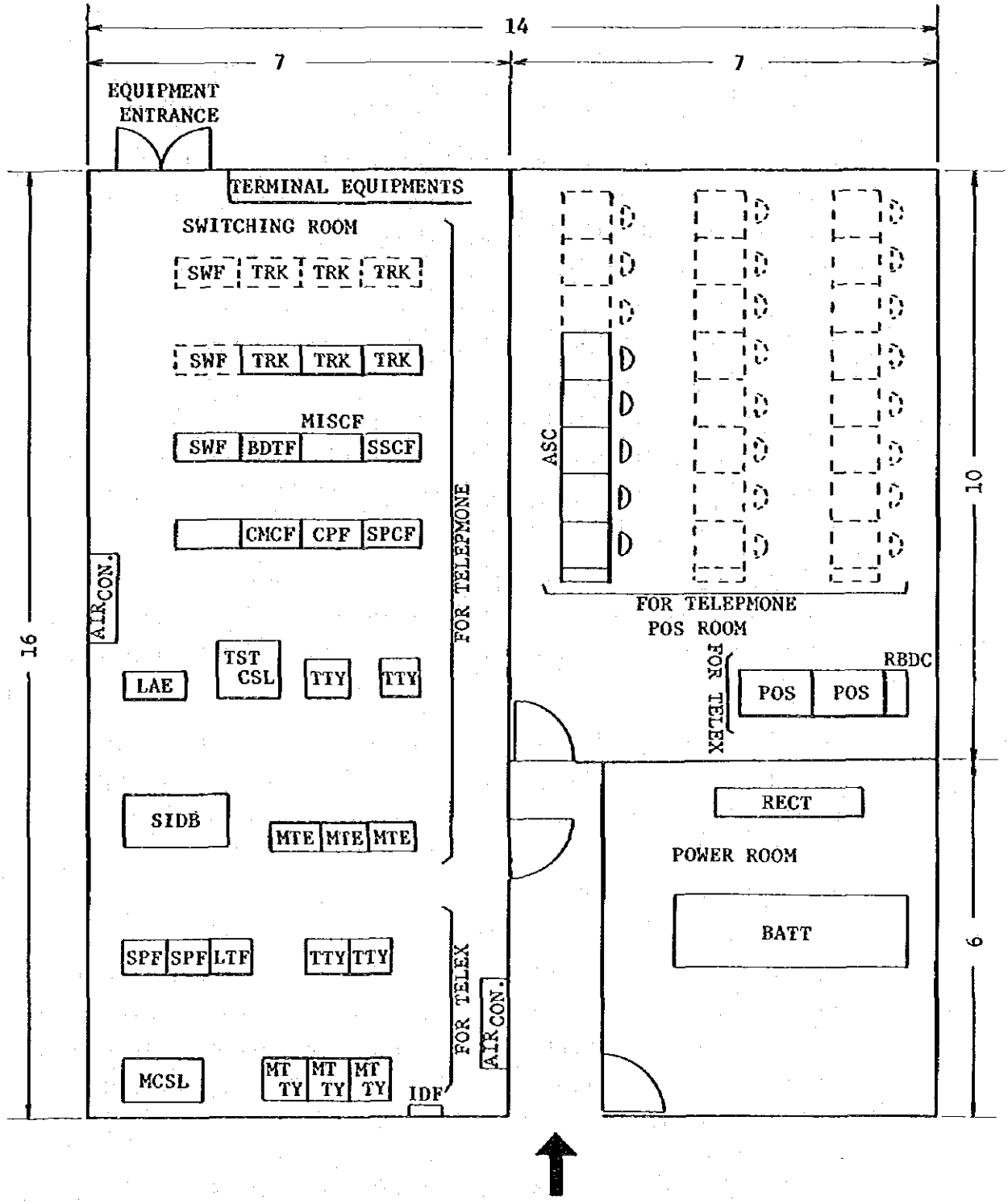
And, in designing the air conditioner, the points to be duly considered are as in the following.

1) carorific power of equipments

2) carorific value of personnel (130 Kcal/person)

3) heat capacity of lighting fixtures

4) incoming heat capacity from window glass and next room



LEGEND:

FRONT SIDE OF EQUIPMENT

FUTURE EXPANSION FRAME

SLALE: 1/100
UNIT: METER

Fig. 1 FLOOR LAYOUT PLAN

IV. Personnel programme

1. Upbringing and supplement of personnel

The upbringing and supplement of the personnel necessary for handling electronic exchange systems are important subjects in order to proceed with this switching project. The key point whether the installation and operation of the electronic exchange systems will be successful or not is the upbringing and supplement of the personnel, which is of vital importance to obtain successful result of this project. When considering the personnel programme, therefore, it is necessary to form a programme taking into account not merely the training at the time of installation but also the maintanance and operation to be undertaken after the installation of the system.

Many competent personnel will be required in order to implement this project and to carry out the maintenance as well as operation after the installation, covering various fields such as system management, techniques, maintenance and operation.

In this point of veiw, MPC must work out long-term personnel programmes, and should undertake proper recruitment programmes, positive personnel programmes and an appropriate personnel administration.

2. Methods of training

The establishment of training system for the personnel necessary for the installation of electronic exchange system and the maintenance as well as operation after the installation is indispensable, and the training systems are to be well organized, from a long term point of view, as follows:

1) Factory and on the spot training by the contractor

As the training must be carried out using machines, it is desirable to undertake all the training at factory. However, taking into account the period, number of trainees and expenses, the training must be done at factory and on the actual site, separately. Details of the training will be decided by

mutual consent of RWANDA MPC and the contractor.
The following is an example of training details.

- Training at factory

  contents : basic course

  engineering course

  hardware course

  software course

  operation course

  maintenance course

  duration : 2.5 month

  trainee : 3 persons (telephone)

  2 persons (telex)

- Training at the site

  contents : OJT

  duration : 1 month

  trainee : 20 - 40 persons (telephone and telex)

2) Training at the workshop (MPC programme)

The trainees who have completed the training provided by the contractor and the engineer sent by the contractor, as the instructors, will carry out training through the daily activities.

3) Training assigned to outside organs (MPC programme)

Training for new employees and training for leveling up techniques, by organizing special courses, will be undertaken at the National Telecommunication Institute (l'ecole national des Telecommunications) and so on.

In addition, the employees with an excellent capability will be sent to universities or institutes in Rwanda or abroad, or overseas institutes concerned with communications.

It is necessary for the training mentioned in 2) and 3) above to be carried out both intentionally and continuously throughout the year.

3. Organization to proceed with this project

The process from the installation planning to the construction and actual operation of the switching system can not be completed within a short period, and, it is necessary to promote specially and strongly the actual stages involved in the installation planning, construction and operation of the system. It is also necessary to establish an organization to realize the above. Similar to the upbringing of the personnel, the strength of this promoting organization will exert an important influence on the result of the implementation project.

It is desirable to select a man of ability and capability of section chief level as the leader, and to provide him with an authority necessary for proceeding with the installation project. Some members of the present exchange personnel will become the main force of the implementation project, and the necessary personnel in connection with the project will be as follows.

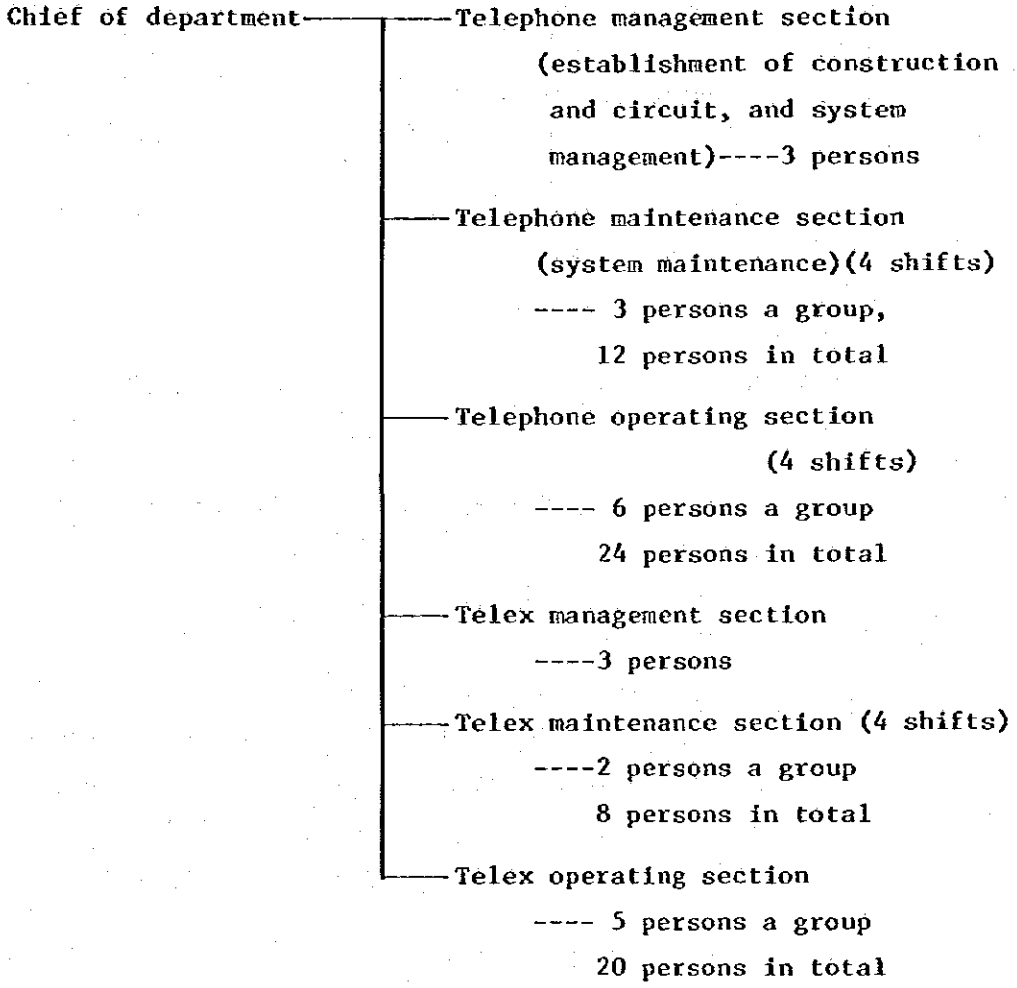
Project manager	:	1 person
Chief engineer	:	1 person
Engineer and technician	:	5 - 6 persons

4. Maintenance and operation personnel after the completion of the implementation project

As for maintenance and operation, about 25 technicians and 50 operators at minimum should be secured. The above-mentioned personnel for promoting the implementation project and the persons who have undertaken the training by the contractor will naturally be the main body of the maintenance and operation personnel. Since the absolute number of technicians is not sufficient, the first and second upbringings of personnel at the National Telecommunication Institute must be done as soon as possible before the implementation project completed. After these training,

further long-term OJT programmes must be undertaken by the Institute and MPC.

As to a standard idea of personnel arrangement, an example is shwon as below.



5. Personnel recruitment programme

For the purpose of promoting the present programme as well as long-term programmes in the future, a substantial number of capable personnel will be required to cover the fields of maintenance and operation. It is quite necessary to set up a personnel programme for each year, to proceed with the recruitment programme positively and to provide personnel with training opportunities.

C. Radio Links

The consequence of preliminary design study of the radio links is as follows.

1. Conclusions

1.1 The study team recommends as following items.

1.1.1 To establish microwave (upper 6 GHz band) radio links between Earth Station and Bâtiment Technique and Mt. Jari.

1.1.2 To improve UHF (400 MHz band) radio link between Mt. Jari and Tonga and to establish UHF (400 MHz band) radio link between Tonga and Butare.

1.1.3 To establish the antenna supporting towers related to above mention 1.1.1 and 1.1.2.

1.1.4 To improve the emergency power supply equipments at Mt. Jari and Butare.

1.2 The Rwanda government should obligate as following items.

1.2.1 To establish the foundation of all the antenna supporting towers and to improve the foundation of emergency power supply equipment at Mt. Jari and Butare. But the data of required foundations and the anchor bolts of antenna supporting towers will be supplied by contractor.

1.2.2 To provide with the floor area for proposed equipments.

1.3 Pending matter

1.3.1 As for improvement of the emergency power supply equipments of Bâtiment Technique and Tonga will be further examined its possibility by the study team.

1.4 Recommendation

1.4.1 The places of construction of each antenna supporting tower are shown in the drawings attached hereto.

1.4.2 The layout of the equipments are shown in the drawings.

1.4.3 To remodel partially all of the radio station buildings. Especially to be care for dust, because it will cause breakdown of radio equipments.

2. Radio route of microwave and UHF radio system.

To be shown as Fig.1, 2 and 3.

3. Confirmation of visibility.

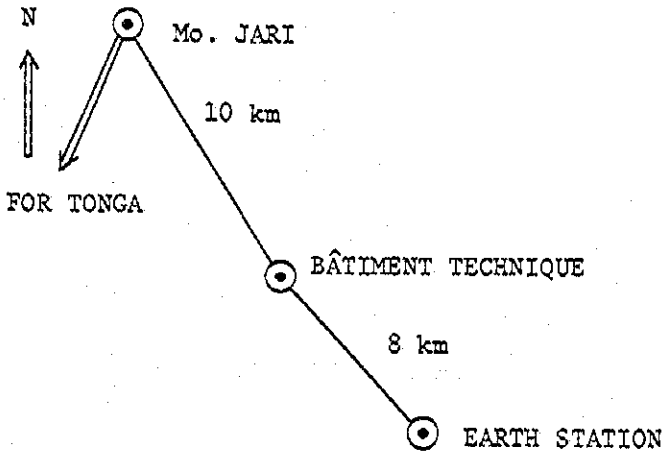
To be shown as Fig.4, 5, 6 and 7.

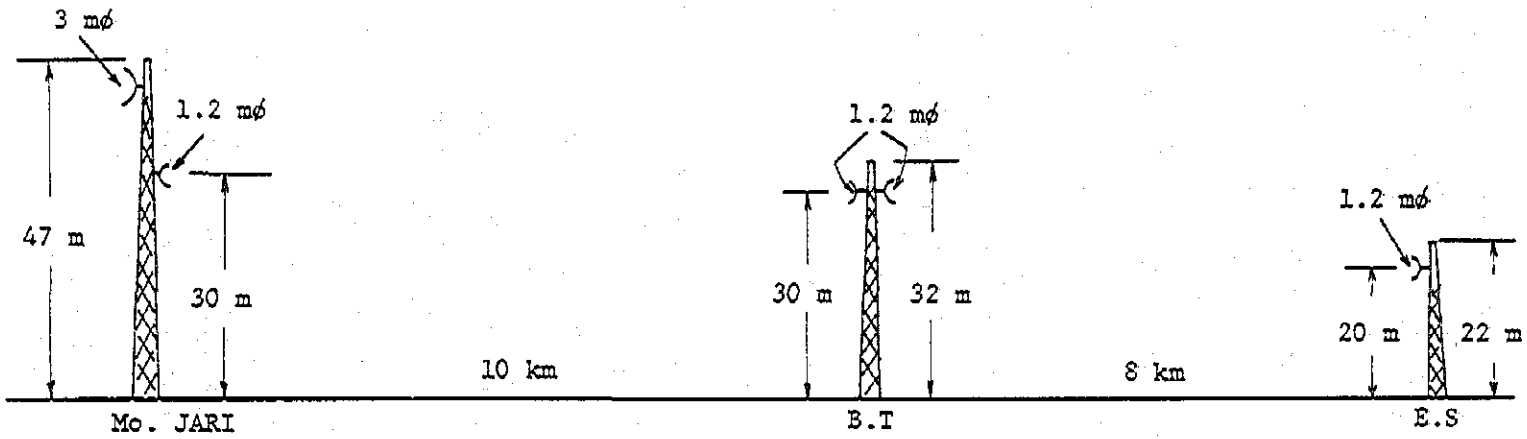
4. Outline of microwave and UHF radio system.

4.1 Microwave radio system.

MICRO WAVE ROUTE MAP

Fig.-1

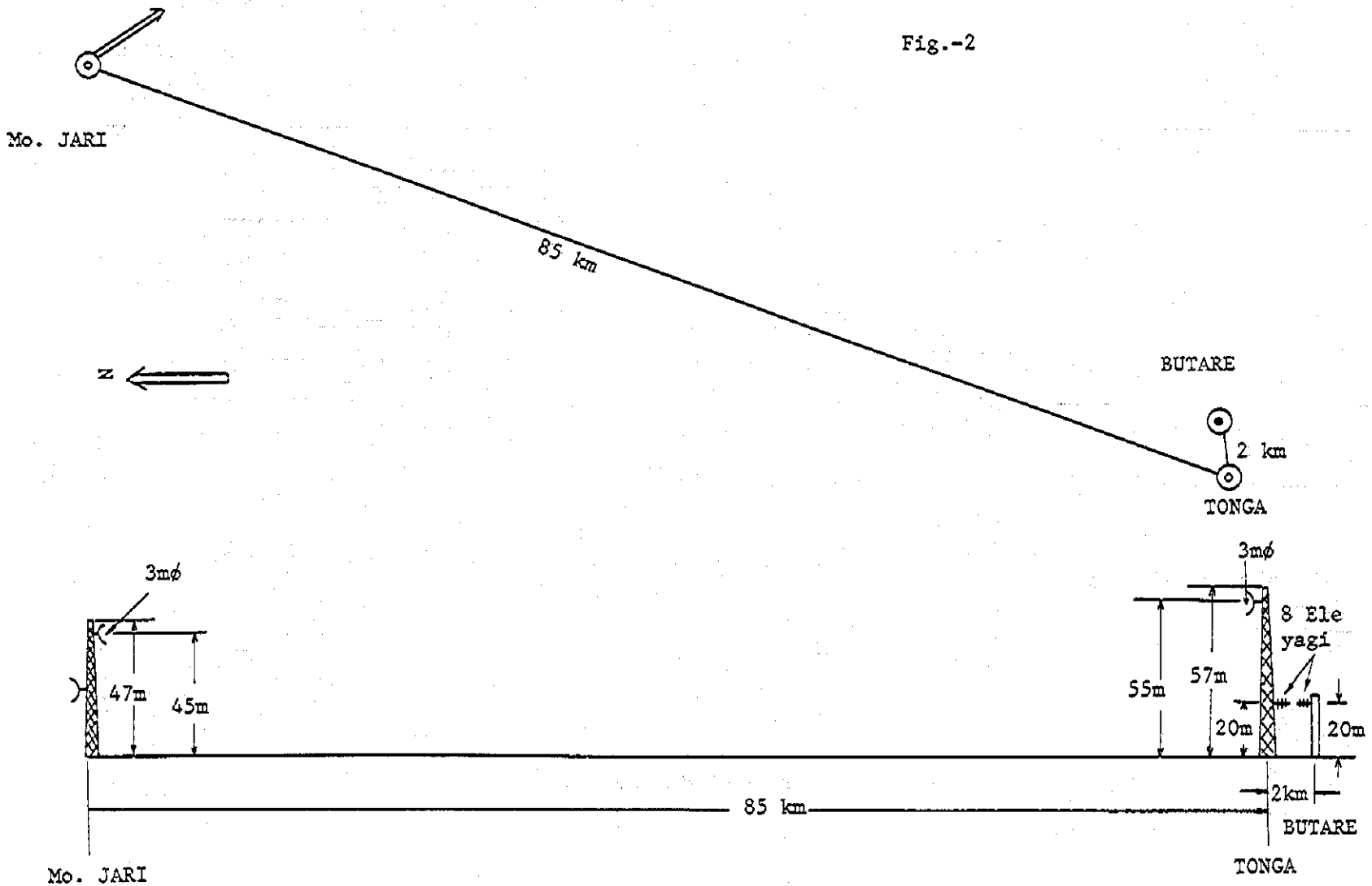




UHF ROUTE MAP

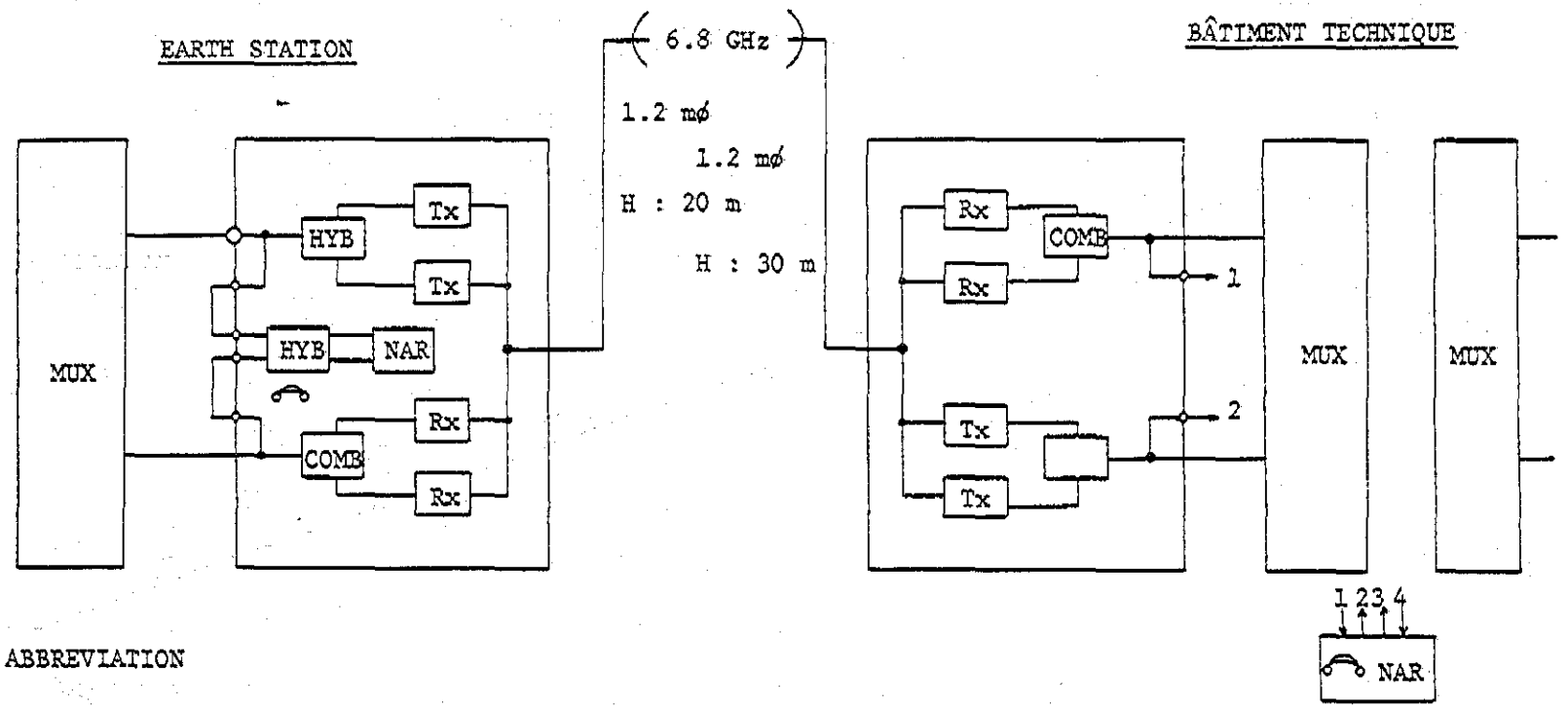
FOR BÂTIMENT TECHNIQUE

Fig.-2



SYSTEM BLOCK DIAGRAM

Fig.-3



ABBREVIATION

Tx : Transmitter
Rx : Receiver
HYB : Hybrid
COMB: Combiner

NAR : Supervisory & control equipment

Fig.-3-2

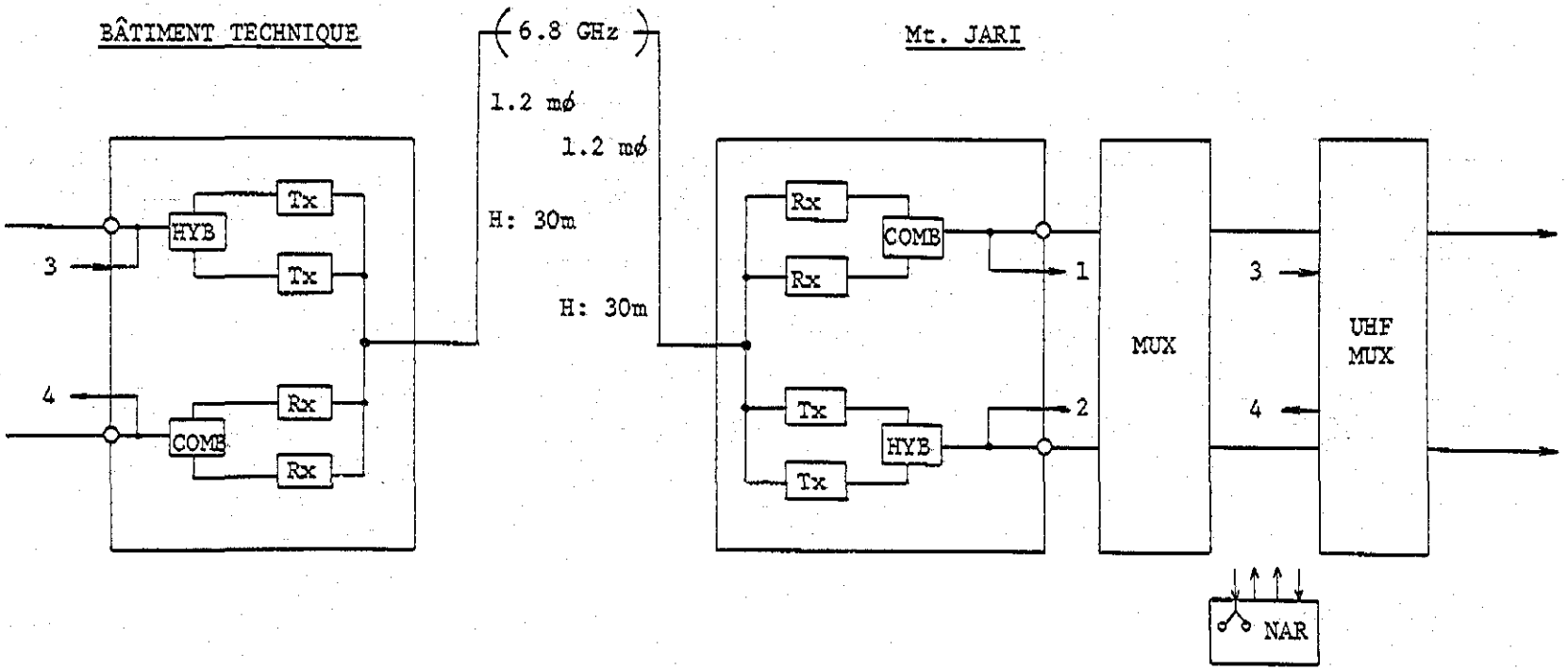
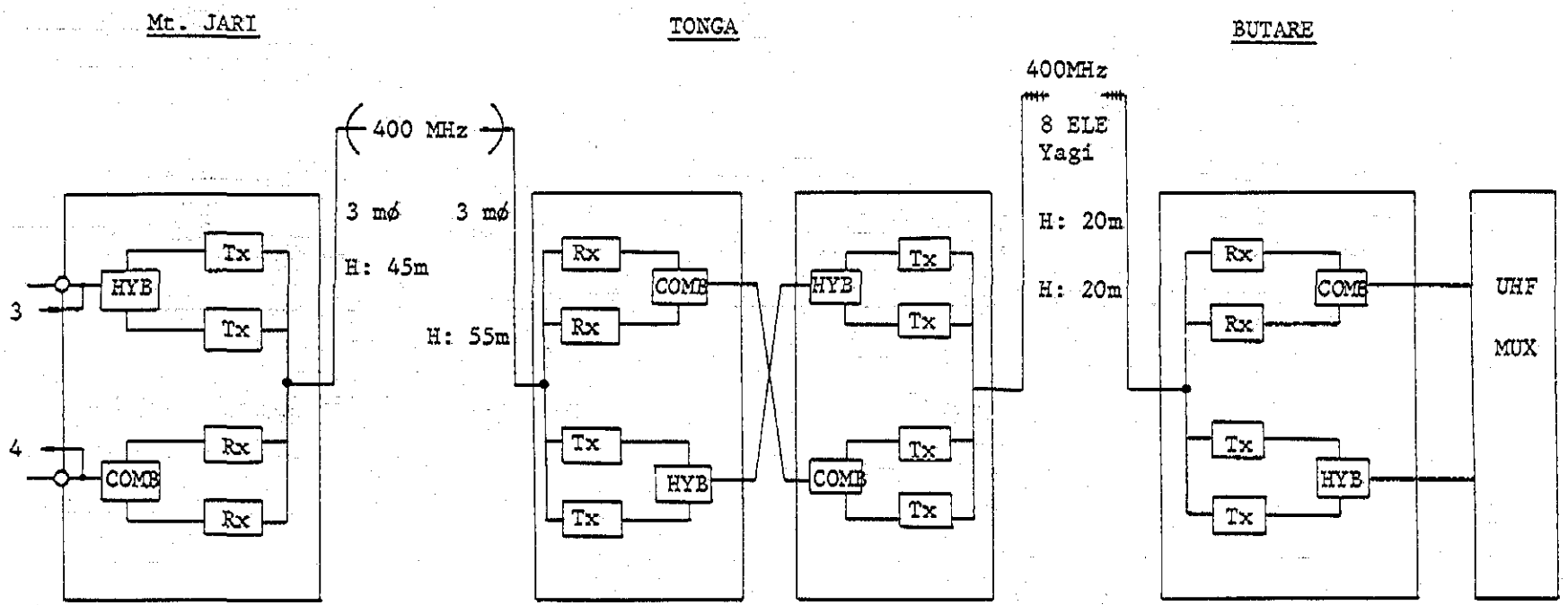

BÂTIMENT TECHNIQUE
6.8 GHz
1.2 mø
1.2 mø
H: 30m
H: 30m
Mt. JARI
Tx
Tx
HYB
3
4
Rx
Rx
COMB
Rx
Rx
COMB
1
Tx
Tx
HYB
2
MUX
3
4
UHF
MUX
NAR

Fig.-3-3



Repeater station

(B.T)

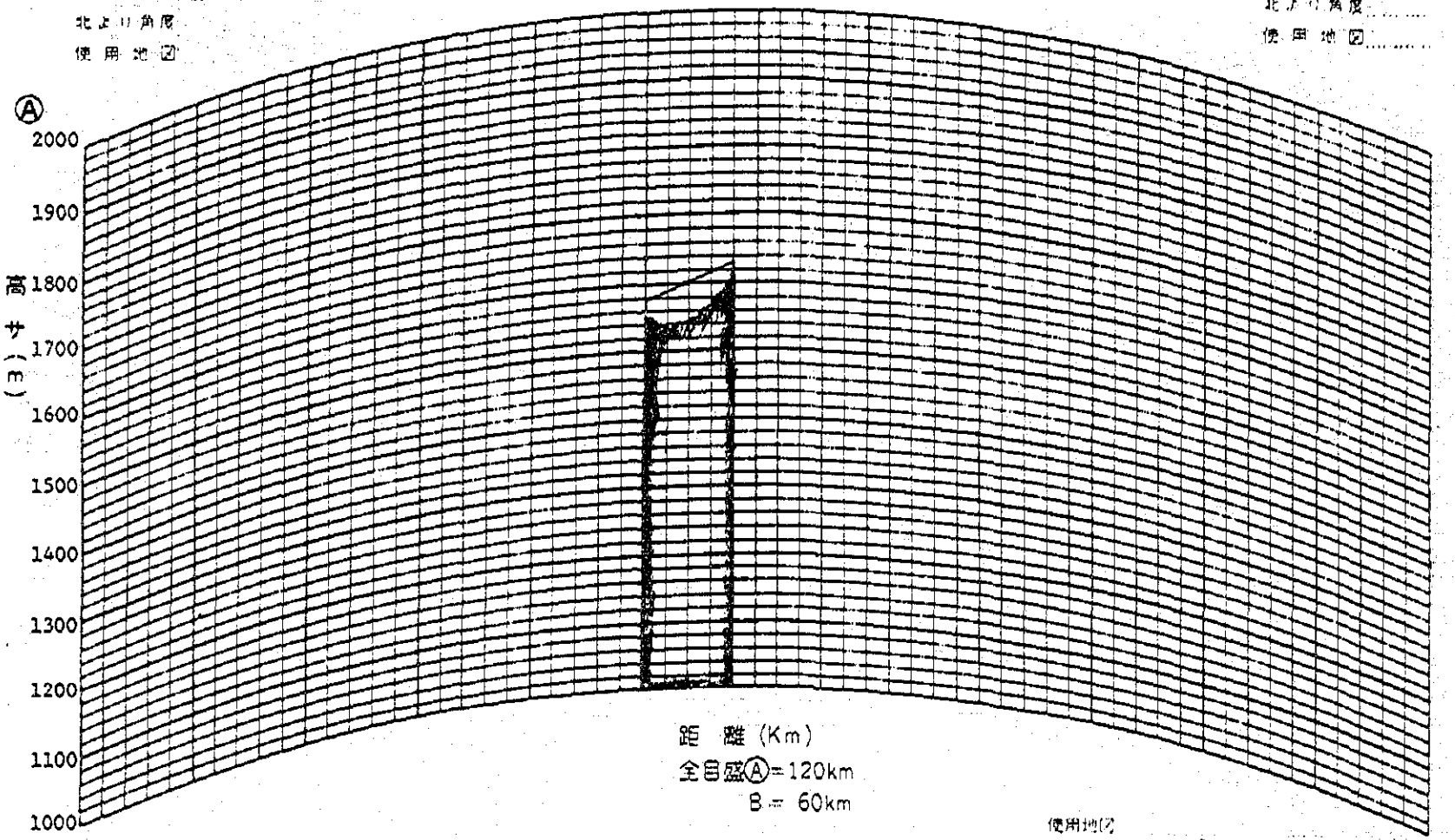
標高 1550 m
空中線地上高 30 m
空中線実効高 m
平均地表高 m
北より角度
使用地図

周波数 6.8 GC
波長 m
実効輻射電力 W
距離 8.0 km

E db
電界強度 E db
Ecor db

(E.S)

標高 1610 m
空中線地上高 20 m
空中線実効高 m
平均地表高 m
北より角度
使用地図



高サ(E)

使用地図

図 Fig 7-2 ——— 断面図

No.

(Mt. Jari)

標高 2070 m
空中線地上高 30 m
空中線実効高 m
平均地表高 m
北より角度
使用地図

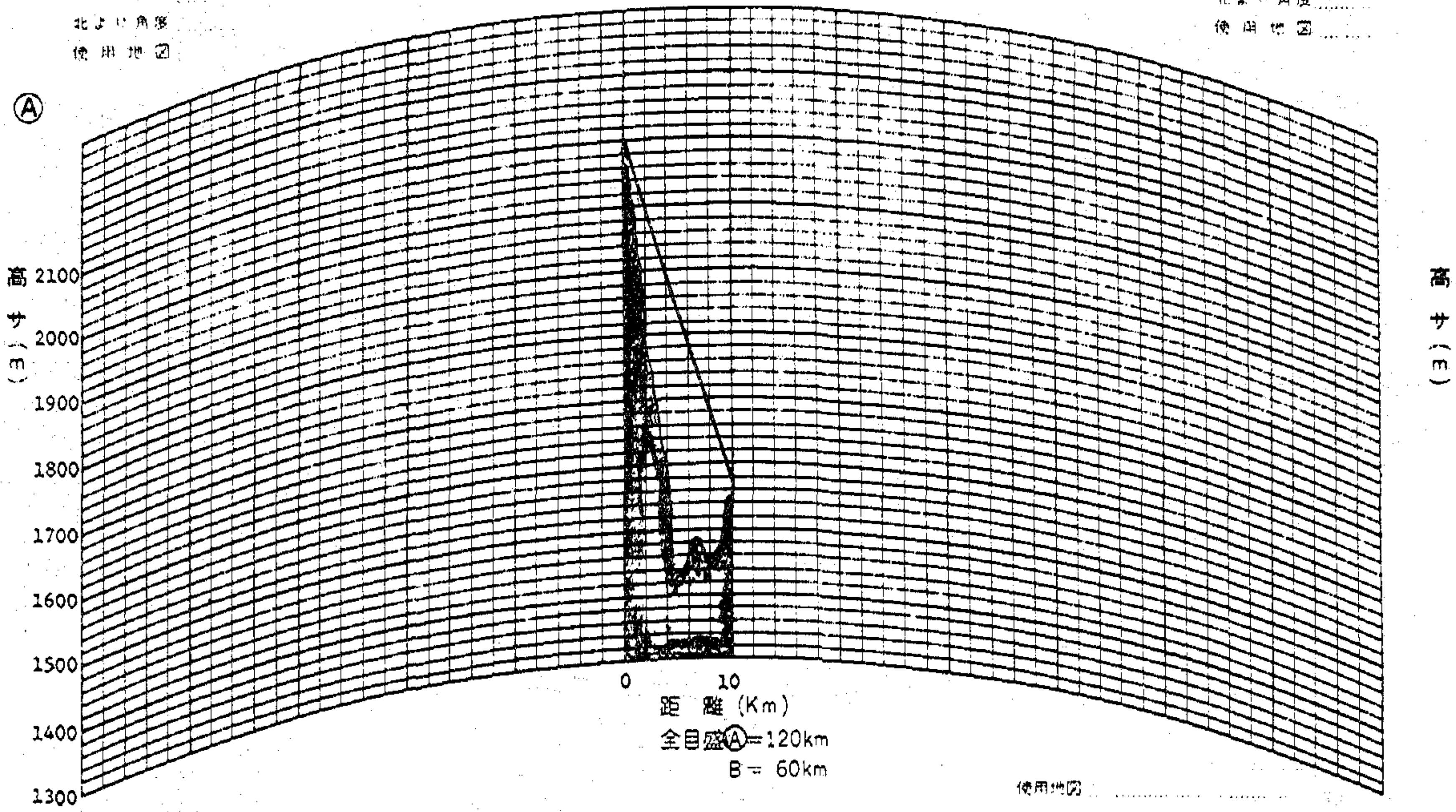
周波数 6.8 GC
波長 m
送信機出力 W
距離 10.0 km

E db
電界強度 E db
Eact db

(B.T.)

標高 1550 m
空中線地上高 30 m
空中線実効高 m
平均地表高 m
北より角度
使用地図

Ⓐ



使用地図

第 図 Fig 7-3 断面図 原図担当 写図担当 No.

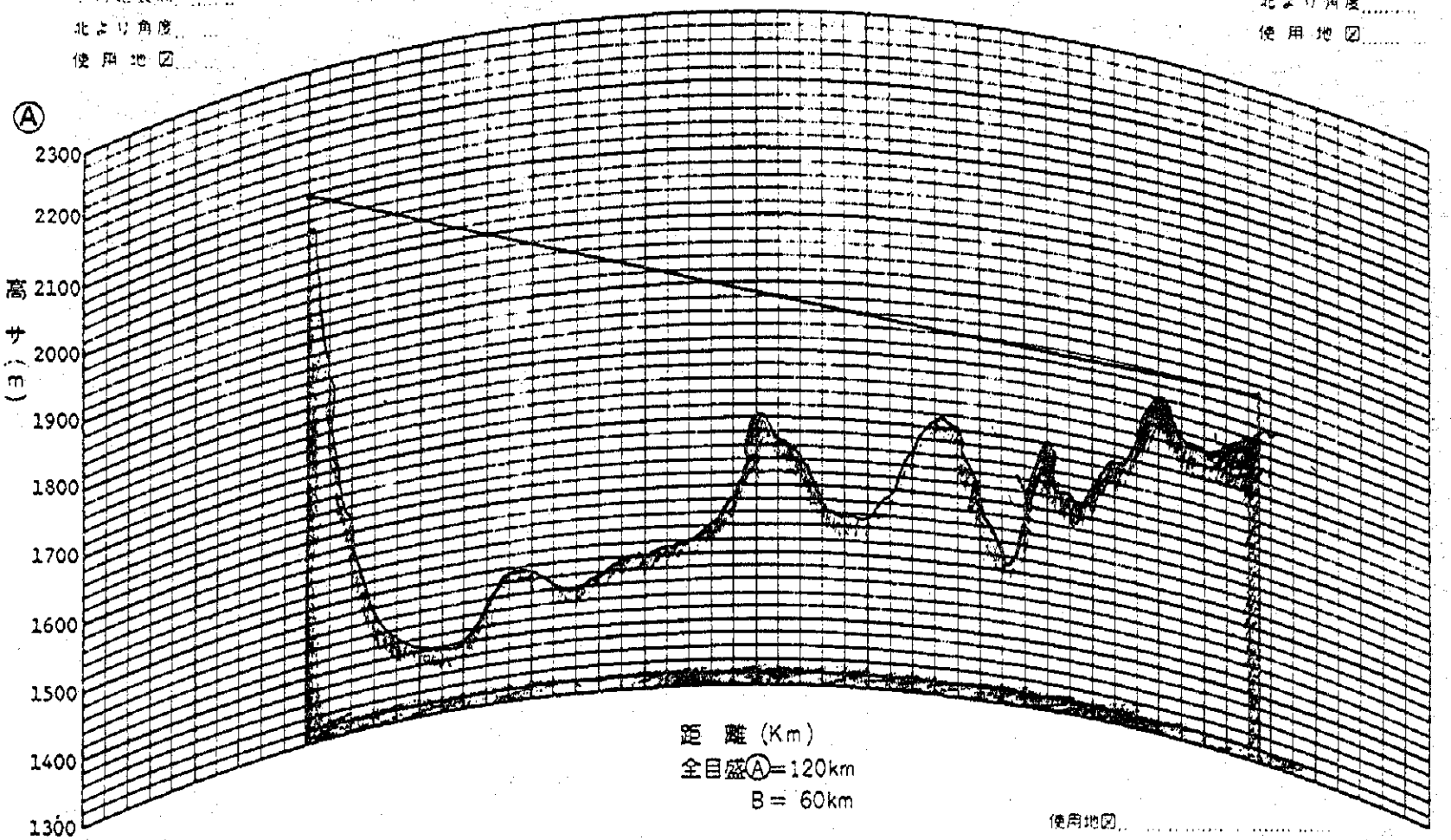
（Mt. Jari）

標　高　207.0 m
空中線地上高　45 m
空中線実効高　　m
平均地表高　　m
北より角度
使用地図

周波数　　GC　　E　　db
床　　長　　m　　電界強度 E　　db
実効輸射電力　　W　　　Dact　　dh
距　　離　85.0 km

（Tonga）

標　高　1790 m
空中線地上高　55 m
空中線実効高　　m
平均地表高　　m
北より角度
使用地図



使用地図

第　　図 Fig 7-4 ——— 断面図　原図担当　　写図担当　　No.

高さ（m）

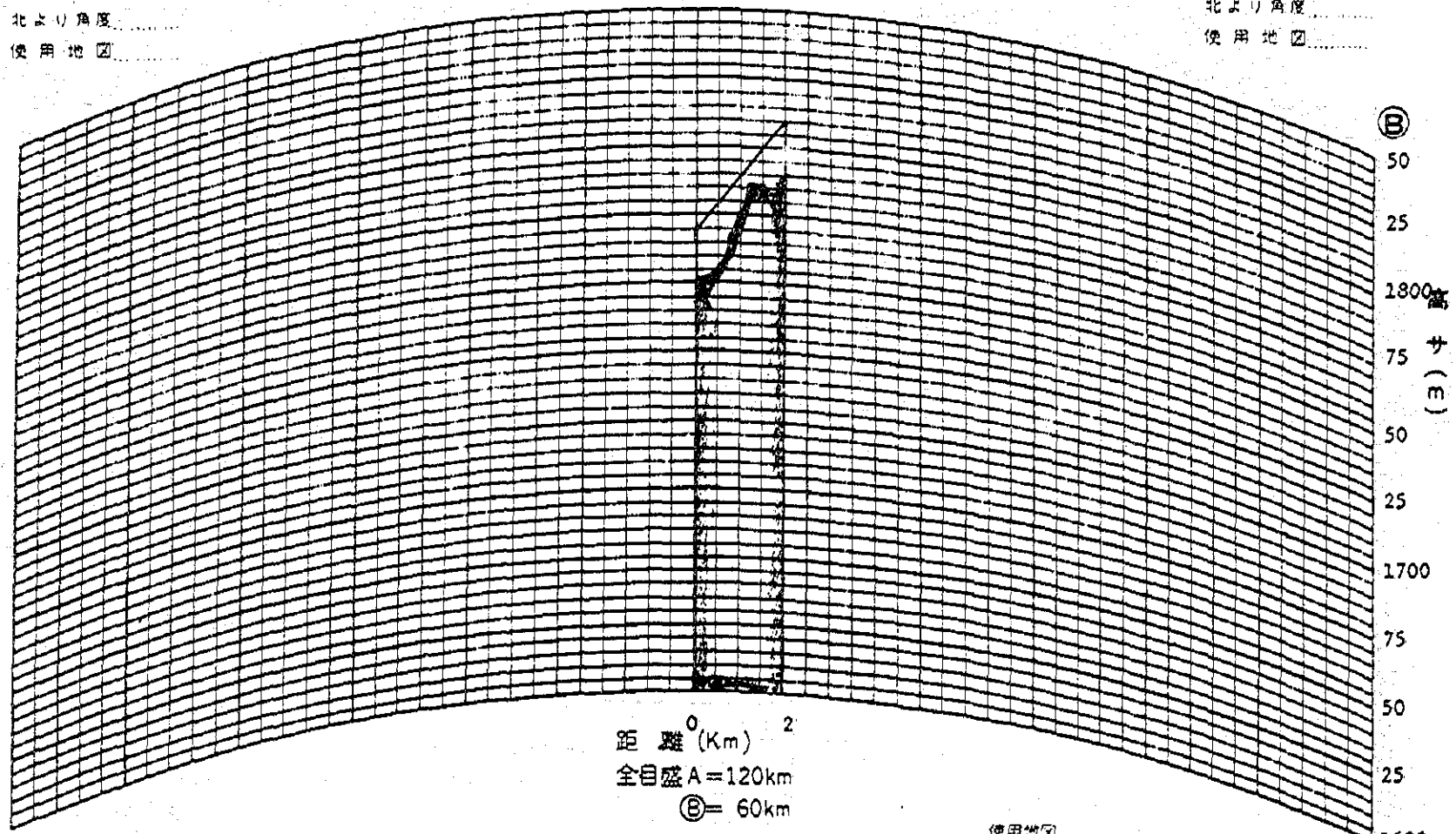
(Butare)

標　高 1750 m
空中線地上高 20 m
空中線実効高 m
平均地表高 m
北より角度
使用地図

周波数 400 MHz　　E db
波　長 m　　電界強度 E db
実効輻射電力 W
距　離 2.0 km　　Eact db

(Tonga)

標　高 1790 m
空中線地上高 20 m
空中線実効高 m
平均地表高 m
北より角度
使用地図



高サ(m)

A-92

使用地図

第　図 Fig 7-5 ——— 断面図　原図担当　写図担当　No.

4.1.1 Radio frequency: Upper 6 GHz band
(CCIR Rec. 384-2)
point radio frequencies should be decided on contract.

4.1.2 Transmission capacity.

(1) Earth station - Bâtiment Technique up to 60 telephone channels (Initial 24 Telephone channels)

(2) Bâtiment Technique - Mt. Jari
up to 300 Telephone channels (Initial 120 Telephone channels)

(3) Microwave radio equipments equip with supervisory, control and orderwire telephone signals.

4.1.3 Quality of microwave radio links
S/N≥60 dB (Per 1 hop)

4.2 UHF radio system

4.2.1 Radio frequency range:
335 MHz-470 MHz
point radio frequencies should be decided on contract.

4.2.2 Transmission capacity
up to 24 telephone channels (Initial 12 telephone channels)

4.2.3 Quality of UHF radio links
S/N≥40 dB (Per 1 hop)

Annex-1

Specification of Microwave Radio Equipment

1. General

1.1 Radio frequency: Upper 6 GHz Band (CCIR Rec. 384-2)
Point radio frequencies should be decided on contract.

1.2 Transmission capacity: Up to 300 or 60 telephone channels.
Band-width 60 KHz to 300 KHz or 1,300 KHz, (CCIR Rec. 380-3).
Supervisory, control and orderwire telephone signals.
Band-width 0.3 KHz to 56.0 KHz.

2. Environmental Condition

Proposed radio equipment is designed so as to operate under the following conditions.

2.1 No serious performance degradation is caused under ambient conditions of operating temperature in a 0° C to 45° C range and relative humidity below 95%.

2.2 Workable in a -10° C to 50° C temperature range.

3. Transmitter - Receiver.

3.1 Transmitting and receiving: Upper 6 GHz (CCIR Rec. 384-2) radio frequency band:

3.2 Transmitting capacity: Multiplexed telephone signals of up to 60 CH or 300 CH.

3.3 Type of repeating: Remodulation (baseband-relay type)

3.4 Type of modulation: FM (Frequency modulation)

3.5 Transmitter output: 21 dBm (Typical) power (at TX unit output)

3.6 Frequency deviation: 200 KHz r.m. S/CH

3.7 Noise figure: 5.5 kB (Typical) (at RX unit input)

3.8 If bandwidth: 15 MHz

3.9 Squelch level: -86 dBm (Nominal)

4. Power Supply and Consumption.

4.1 Power Source: -24V (Nominal)
-20.0V ∿ -27.5V
: -48V (Nominal)
-36.0V ∿ -57.0V

4.2 Power Consumption: 55W/bay (Typical)

5. Antenna and Feeder.

5.1 Radio Frequency Band: Upper 6 GHz (CCIR Rec. 384-2)

5.2 1.2m ϕ Parabolic Antenna

5.2.1 Antenna gain: 36.0 kBi

5.2.2 Antenna V.S.W.R: 1.10

5.2.3 Antenna F/B ratio: 50 dB

6. Waveguide Feeder

6.1 Waveguide Feeder loss: 5.0 dB/100m (Typical) (at 6.8 GHz)

6.2 V.S.W.R: 1.10

Annex-2

Specification of UHF Radio Equipment

1. General

1.1 Radio Frequency Range:
335 MHz to 470 MHz
point radio frequencies should be decided on contract.

1.2 Transmission Capacity:
Up to 24 telephone channels.
Band-width 12 KHz to 108 KHz
Supervisory and orderwire telephone signals.
Band-width 0.3 KHz to 7.4 KHz

1.3 Environmental Condition.
Proposed radio equipment is designed so as to operate under the following conditions.

1.3.1 No serious performance degradation is caused under ambient condition of operating temperature in a 0° C to 50° C range and relative humidity below 95% (at 35° C)

1.3.2 Workable in a -10° C to 60° C temperature range.

2. Transmitter

2.1 Type of modulation: FM (Frequency modulation)

2.2 Transmitter output power: 40 kBm (10 W) (at TX unit output)

2.3 Frequency deviation: 35 KHz r.m. S/CH

3. Receiver

3.1 Noise figure: Less than 6 dB (at RX unit)

3.2 Intermediate frequency: 35 MHz

3.3 Intermediate frequency: 1.3 MHz band width

4. Power Supply and Consumption

4.1 Power Source: -24V (Nominal)
-19.2V ∿ -27.6V
: -48V
-38.4V ∿ 55.2V

4.2 Power Consumption
On -24 VDC Operation: Less than 80 W
On -48 VDC Operation: Less than 120 W

5. Antenna and Feeder

5.1 Radio Frequency Band: 400 MHz band

5.2 3m ϕ Parabolic Antenna

5.2.1 Antenna gain: 19 dB

5.3 Yagi Antenna (8 elements)

5.3.1 Antenna gain: 12 dB

5.4 Feeder loss: 4.2 dB/100m

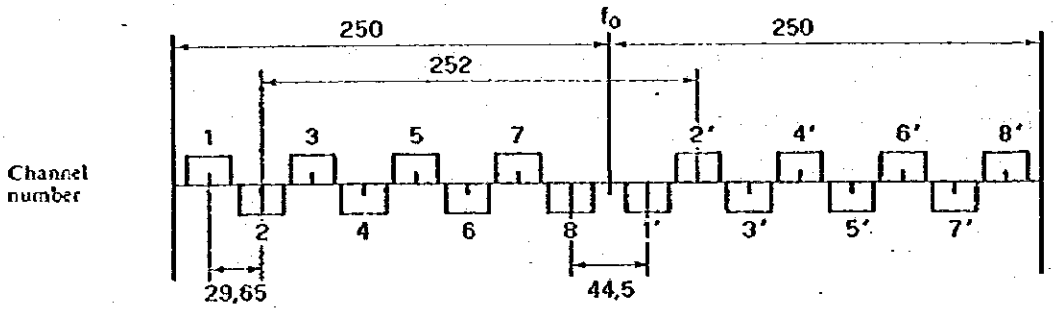


FIGURE 1

Radio-frequency channel arrangement for radio-relay systems operating in the 6 GHz band for use in international connections (the frequencies shown are approximate)
(All frequencies are in MHz)

RECOMMENDATION 384-2 *

RADIO-RELAY SYSTEMS FOR TELEVISION AND TELEPHONY

Radio-frequency channel arrangements for systems with a capacity of either 2700 telephone channels or up to 1260 telephone channels, or the equivalent, operating in the 6 GHz band

(Study Programme 1A/9)

(1963 – 1966 – 1974)

The C.C.I.R.,

CONSIDERING

(a) that radio-relay systems with a capacity of 2700 telephone channels should prove to be feasible in the 6 GHz band, if due care is exercised in the planning of radio paths to reduce multipath effects;

(b) that it is sometimes desirable to be able to interconnect, at radio frequencies, radio-relay systems on international circuits in the 6 GHz band;

(c) that it may be desirable to interconnect up to eight go and eight return channels in a frequency band 680 MHz wide;

(d) that economy may be achieved if at least four go and four return channels can be interconnected between radio-relay systems, each of which uses common transmit-receive antennae;

(e) that a common radio-frequency channel arrangement for both up to 1260 and 2700 telephone channel radio-relay systems offers considerable advantages;

(f) that many interfering effects can be reduced substantially by a carefully planned arrangement of the radio frequencies in radio-relay systems employing several radio-frequency channels;

(g) that the radio-frequency channels should be so arranged that an intermediate frequency of 70 MHz may be used for up to 1260 channel systems;

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* This Recommendation applies only to line-of-sight and near line-of-sight radio-relay systems.

(h) that the radio-frequency channels should be so arranged that an intermediate frequency of either 100 MHz or 140 MHz may be employed for 2700-channel systems, as outlined in Report 287-2;

UNANIMOUSLY RECOMMENDS

1. that the preferred radio-frequency channel arrangement for up to eight go and eight return channels, each accommodating 2700 telephone channels, or the equivalent, and operating at frequencies in the 6 GHz band, should be derived as follows:

Let f_0 be the frequency (MHz) of the centre of the band of frequencies occupied;

f_n be the centre frequency (MHz) of one radio-frequency channel in the lower half of the band;

f'_n be the centre frequency (MHz) of one radio-frequency channel in the upper half of the band;

then the frequencies (MHz) of individual channels are expressed by the following relationships:

lower half of the band: $f_n = f_0 - 350 + 40\,n$,
upper half of the band: $f'_n = f_0 - 10 + 40\,n$,

where $n = 1, 2, 3, 4, 5, 6, 7$ or 8;

2. that, in the section over which the international connection is arranged, all the *go* channels should be in one half of the band, and all the *return* channels should be in the other half of the band;

3. that different polarizations should be used alternately for adjacent radio-frequency channels in the same half of the band;

4. that, when common transmit-receive antennae are used, and not more than four channels are accommodated on a single antenna, it is preferred that the channel frequencies be selected by making either:

$n = 1, 3, 5$ and 7 in both halves of the band or
$n = 2, 4, 6$ and 8 in both halves of the band;

5. that the preferred arrangement of radio-frequency polarization should be one of those shown in Fig. 1, depending upon whether antennae for single or double polarization are used;

6. that the preferred radio-frequency channel arrangement for up to 16 go and 16 return channels, each accommodating up to 1260 telephone channels, or the equivalent, should be obtained by interleaving additional channels between those of the main pattern and should be expressed by the following relationship:

lower half of the band: $f_N = f_0 - 350 + 20\,N$,
upper half of the band: $f'_N = f_0 - 10 + 20\,N$,

where $N = 1, 2, 3, \ldots 15, 16$;

7. that, in the section over which international connection is arranged, all the *go* channels should be in one half of the band and all the *return* channels in the other half of the band;

8. that different polarizations should be used alternately for adjacent radio-frequency channels in the same half of the band;

9. that when common transmit-receive antennae are used, and not more than four radio-frequency channels are accommodated on a single antenna, it is preferred that the channel frequencies be selected by making either:

$N = 1, 5, 9, 13$ or
$N = 2, 6, 10, 14$ or
$N = 3, 7, 11, 15$ or
$N = 4, 8, 12, 16,$

in both halves of the bands and the preferred arrangement of radio-frequency polarization is as shown in Fig. 2;

10. that the preferred centre frequency (f_0) is 6770 MHz; other centre frequencies may be used by agreement between the Administrations concerned.

Note 1. — This radio-frequency channel arrangement permits all local oscillator frequencies to be derived from a common oscillator, if desired.

Note 2. — The radio-frequency channel arrangements for systems of up to 1260-channel capacity and of 2700-channel capacity may be used on intersecting routes, as long as adequate antenna discrimination is provided.

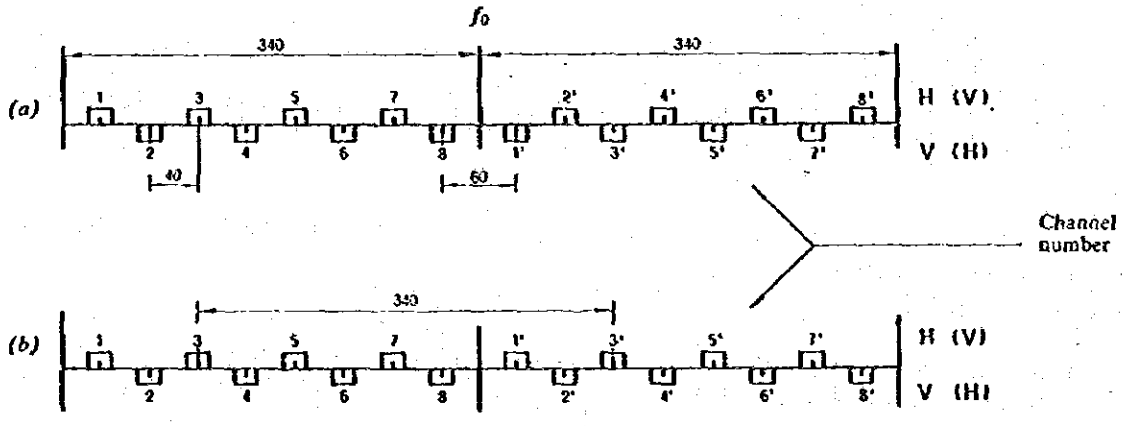


FIGURE 1

(a) Channel arrangement for antennae with double polarization
(b) Channel arrangement for antennae with single polarization
(All frequencies are in MHz)

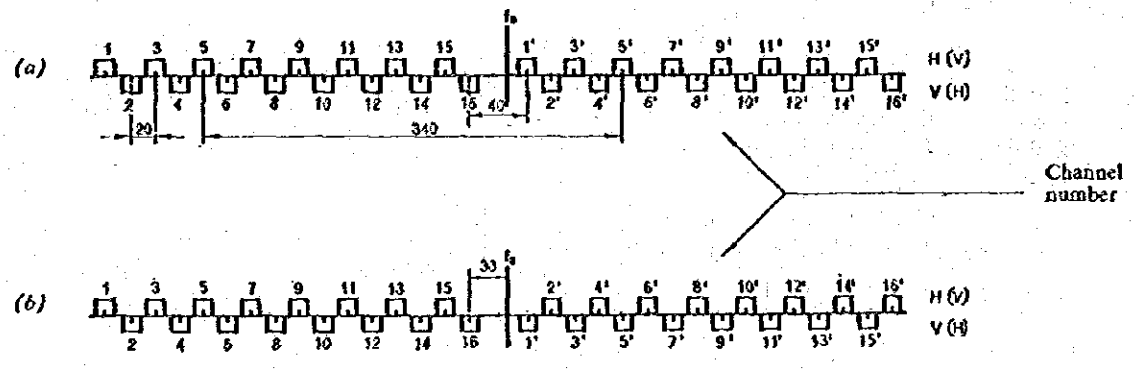


FIGURE 2

(a) Channel arrangement for antennae with single polarization
(b) Channel arrangement for antennae with double polarization
(All frequencies are in MHz)

D. Civil and Architectural Work Necessary for the Project

1. Towers and Mast

1.1 General

The contractor shall be entirely responsible for design, fabrication, transportation to Kigali and erection of towers and mast. Unless otherwise mentioned in table 1, towers and mast shall be also provided with following facilities and appurtenancies.

1) Antenna mount

2) Working and rest platform

3) Climbing ladders

4) Access way where applicable

5) Vertical and horizontal feeder support where applicable

6) Protection grounding

7) Aircraft obstruction lighting and painting where applicable

1.2 Engineering and construction practice and standards.

The design, fabrication and erection work shall conform to the best engineering practice and national standards such as EIA Standard - Structural Standards for Steel Antenna Towers and Antenna Supporting Structures issued by Electronic Industries Association - and its relevant standards, or AIJ Standard - Structural Design Standard for Steel Tower issued by Architectural Institute of Japan and its relevant standards, or approved similar standards.

1.3 Design

The contractor shall comply with the standards applicable for tower designing.

Full account shall be taken of the wind load or seismic load acting on all structures including facilities and appurtenances attached thereto.

1.4 Wind load

The basic design wind speed for calculating all structures and foundations is of 27m/sec or more. The structures and foundations including facilities and appurtenances attached thereto shall survive without any permanent damage when subjected to the wind speed mentioned above.

1.5 Seismic load

Seismic coefficients taken into account for designing all structures and foundation are stated as follows.

Horizontal seismic coefficient 0.1
Vertical seismic coefficient 0.05

However, all structures and foundations may not be considered that they are subjected to the wind load and seismic load simultaneously.

1.6 Twist, sway, displacement and degradation in signal level.

When subjected to the wind load or seismic load mentioned hereinbefore, twist sway, displacement and degradation shall not exceed the values as follows.

Tower twist ..... 2 degree
sway ..... 2 degree
displacement 1/100
degradation in signal level ..... 3 dB

Mast twist ..... 5 degree
sway ..... 5 degree
displacement 1/100
degradation in signal level ..... 3 dB

1.7 Materials

All steel materials including anchor bolts shall be of structural quality conforming to the latest relevant JIS - Japan Industrial Standards.

The manufacturers of the steel materials shall provide the certificate concerning their mechanical and chemical characteristics.

1.8 Aircraft obstruction lighting and painting.

Obstruction lighting system and painting of towers for aircraft hazard shall be provided at the sites described in table 1.

Standards for these lighting and painting shall be as specified in the specification and as specified in relevant documents of I.C.A.O. - the International Civil Aviation Organization - or equivalent specifications.

1.9 Protection grounding.

Each tower and mast shall be equipped with an effective lighting to the structures, radio equipments and antenna system.

1.10 Galvanizing.

All steel work shall be coated by hot-dip galvanizing after fabrication has been completed. Anchoring bolts forming portion of foundation shall be galvanized down to a distance of 10 cm under the surface of the concrete.

Table 1

Site	Tower or Mast		Antenna			Aircraft obstruction	
	Type	Heights m	Diameter m	Heights m	Direction	Lighting	Painting
Earth Station	Self-supporting	22	1.2	20	Bâtiment Technique	-	-
Bâtiment Technique	ditto	32	1.2 1.2	30 30	Earth Station Mt. Jari	Beacon lamps or side lamps at the top	O
Mt. Jari	ditto	47	1.2 3.0 G	30 45	Bâtiment Technique Tonga	ditto	O
Tonga	ditto	57	3.0 G YAGI	55 30	Mt. Jari Butare	Beacon flashing lamps at the top beacon lamps or side lamps at the middle	O
Butare	Mast	20	YAGI	20	Tonga	-	-

Abbreviations

G : Grid antenna

YAGI : Yagi antenna

O : Applied

- : Not applied

2. Foundations of antenna structures and emergency engine generator.

2.1 General

The contractor shall be responsible for designing the foundations, however, M.P.C. - Ministry of Posts and Communications - shall construct the foundations accurately in size and position according to the requirements of the designs.

2.2 Design

Foundation design shall conform to the best engineering practice and national standards such as EIF Standard - Structural Standards for Steel Antenna Towers and Antenna Supporting Structures issued by Electronic Industries Association - and its relevant standards, or AIJ Standards - Structural Design Standards for Building Foundation issued by Architectural Institute of Japan and its relevant standards or approved similar standards.

2.3 Bearing capacity of soils

Allowable bearing capacity of soils at each site shall be decided by the contractor after investigation of sub-soil conditions.

However, maximum bearing capacity shall not be greater than 20 t/m^2. For designing the foundations the contractor shall refer to the relevant clauses of "Towers and Mast".

2.4 Drawings

Detailed drawings, or execution drawings where applicable, based upon the designs are to be prepared by the contractor.

They shall include all informations necessary for the foundation works.

2.5 Basic requirements for the materials

1) Cement

All cement to be used shall be normal portland cement and

is to comply with relevant BS, JIS - Japan Industrial Standards - or approved similar standards. Minimum of 330 kg/m^3 of cement per 1 m^3 of concrete in place shall be used.

2) Concrete

Minimum compressive strength of the concrete tested after 28 days shall be 180 kg/cm^2 or more in cylindrical pieces/ or 225 kg/cm^2 or more in cubic pieces.

3) Reinforcing bars

Reinforcing bars are to be of round bars and those mechanical properties shall be as shown in the table below;

Yield point kg/cm^2	Tensile strength kg/cm^2	Elongation %
2,400 or more	3,900 - 5,300	20 or more

4) Rough quantities of materials and works

In absence of informations concerning the soil conditions at each site and others, we prepared the rough estimation of the quantities as the following table.

The values on the table is changeable during the course of implementation designs.

5) Rough quantities of materials and works (total)

Reinforcing bar t	Concrete m^3	Formwork m^2	Excavation m^3	Back filling m^3	Gravel laying m^3
12	210	330	1,600	1,300	35

Remarks

1. Foundation of tower is to be applied to the following sites.

   E/S
   Bâtiment Technique
   Mt. Jari
   Tonga
   Butare

2. Foundation of emergency engine generator is to be applied to the following sites.

   Mt. Jari

3. Proposed building for radio and power equipments

3.1 General

M.P.C. (Ministry of Posts and Communications) shall be responsible for design and construction of the exchange building at the site of Bâtiment Technique and the power building at the site of Earth Station. However, the contractor shall come into contact and cooperate with M.P.C. for designing the buildings and also provide the equipments and installation of air conditioning.

Detailed informations necessary for the design, provided by the contractor, are as follows.

1) effective clear heights (for example, distance between floor level and bottom face of girder or beam).

2) size of carry-in doors for equipments.

3) finishing materials recommended.

4) size and position of openings in walls and trenches for cable installation where applicable.

5) allocation and size of insert rails or similar facilities where applicable.

6) recommended facilities for being free from dust and earth, at the same time, for air-conditioning.

7) arrangement and weights of equipments and design live loads.

8) others necessary or recommendatory for building design, operating and maintenance.

Unless otherwise mentioned, any structural materials for construction may be used, however, minimum compressive strength of concrete after 28 days is preferable to be more than 180 kg/cm^2 by cylindrical test pieces or 225 kg/cm^2 by cubic test pieces.

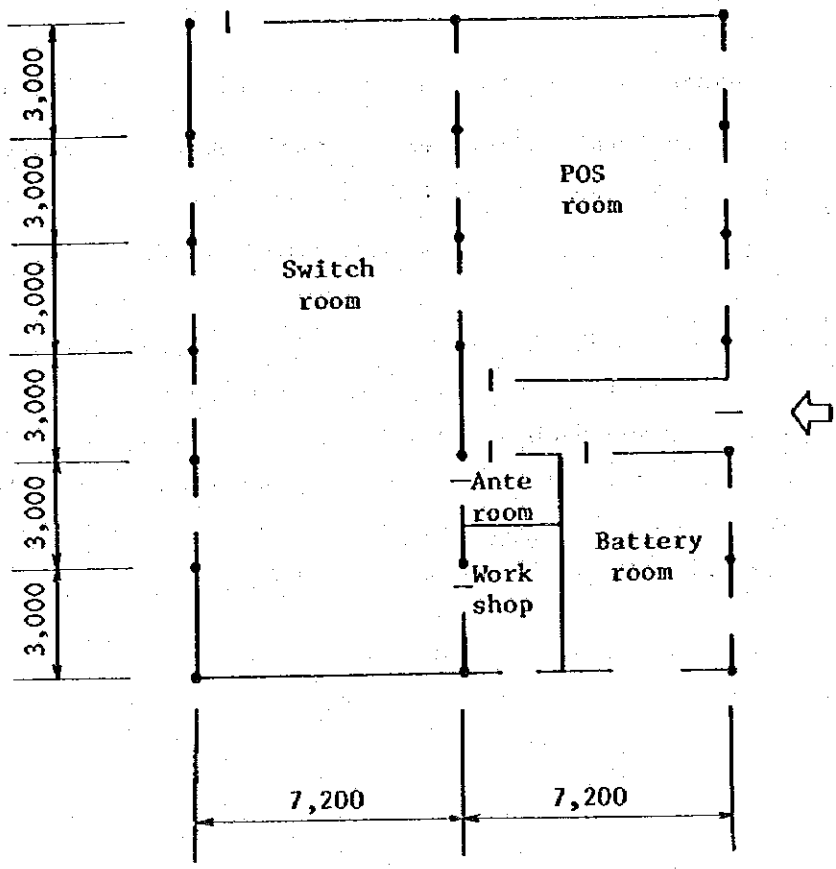
3.2 Exchange building at the site of Bâtiment Techinique.

All structural members except walls shall be constructed of rigid frame and of reinforced concrete.

Draft floor allocation plan is shown in figure 1.

3.3 Power building at the site of Earth Station.

The foundations including tie-beams and slabs or slabs on soils if applicable shall be constructed of rigid frame and of reinforced concrete, however, any structural materials may be used for walls, roof and others. Draft floor allocation plan is shown in figure 2.

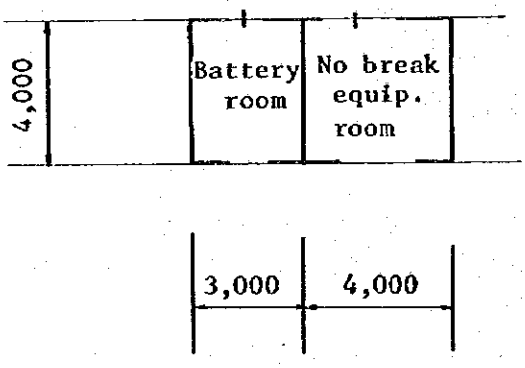


Floor allocation plan (draft)

Scale 1:200

PROPOSED EXCHANGE BUILDING
BÂTIMENT TECHNIQUE

Fig. 1



Floor allocation plan (draft)

Scale 1:200

PROPOSED POWER BUILDING NYANZA

Fig. 2

4. Access road and site ground planning for Earth Station

4.1 Access road

M.P.C. shall provide the access road from the proposed site of Earth Station to the existing road for construction, transportation of equipments and others.

The road shall be of 6m in width so as to be capable of passing of car with crane facilities and is of approximately 250 m in distance. This access road shall be completed before commencement of site works.

4.2 Site ground planning

M.P.C. shall be responsible for cutting the grass and plants at the over all site and roughly levelling the ground for construction and transportation of equipments.

This works shall be completed before commencement of site works. Design and detailed drawings of final ground planning such as levelling the ground, gardening, arrangement of drainage, allocation of paths and others shall be provided by the contractor, however, M.P.C. shall be responsible for the site works according to the drawings.

This site works shall be commenced after completion of all construction and installation of equipments at the site.

5. Improvement of the existing buildings or rooms

Where radio and power equipments are to be newly installed, M.P.C. shall provide the improvement of the buildings or rooms for satisfactory operation and maintenance.

Buildings or rooms to be improved, and example methods of improvement are as follows.

5.1 Battery room of Mt. Jari, and radio equipment room and battery room of Butare.

All over the floors and interior walls shall be re-finished with cement sand pluster (steel trowelled finish) and painting. The false-ceiling, if installed, shall be painted.

These rooms shall be kept to be always clean by means of sweeping and others.

5.2 Radio equipment room of Mt. Jari.

Radio equipment room shall always be free from dust, soil and overheating of the equipment. Suitable improvement methods for such hazards mentioned above are as follows.

1) All windows and doors of the room shall be always closed.

2) Ante-room shall be provided by means of partitions with windows and door.

3) To protect the equipments from temperature-ascending, mechanical ventilating system shall be provided.

4) The room shall always be clean by electric sweeper or similar tools.