REPORT ON THE SECOND SURVEY

FOR

THE MICROWAVE NETWORK PROJECT IN ETHIOPIA

(ADDIS ABABA - ASMARA ROUTE)

TECHNICAL SPECIFICATION FOR SUPPLY AND INSTALLATION OF COMMUNICATION EQUIPMENT

(DRAFT)

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OVERSEAS TECHNICAL COOPERATION AGENCY

GOVERNMENT OF JAPAN

CONTENTS

ANNEX AND DRAWING CONTENTS

CHAPTER I GENERAL

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1-1 Purpose

This part of the Specification hereby presented pertains to design, manufacture, supply and installation of the microwave radio links in Ethiopia at the request of the Imperial Board of Telecommunications of Ethiopia.

1-2 Project Outline

The link shall be established for wide-band signal transmission between Addis Ababa and Asmara. A route map of the link is shown in Drawing 1-1. Addis Ababa, Dessie, Macalle, and Asmara shall be connected by the link, respectively.

This link shall be initially used only as national transmission network, but must be considered for international connection in the future.

Microwave links shall be established between Addis Ababa and Bete Giorgis radio terminal stations and between Korke station and Dessie radio terminal station. A loaded cable system shall be established between Macalle telephone office and Macalle North radio terminal station. Coaxial cable carrier system shall be established between Bete Giorgis radio terminal station and Asmara telephone office.

Above mentioned microwave link is planned to be used for television transmission in the directions Addis Ababa to Bete Giorgis and Korke to Dessie stations. However, it will be finally decided after award of proposal whether television transmission would be included in this project, even this technical specification presuppose television transmission from initial stage.

Accordingly, the Tenderer shall offer separately. The network plan under this project is shown in Drawing 1-2, 1-3.

1-3 Contract Scope

The contract scope shall include all work requisite to the completion of the link. Such work shall include, design, manufacturing of equipment, supply of goods, supervision of installation, testing and training. The work is classified into the following systems to be established;

(1) Microwave System
(2) Multiplex System
(3) Cable System
(4) Voice Frequency Telegraph System
(5) Power System
(6) Tower
(7) Associated Facilities

1-4 Completion

All work governed by this contract shall be scheduled to be completed not later than the end of July 1972.

1-5 Sharing Use of Equipment Room

It shall be noted that in several stations concerned, the installation of equipment under separate projects is planned. Accordingly, the equipment requirement space under this project shall be minimized.

1-6 Fundamental Requirements

Equipment and materials to be supplied and work to be executed, besides being compatible with the description given in the General Conditions of Tender and the ralated statement that appears later, shall also satisfy the following general requirement.

(1) General

(a) The most advanced, up-to-date techniques shall be employed.

(b) Costs of construction, operation, and maintenance shall be the minimum possible.

(c) Sufficient consideration shall be made for durability as well as the prevention of damage, loss, false operation, and instability under all conceivable conditions.

(d) Safety shall be secured for all personnel involved

(e) Characteristics of the system shall, except when clearly indicated in the Specifications, conform to C.C.I.T.T. and C.C.I.R. Recommendations and I.T.U. Radio Regulations.

(f) Conformity with other related national and international regulations and agreements shall be guaranteed.

(g) The Tenderer shall submit item-by-item statement of compliance for every item of the specification.

(2) Environmental Conditions

(a) Equipment and materials to be supplied shall be so treated that they will throughly withstand the environmental conditions in Ethiopia.

(b) Outdoor facilities shall satisfy the requirements in the Specifications under the following environmental conditions;

Ambient temperature	-5°C to 45°C
Ambient relative humidity	Up to 95 %
Wind velocity	Up to 55 m/s.

(c) Indoor facilities shall satisfy the requirements in the Specifications under the following environmental conditions;

	Radio equipments	Carrier equipment etc.
Ambient temperature	0 - 40 °C	5 - 40 °C
Ambient relative humidity	Up to 95%	Up to 95%

(d) Those facilities shall be such that, even in case the ambient temperature exceeds ±10°C from the limits mentioned above and such conditions last for long time, the characteristics of facilities will not be seriously affected. When the ambient temperature returns to within the limits mentioned above, the facilities shall once again be able to satisfy the requirements in the Specifications.

(e) The highest station has an altitude of about 3600 meters.

(3) Requirement for Equipment

(a) Equipment shall be the minimum possible in size and weight.

(b) Equipment shall be such that it can be accommodated in a metallic, sturdy bay or casing without distortion and can be neatly arranged. Moreover, those bays shall be capable of back-to-back arrangement.

(c) Soild-state techniques shall be used, but use of TWT and Klystron are acceptable.

(d) Equipment shall be composed, as far as possible, of plug-in units featuring interchangeability.

(e) All maintenance work shall, in principle, be able to be performed through the front of the equipment.

(f) Adjustment units shall be such that they operate accurately and smoothly and that adjustment points are not easily changed by a repairman brushing the point with his sleeve or by building vibrations.

(g) The high voltage units shall be such that there will be no danger to human life at the time of adjustment. The danger shall also be indicated by appropriate warning labels or signs.

(h) Portions that require dust-proofing, such as relays, shall be protected with covers.

(i) Equipment shall be provided with lamps that indicate the state of operation. Equipment operational status shall be indicated by visible alarms, which are centralized at a place in the building where maintenance personnel can recognize them easily.

(j) All equipment, except those to be installed in engine generator room and desk-type equipment, shall be wired above the bays.

(k) The color of the equipments except engine generator shall be light gray or similar color. The Contractor shall submit color samples for approval.

(l) Wiring in each equipment shall be color-coded properly.

(m) Panels and analogous assemblies, as well as input and output terminals of each equipment, for detachable connection, shall be given

the same notations as in the circuit diagram. Adjustments shall be given the proper scaling when necessary.

(n) A name plate showing appellation, date and number of manufacture, and name of manufacturer shall be attached to each equipment in a place where it is easy to notice. For power equipment, the ratings shall also be indicated.

(o) Power source for all equipment, except power equipment and measuring equipment, shall be DC-24 V with ripple voltage of 20 mV r.m.s. or less. Equipment shall be capable of satisfactory operation within voltage variations of ±10%.

(4) Miscellaneous

(a) The Contractor shall take measures at his own responsibility to eliminate harmful radio interference which may arise within the system to be established under this contract or between this system and any other radio system including satellite system.

(b) Work shall be executed in full coordination, and without causing confusion, with other work under execution at about the same period.

(5) Data to be presented

(a) For each equipment or bay, the following description shall be furnished;

(1) Size and fully equipped weight.
(2) Power consumption at initial stage and in 1984.

(b) For this project, over-all reliability, each system reliability and the basis of calculation shall be described systematically.

CHAPTER II MICROWAVE SYSTEM

CHAPTER II MICROWAVE SYSTEM

2-1 General

This Chapter specifies the line-of-sight microwave systems included in this project.

2-2 Route

A route outline appears in Drawing 1-1, and a profile of each hop is found in Drawings 2-1 to 2-16. These drawings are based on the field surveys For actual design, however, the Contractor shall confirm profile data on his own responsibility. The future plan is shown in Drawing 2-17.

2-3 Radio Frequency Plan

The basic frequency plan for the microwave systems under this project preferably uses the 4 GHz band in C.C.I.R. Recommendation 382-1, but it is acceptable to use the 6 GHz band in C.C.I.R. Recommendation 384-1.

The Tenderer shall propose the concrete frequency plan for each radio carrier frequency including the future plan conforming to the basic plan described above.

2-4 Required Transmission Line

(1) Required bearer;

(a) Telephone bearer;

One both-way bearer for multi-channel telephone signal transmission shall be established between Addis Ababa and Bete Giorgis radio terminal stations. Accordingly, two both-way bearers shall be necessary between Dessie radio terminal station and Korke station.

This bearer is to be connected to the multiplex equipment described in Chapter 3 at Dessie and Macalle North radio terminal stations, and to the coaxial cable carrier system at Bete Giorgis radio terminal station.

(b) Stand-by bearer;

One both-way bearer as stand-by for the bearer in (a) above shall be established between Addis Ababa and Bete Giorgis radio terminal stations and between Dessie radio terminal station and Korke station.

One way bearer in the direction from Addis Ababa to Bete Giorgis shall be also used for television transmission between Addis Ababa and Bete Giorgis radio terminal stations via Dessie and Macalle radio terminal stations, when this bearer is not used for telephone transmission.

(2) Final scheme

Besides the plan above, the establishment of more television bearer will be made in the future (Refer to Drawing 2-17). Then the system shall be designed, taking this scheme into account.

(3) Miscellaneous

Outline of the configuration of the required transmission line is shown in Drawing 1-2. The switching system is described in Drawing 2-18. Space diversity systems shall be established in the hops where Tenderer considers it necessary from his designing activities.

2-5 Transmission Quality

(1) The signal to be transmitted through the telephone and stand-by bearers is an FDM telephone baseband 960 channel signal occupying the 60 KHz - 4,287 KHz band (Refer to C.C.I.R. Recommendation 380-1).

(2) The signal to be transmitted through the stand-by bearer is a television video signal of system B or G in C.C.I.R. Report 308-1. (625 lines, nominal video bandwidth 5 MHz). Further, simultaneous transmission of a television sound signal with a video signal shall be available through the bearer. Facilities shall be designed so that, in the future, a color television signal (PAL system) can be also transmitted without any modification.

2-6 Overall Characteristics

The characteristics of the signals at the interconnection terminals of the Link shall be as follows:

(1) Telephone Baseband;

(a) Nominal input and output impedance shall be 75 ohms unbalanced, and return loss within the baseband shall be not less than 24 dB. (Refer to C.C.I.R. Recommendation 380-1)

(b) Nominal signal level in terms of channel test tone shall be;

Input level: -36 dBr

Output level: -23 dBr

(Refer to C.C.I.R. Recommendation 380-1)

(c) The noise power of each section between Addis Ababa and Dessie, between Dessie and Macalle North and between Macalle North and Asmara stations, at L km length, at a point of zero relative level in a telephone channel, shall not exceed the values given below; (Refer to C.C.I.R. Recommendation 395-1)

(i) 3 L pW psophometrically weighted mean power in any hour.

(ii) 3 L pW psophometrically weighted one-minute mean power for more than 20% of any month.

(iii) 47,500 pW psophometrically weighted one-minute mean power for more than (L/2,500) x 0.1% of any month.

(iv) 1,000,000 pW unweighted (with an integrating time of 5 ms) for more than (L/2,500) x 0.01% of any month.

(d) Attenuation/frequency characteristics of each baseband section in the baseband shall be kept within ± 1.0 dB relative to 100 KHz.

(e) Signal outside the baseband range at the output interconnection terminals of the microwave systems shall satisfy the conditions below; (Refer to C.C.I.R. Recommendation 381-1)

(i) The level of any pilot signal outside the baseband shall be suppressed below -50 dBmO.

(ii) The level of the total power of all the signals outside the baseband range, including noise, shall be less than -17 dBmO.

(2) Television Video Signal

(a) Nominal input and output impedance shall be 75 ohms unbalanced, and return loss within the video band shall not be less than 24 dB. (Refer to C.C.I.R. Recommendation 421-1)

(b) Nominal input and output signal amplitude, picture signal amplitude and synchronizing signal amplitude shall be 1 V, 0.7 V and 0.3 V peak-to-peak, respectively. The variations of insertions gain shall not exceed ± 0.2 dB/sec. and ± 0.6 dB/hour. (Refer to C.C.I.R. Recommendations 421-1)

(c) Signal-to-noise ratio shall be as follows:
(Refer to C.C.I.R. Recommendations 289 & 421-1)

(i) Signal, excluding synchronizing signal, to the r.m.s. value of continuous random noise ratio between 10 KHz and 5MHz read on an instrument having an effective time constant in term of power of one second, using weighting network, shall not be less than the values given below;

61 dB for more than 20% of any month.
49 dB for more than 0.1% of any month.

(ii) Signal (peak-to-peak)-to-noise (peak-to-peak) ratio for periodic noise shall not be less than the values given below;

Power supply hum including lower order harmonics 35 dB;
Single-frequency noise between 1 KHz and 1 MHz 55 dB;

(iii) Value to which the signal-to-noise ratio for

Single-frequency noise may decrease linearly between 1 MHz and 5 MHz 35 dB;

(d) Linear waveform distortion shall be as follows:
(Refer to C.C.I.R. Recommendation 421-1)

(i) Field-time distortion shall not exceed ± 3.3%, measured with the Test Signal No. 1 in C.C.I.R. Recommendation 421-1.

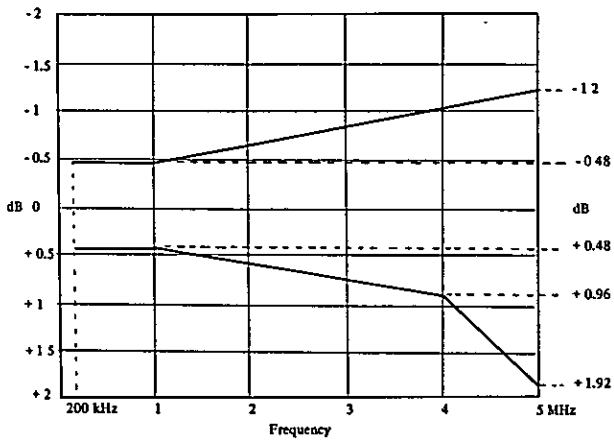
(ii) Line-time waveform distortion shall not exceed ± 3% measured with the Test Signal No. 2 in C.C.I.R. Recommendation 421-1.

(iii) Short-time waveform distortion, measured with the Test Signal No. 2 in C.C.I.R. Recommendation 421-1, shall not exceed the values given below;

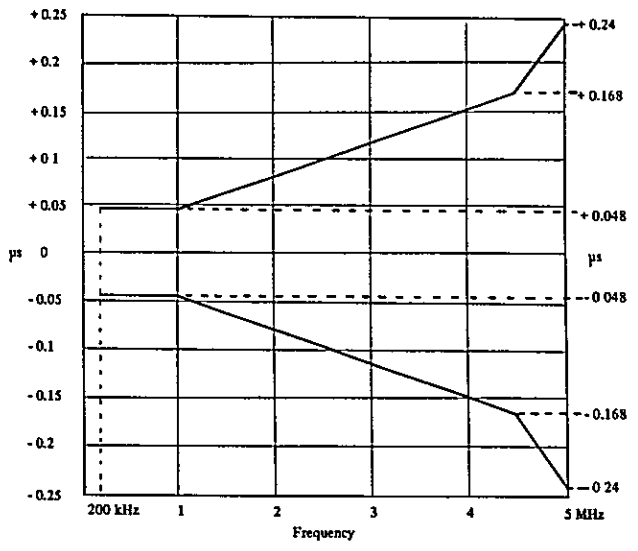
Overshoot	± 12%
Rise-time	0.16 μs

(e) Steady-state characteristics shall be as follows:
(Refer to C.C.I.R. Recommendation 421-1)

(i) Attenuation/frequency characteristics shall lie within the following mask:



(ii) Envelope-delay/frequency characteristics shall lie within the following mask;



(f) Non-linearity distortion shall be as follows;

(i) The non-linearity distortion expressed as a percentage, in the form (1-m/M)x100, and measured with Test Signal No.3, using a superimposed sine-wave at 1 MHz in C.C.I.R. Recommendation 421-1, shall not be more than 9.6%.

(ii) Quality of PAL color television signal transmitted through the stand-by bearer shall be sufficient. The Contractor shall submit a reasonable value to transmit PAL system color television signal, expressed differential phase and differential gain characteristics, measured with a Test Signal using superimposed sine-wave at 4.43MHz in C.C.I.R. Recommendation 421-1.

(iii) The amplitude of line-synchronizing signal, measured with the Test Signal No.3 in C.C.I.R. Recommendation 421-1, shall lie between 0.26V and 0.314V.

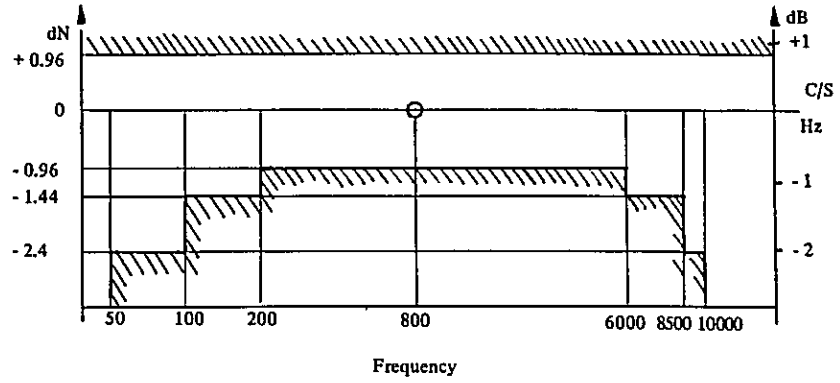
(iv) The specification in respect to system performance mentioned above, shall be applied for the section between Addis Ababa and Bete Giorgis radio terminal stations, while the system performance for the section between Addis Ababa and Dessie radio terminal stations and between Addis Ababa and Macalle North radio terminal stations shall not be inferior to that for between Addis Ababa and Bete Giorgis radio terminal stations.

(3) Sound Channel

This specification deals with the over-all performance for a single sound program channel to be transmitted by means of frequency modulated sub-carrier inserted in the baseband above the video band and below the continuity pilot. (Refer to C.C.I.R. Recommendation 402 and C.C.I.T.T. Recommendation J.21 J.13)

(a) Audio bandwidth shall be from 50 to 10,000Hz.

(b) Attenuation/frequency characteristics shall lie within the following mask (relative to the value measured at 800Hz, measured at the end of the circuit).



(c) Signal to noise ratio shall be as follows, at the end of the circuit where nominal level is + 6 dB (rel. 0.775V) measured with the program circuit-psophometer as defined by C.C.I.T.T.;

No loading condition of video signal,

not less than 62 dB

Loading condition of video signal,

not less than 56 dB

(d) As for non-linear distortion, total harmonic distortion shall not exceed the following values, under the condition that sinusoidal signal of 9 dB (rel. 0.775V) is sent to the origin of the circuit where nominal level is 0 dB (rel. 0.775V)

36 dB at fundamental frequencies below 100Hz

40 dB at fundamental frequencies above 100Hz

(e) The specification in respect to system performance mentioned above, shall be applied for the section between Addis Ababa and Bete Giorgis radio terminal stations, while the system performance for the section between Addis Ababa and Dessie radio terminal stations and between Addis Ababa and Macalle North radio terminal stations shall not be inferior to that for between Addis Ababa and Bete Giorgis radio terminal stations.

(f) The overall performance for television signal mentioned in (2) above, shall be satisfied, even if the sound signal is transmitted.

(4) Data to be Presented

(a) The Tenderer shall submit calculation data for the system design, allotment of thermal, distortion and interference noise, quoting the characteristics of equipment to be used, such as transmitting power, antenna gain, receiver noise figure, feeder loss, etc. Moreover, a block diagram of the overall microwave systems shall also be submitted.

(b) The Tenderer shall submit data on estimated power consumption at initial stage and for 1984 for microwave systems at each station.

(c) The Tenderer shall submit his delivery experience, preferably supported by a certificate from an authoritative telecommunication organization, for microwave systems of 300 channels or more and of television relay already put into operation. Names and sections of links as well as route-km and channel-km shall be described, classified according to the frequency bands and transmission capacities.

2-7 Radio Repeater

(1) General

(a) Radio repeater shall consist of microwave transmitter, receiver, modulator, demodulator, etc.

(b) These may be accommodated in the bay in a suitable comibnation.

(2) Radio Frequency

(a) Carrier frequency based on the description in 2-3 shall be used.

(b) Accuracy of carrier frequency shall be kept within 1×10^{-4}.

(c) Spurious radiation at the output of the branching filter shall be less than -65 dB relative to the non modulated carrier level. Measures shall be taken to prevent the occurrence of spurious radiation which may exert an adverse influence.

(d) Suppression of image frequency shall not be less than 65 dB, including the branching filter, relative to nominal wanted signal level.

(3) Modulation

(a) Telephone Baseband Signal:

(i) Type of modulation shall be frequency modulation (FM).

(ii) Frequency deviation shall be 200 kHz r.m.s. per channel test tone. (Refer to C.C.I.R. Recommendation 404-1)

(iii) When using pre-emphasis, the characteristics shall conform to C.C.I.R. Recommendation 275-1.

(b) Television Video Signal

(i) Type of modulation shall be frequency modulation (FM).

(ii) Frequency deviation shall be 8 MHz p-p for 1 V p-p video signal. (Refer to C.C.I.R. Recommendation 276).

(iii) When using pre-emphasis, the characteristics shall conform to C.C.I.R. Recommendation 405.

(4) Intermediate Frequency (IF)
(Refer to C.C.I.R. Recommendation 403-1)

(a) Nominal center frequency shall be 70 MHz.

(b) Nominal signal level shall be:

Input level: 0.3V r.m.s.

Output level: 0.5V r.m.s.

However, they may be modified in order to suit such arrangement as direct through-connection at the IF stage.

(c) Nominal input and output impedance shall be 75 ohms unbalanced, and return loss within a band covering the baseband and the continuity pilot frequency on both sides of the center frequency shall be not less than 26 dB.

(5) Continuity Pilot
(Refer to C.C.I.R. Recommendation 401-1)

(a) Continuity pilot shall be transmitted through microwave bearer in order to indicate the continuity of the bearer.

(b) Frequency of the continuity pilot shall be 4,715 kHz or 8,500 kHz for telephone bearer, and 8,500 kHz for stand-by and television bearers.

(c) Frequency stability of the continuity pilot shall be better than 5×10^{-5}.

(d) Frequency deviation shall be 140 kHz r.m.s.

(e) The level of the continuity pilot at the output interconnection terminal of the microwave system shall be suppressed below -50 dBm0. (Refer to C.C.I.R. Recommendation 381-1)

(6) Automatic Gain Control (AGC)

Automatic gain control function to cope with input receiving signal variations shall be provided in the receiver. By this function, the IF output level variation shall be maintained within 2.0 dB for 40 dB fading range.

(7) Squelching and Restoring Devices

(a) Squelching function shall be provided in the receiver in order not to send a noise burst to the next stage in case the input signal of the receiver fades out.

(b) IF restoring oscillator shall be provided in the transmitter in order that the transmitter will function normally with the output of the restorer when the IF input signal fails.

(8) Sound Channel
(Refer to C.C.I.R. Recommendation 402 and C.C.I.T.T.Recommendation J21, J31)

(a) Sound vision combiner and separator shall be so designed that the automatic switch over function can easily be added. In case the working sound vision combiner or separator fails, it shall be switched over automatically to stand-by one, but stand-by equipments are not required at the initial stage.

(b) Frequency of sub-carrier shall be 7.5 MHz.

(c) Deviation of sub-carrier shall be 140 kHz r.m.s. for a sinusoidal signal of + 9 dB (rel. 0.775V) at the input of the circuit.

(d) Deviation of IF and RF carrier;

The amplitude of the unmodulated sub-carrier shall be such as to produce a deviation of the IF and RF carrier of 300 kHz r.m.s.

(e) Nominal input and output impedance of audio channel shall be 600 ohms balanced, and return loss at input terminal of sound vision combiner shall not be less than 24 dB.

(f) Maximum audio signal at the input and the output of the circuit shall be + 9 and +15 dB (rel. 0.775V) respectively. The level at the input and the output of audio channel shall be adjustable $\pm$ 2 dB relative to the nominal level.

(9) Data to be Presented

The Tenderer shall submit explanatory data on the following items;

(a) Outline of operation.

(b) Block diagram of each equipment.

(c) Level diagram.

(d) Price and guaranteed life of such special parts as klystrons and travelling wave tubes, if adopted.

2-8 Space Diversity System

(1) General

A space diversity system shall be established in the hops where Tenderer considers it necessary from his design activities.

(2) Space Diversity System

(a) Diversity antennas for signal reception shall be mounted with an optimum interval between them on the tower at stations concerned.

(b) The "in phase" linear adder controlled for individual bearer is the most preferable type. In case that an IF switching method is adopted, the transfer time shall be less than 10 μS.

(c) Propagation paths in the hops concerned shall be assured of, at least, the following clerance, where "f" is the radius of the first Fresnel zone and "K" is the coefficient of effective earth's radius.

Upper path:	"2/3 f"	at K = 2/3
Lower path:	"2/3 f"	at K = 4/3

(3) Data to be presented

(a) Schematic diagram and detailed explanation of space diversity system.

(b) Calculation, prescription for improvement factor due to adopting the space diversity system and correlative coefficient etc.

2-9 Antenna System

(1) General

(a) Antenna system shall consist of antenna, feeder, branching filter, etc.

(b) At all stations, the antenna shall be installed on towers to be constructed by the Contractor. (Refer to Chapter 9).

(c) One passive reflector shall be used between the Dessie radio terminal station and Korke station. Near zone type reflector is not permitted to be used at all stations.

(2) Characteristics and Necessary Conditions

(a) The antenna system characteristics shall be such that overall characteristics conform to the requirements in 2-6.

(b) Parabolic or similar type antenna shall be used. The front-to-back coupling loss shall not be less than 63 dB.

(c) Feeder shall be either waveguide or coaxial type feeder.

(d) Antenna mounting structure shall be such that the antenna direction can be adjusted within a certain range necessary for installation.

(e) The passive reflector structure shall be such that the direction can be adjusted within a certain range necessary for installation.

(f) Feeder mounting structure shall allow heat expansion of feeders without causing adverse influence mechanically or electrically.

(g) The outdoor portion of the feeder system shall be air-tight and shall be filled with pressurized dry air in order to prevent the penetration of moisture, dust etc. Sufficient measures shall be taken to keep the dry air pressure unaffected by temperature variations.

(3) Data to be Presented

The Tenderer shall submit explanatory data on the following items;

(a) Envelope pattern drawings of horizontal and vertical antenna directivity.

(b) Cross polarization discrimination, if dual polarization antenna adopted.

(c) Characteristics of passive reflector. (surface smoothness, size etc.)

2-10 Switching System

(1) General

A switching system shall be provided, which enables automatic switch-over of the faulty normal bearer to a stand-by bearer whether television signal is transmitted or not. The Tenderer shall refer to Drawing 2-18 which shows one example of the switching system.

(2) Switching Section

(a) Switching stations shall be Addis Ababa, Bete Giorgis, Macalle North and Dessie radio terminal stations. Korke station may either be a switching station or not.

(b) Telephone bearer switching shall be conducted in principle at the baseband stage, except for Korke station.

(3) Switching Capacity

The switching capacity shall be so designed that it can finally accommodate the bearers included in the final scheme described in Drawing 2-17. When more television bearers described in Drawing 2-17 are installed in the future, the switching system accommodating that bearer shall be easily established by addition of panels etc.

(4) Switching Function

(a) Switching Time

(i) Operation time required from start to completion of switching action shall not exceed 10 ms.

(ii) Transfer time shall not exceed 2 ms.

(b) Automatic Switching-over

(i) The switching action to the stand-by bearer shall be started when the normal bearer comes into the following state;
the contir ity pilot level drops by more than 6 dB from the normal level;
noise power in the band surrounding the continuity pilot becomes below 35 dB in terms of signal-to-unweighted noise ratio of the top channel in telephone baseband, a similar condition shall also be applied to the television bearer established in the future.

(ii) The stand-by bearer shall be returned to the ordinary state when normal bearer restores to the normal condition.

(iii) For switching-over, the telephone bearer shall have priority over the television bearer.

(iv) When a television signal is transmitted through the stand-by bearer, switching shall be normally conducted even if telephone bearer become faulty simultaneously in both direction.

(c) Manual Switching-over:

(i) The switching system shall be so designed that, by manual operation at the switching station on the receiving side, any normal bearer can be switched over to the stand-by bearer.

(ii) Automatic operation shall have priority over manual operation.

(iii) Automatic operation shall be locked out manually whenever necessary.

(d) Protection from False Operation

Switching devices shall be designed to protect sufficiently from false operation. Further, during failure of the service channel, present state shall be maintained.

(5) Display

At the switching stations, at least the following items shall be indicated:

(a) The state of bearer switching

(b) Normal or abnormal state of control signal transmission line.

(c) Normal or abnormal state of each bearer.

(d) Audible alarm in case of abnormality.

Those items shall be indicated on the desk-type supervisory equipment in the supervising room in case of an attended station, and at a place where the maintenance personnel can easily notice them, as well as on the desk-type supervisory equipment in the supervising room of the supervising station, in case of an unattended station.

(6) Data to be Presented

The Tenderer shall submit explanatory data on the following items:

(a) Outline of operation including failure of a service channel, television signal transmitting and overall block diagram of the switching system.

(b) Composition of control signal and required characteristics of signal transmission line.

2-11 Supervisory and Control System

(1) Local Supervisory and Control System

(a) Failure of important equipment shall be indicated concentratedly in each station at a place where such indications can be easily noticed and, in each attended station, on desk-type supervisory equipments. Alarms shall be indicated visibly and audibly.

(b) Control shall be available for the main equipment in each station.

(2) Remote Supervisory and Control System

Unattended stations shall be remotely supervised and controlled. Signals for such a system shall be transmitted through the service channel described in 2-12.

(a) Remote Alarm

(i) Alarms of supervised stations shall be indicated visibly and audibly at the supervising station. The system shall be so designed that the subject of an alarm and the name of station concerned can be definitely discerned.

(ii) The subjects of alarm shall be as follows:

The items shown in table below shall be indicated and, at least three more alarms shall be reserved as spares;

Alarm subjects	Remarks
Alarm for Microwave Equipment Alarm for Power Equipment Failure of rectifier Over-current relay alarm Failure of commercial power (**) Running of engine-generator respectively Failure of engine-generator respectively Low level in fuel storage tank Alarm for Building Facilities Fire alarm Door alarm Other Alarms Maintenance* Non-urgent alarm	Related to Chapter 6

* This alarm may supersede respective alarms in case the equipment concerned are under maintenance work.

** This alarm shall be accommodated only at the concerned station.

(b) Remote Control

(i) This control shall not interfere with normal service.

(ii) Control shall be protected from false operation caused by accidental contact by maintenance personnel and by deterioration of signal transmission line.

(iii) The state of operation of controlled equipment shall be confirmed at the control station.

(iv) The subjects of control shall be as follows:

Microwave equipment shall be controlled if necessary. Start and stop control of engine-generators shall be available. At least five more controls shall be reserved as spares.

(c) Interface

(i) Conditions at the interface shall be unified in following states, respectively between the supervisory and the supervised equipment, and between the control and the controlled equipment, in principle;

for example Normal state ------ Open

Abnormal state---- Earth
(Controlled)

(ii) Wirings shall be terminated at the terminals of the supervised and controlled equipment concerned.

(iii) In order to enable further extension of remote alarms and controls to additional boards or places, terminals shall be provided on the remote supervisory and control equipment at the radio terminal station. The conditions in (a) and (b) above shall also be applied to these terminals.

(3) Data to be Presented

The Tenderer shall submit explanatory data on the following items:

(a) Outline of operation including such cases as failure of a service channel, television signal transmitting and overall bolck diagram of the supervisory and control system.

(b) Composition of remote supervisory and control signal and required characteristics of signal transmission line.

(c) Time required from the initiation of operation to completion of display or control.

2-12 Service Channel

(1) General

Service channel shall be provided either over the part below the telephone baseband of the main radio-relay system, or over an auxiliary radio-relay system in the same band as the main system. In case of using the part below the telephone baseband, the signal of the service channel shall be transmitted simultaneously over the telephone bearer and the stand-by bearer. Even in case of failure of either of the two bearers, the service channel signal shall be transmitted normally without manual operation. When a television signal occupies the stand-by bearer, the service channel signal in the stand-by bearer shall be stopped automatically. Moreover, when television signal transmission is stopped in the stand-by bearer because of failure of the telephone bearer, etc., the transmission of the service channel signal by stand-by bearer shall be started immediately and automatically. In case of using the auxiliary radio relay system, the service channel signal shall be transmitted over two circuits, and the equipment function mentioned above shall be maintained. The service channel shall be established for the transmission of switching, remote alarm and remote control signals, and for the order wire.

(2) Service Channel

(a) Service channel characteristics shall satisfy the requirements of the above mentioned signals to be transmitted.

(b) Service channel shall be sufficiently protected from failure.

(c) The Tenderer is requested to propose the most appropriate method of establishing the service channel.

(3) Order Wire

(a) An omnibus speaker order wire shall be set up to connect all the stations together.

(b) Two express speaker order wires, to connect all the radio terminal stations and supervising stations together, and to connect between Addis Ababa terminal station and Asmara telephone office, shall be set up.

(c) The telephone set shall be so arranged that it can be used conveniently by the maintenance personnel. Terminals or jacks for further extension of order wires shall be also provided.

(d) Characteristics of the order wire shall be as follows:
(Refer to C.C.I.R. Recommendation 400-1)

(i) The order wire shall be a four-wire circuit.

(ii) Bandwidth of the order wire shall be 300 Hz - 3,400 Hz.

(iii) Nominal input and output impedance shall be 600 ohms balanced.

(iv) Psophometrically weighted mean noise power at a point of zero relative level shall not exceed 20,000 pW for every switching section.

(4) Data to be Presented

The Tenderer shall submit explanatory data on the following items:

(a) Block diagram and frequency allotment of service channel

(b) Required characteristics of facilities concerning service channel

CHAPTER III CARRIER MULTIPLEX SYSTEM

CHAPTER III CARRIER MULTIPLEX SYSTEM

3-1 General

This Chapter describes the carrier multiplex system to be established at Addis Ababa and Macalle North terminal stations, and Dessie and Asmara telephone offices.

(1) The carrier multiplex system shall be used for establishing telephone circuits, telegraph circuits and program circuits, together with the microwave system mentioned in Chapter 2.

(2) The carrier multiplex system is composed of each translating equipment of channel, group and supergroup, and other equipment required for this project. The network plans in this project are shown in Drawings 1-2 and 1-3. The Contractor shall provide all facilities necessary for establishment of the carrier multiplex system in accordance with requirements specified hereunder.

(3) Those circuits accommodated in the carrier multiplex system are also used for international circuits. The telephone circuits will be used for the various type circuits such as junction lines, local lines and order-wires. Therefore, the signalling system to be applied to the carrier multiplex system shall be designed to be applicable to 3-4 (1) (c).

(4) All wiring and cabling between the equipments covered in this Chapter, and the equipments covered in other chapters shall be included.

3-2 Requirement for Carrier Terminal Equipment

(1) Make-up

The make-up of a carrier link shall conform to C.C.I.T.T. Recommendation G211.

(2) Transmission capacity

The transmission capacity of the microwave system is described in Chapter 2. The carrier multiplex system shall be designed to conform to the transmission capacity of the microwave system. The arrangements of the baseband and the line frequency band in the carrier multiplex system corresponding to each system, shall conform to C.C.I.T.T. Recommendation G343, plan I.

(3) Block Diagram of the System

A typical block diagram of the carrier multiplex system is shown in Drawing 3-1 to 3-2. In addition to the equipment shown in the block diagram, miscellaneous equipment such as intermediate power distribution equipment, monitor speaker system, etc. and other equipment required for the maintenance work shall be provided.

(4) Arrangement of the Equipment

The arrangement of the equipment shall satisfy the conditions of C.C.I.T.T. Recommendation G231.

(5) Other Requirements

Adequate test points shall be provided for the equipment, and the points shall be easily accessible. Terminal blocks for communication, power and miscellaneous cables shall be provided on the top of the equipment bay. Necessary alarm indications shall be provided. Even if the equipment is to be partially mounted in a bay, the wiring inside the bay shall be completely prepared, including all wiring necessary for a fully equipped system.

3-3 Equipment to be installed

Equipment to be initially installed at each station shall be as follows:

(1) Frequency generating equipment (Called "FG" hereafter)

(a) Frequency generating equipment to be provided at each station shall be capable of supplying necessary carrier, group and supergroup pilots, and signalling frequencies to equipments corresponding to network plan for 1974 shown in Drawing 1-3, and of supplying those for the expected network plan for 1984 in Drawing 1-3 by adding panels.

(b) Wiring from the frequency generating equipment shall be directly conducted to each equipment.

(2) Supergroup Translating Equipment (Called "SG Tr" hereafter)

(a) Supergroup translating equipment at each station shall correspond to the network plan for 1974 in Drawing 1-3, and correspond to expected network plan for 1984 shown in Drawing 1-3 by adding panels.

(b) Each basic supergroup signal shall be sent to/from the group translating equipment via the supergroup distribution frame (SGDF), and the baseband signal combined in the SG Tr shall be conducted to/from the microwave equipment or cable equipment.

(3) Group Translating Equipment (Called "G Tr" hereafter)

(a) Group translating equipment to be provided at each station shall correspond to the network plan shown in Drawing 1-3.

(b) Each basic group signal shall be sent to/from the channel translating equipment via the group distribution frame (GDF), and supergroup signal shall be sent from/to the SG Tr via the SGDF.

(4) Channel Translating Equipment (Called "CH Tr" hereafter)

(a) Channel translating equipment to be provided at each station, shall correspond to the network plan shown in Drawing 1-3.

(b) Each voice signal shall be sent from CH Tr to the voice frequency distribution frame (VDF), and vice versa. Each basic group signal shall be sent from/to the G Tr via the GDF.

(5) Supergroup Level Regulating Equipment (SG LR)

(a) Supergroup level regulating equipment to be provided at each station shall correspond to the number of supergroups installed.

(b) Both input and output terminals of the SG LR shall be connected to the SGDF.

(6) Supergroup Through Filter

(a) Supergroup through filter to be provided at each station shall correspond to network plan shown in Drawing 1-3.

(b) The filter shall be wired to SGDF.

(7) Program Transmission Equipment

(a) Program transmission equipments to be provided at each station shall correspond to the network plan shown in Drawing 1-3.

(b) The equipment shall be wired to GDF and VDF.

(8) VDF, GDF and SGDF

The VDF, GDF and SGDF shall be provided corresponding to respective capacities for 1984.

3-4 Performance of Translating Equipment

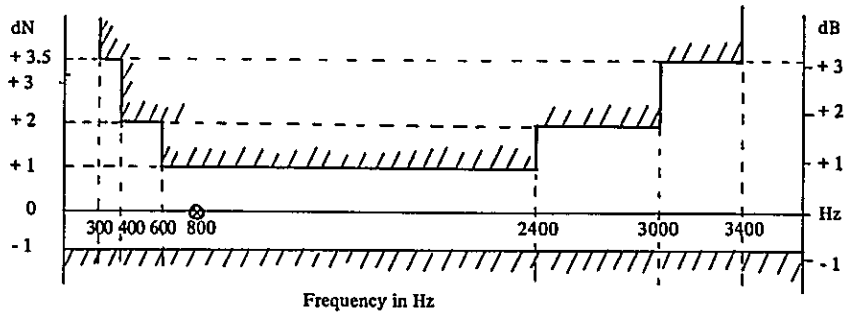
(1) Channel Translating Equipment

(a) Function

The equipment shall be capable of translating 12 voice frequency channels occupying 300 to 3,400 Hz into a B type basic group frequency band specified in C.C.I.T.T. Recommendation G211, and vice versa.

(b) Transmission Characteristics

(i) The overall loss of each pair of channel transmitting and receiving equipments of one terminal equipment shall not exceed the following limits. (Refer to C.C.I.T.T. Recommendation G232).



(ii) The carrier leak of each channel measured at the GDF shall be less than -30 dBm0, and the carrier leak measured at 4-wire transmitting and receiving points (VDF) shall be less than -20 dBm0, respectively.

(iii) For equipment linearity, the variation of overall loss per channel of a combination of transmitting and receiving terminal equipment shall be within ± 0.3 dB when the input level is increased from 0 dBm0 to + 3.5 dBm0. (Refer to C.C.I.T.T. Recommendation G232)

(iv) For transmitting equipment amplitude limiting of an individual channel, the level of high frequency output signal shall not exceed 12 dBm0, measured by means of a quadratic law aperiodic device, when any level not exceeding 20 dBm0, at any frequency between 300 to 3,400 Hz, is applied at the input. (Refer to C.C.I.T.T. Recommendation G232)

(v) The intelligible corsstalk ratio between two channels of the same group, measured on a combination of transmitting and receiving terminal equipment, shall not be less than 65 dB. The unintelligible crosstalk produced in an adjacent channel shall not be less than 60 dB, measured on the same condition as above. (Refer to C.C.I.T.T. Recommendation G232)

(vi) The total psophometrically weighted noise for one pair of channel modulators shall be less than 330 pW (Refer to Recommendation G222)

(c) Signalling

(i) The out-band signalling system shall be adopted on the carrier multiplex system. The following requirements shall be satisfied:

- The signalling frequency shall be 3,825 Hz; (Refer to C.C.I.T.T. Recommendation Q21)

- The transmitting method of the signalling frequency shall be tone-on idle, and shall

be transformable to tone-off idle, when necessary:

-The nominal signalling level shall be within -15 to -20 dBm0.

(ii) DC signalling conditions of the tone-on-idle signalling system shall satisfy the following requirements:

- E and M wires shall be provided for signalling;
- The signalling tone shall not be transmitted when earth potential is applied to the M-wire, and shall be transmitted when the M-wire is opened;
- The E-wire shall be opened while the tone is received, and shall be earth when the tone stops.

(iii) The overall signalling distortion between the stations shall not exceed ± 5% under the following conditions:

- Dialling speed of 10 PPS (make ratio 33%);
- Level variation ± 4 dB;
- Line leakage of the M-wire and E-wire of 100 kilo-ohms.

(iv) The equipment shall satisfy the following conditions in a combination of transmitting and receiving terminal equipment:

- Where 3,400 Hz signal of 5 dB higher than the test tone level is applied to a 4 wire input of the channel translating equipment, the signalling equipment of the same channel shall not erroneously operate.
- Where 100, 150 and 200 Hz signal of 5 dB higher than the test tone level are applied as well as the above, the signalling equipment of adjacent channels shall not erroneously operate.

(v) The signalling relay shall be maintenance-free type.

(d) Voice Connection

The conditions at a voice frequency band shall satisfy the following requirements:

(i) The input and output impedance shall be 600 ohms, balanced, and the return loss shall not be less than 15 dB.

(ii) The level at 4-wire points (VDF) shall meet the following:

- Transmitting : Adjustable 0 to -15 dBr by 1 dB steps

- Receiving : Adjustable -7 dBr to +8 dBr by 1 dB steps

(e) Basic Group Connection

The connection at the GDF shall satisfy the following conditions:

(i) The input impedance shall be 75 ohms, balanced, and the return loss shall be not less than 15 dB, except for the 84,08 kHz $\pm$ 60 Hz.

(ii) The nominal signal level in terms of channel test tone shall be as follows:

- Transmitting -36 dBr

- Receiving -18 dBr

(f) Group Pilot

(i) The equipment shall be capable of injecting and extracting the group pilot of 84.08 kHz specified in C.C.I.T.T. Recommendation G241.

(ii) The output level of the pilot frequency shall be -20 dBm0 as specified in C.C.I.T.T. Recommendation G241. The level of the pilot shall be adjustable within $\pm$ 0.1 dB to the nominal pilot level.

(2) Group Translating Equipment

(a) General

The equipment shall be capable of translating 5 basic groups into a basic supergroup occupying a band of 312 to 552 kHz specified in C.C.I.T.T. Recommendation G211, and vice versa.

(b) Transmission Characteristics

(i) The deviation of frequency/attenuation distortion in the transmitting or the receiving equipment shall not exceed 0.5 dB within the basic group frequency band of 60 to 108 kHz, and 0.25 dB within the channel frequency band of 4 kHz.

(ii) The transmitting equipment carrier leak shall be less than -30 dBm0 on a group measured at the SGDF, and the receiving equipment carrier leak shall be less than -20 dBm0 measured at the output terminal on a basic group side.

(iii) The total psophometrically weighted noise of one pair of group modulators shall be less than 90 pW at a zero relative level point. (Refer to C.C.I.T.T. Recommendation G222)

(iv) The intelligible crosstalk ratio between two groups of the same supergroup measured on a combination of transmitting and receiving equipment shall not be less than 70 dB. (Refer to C.C.I.T.T. Recommendation G242)

(c) Basic Group Connection

The conditions of the basic group connection are specified in 3-4 (1)(e).

(d) Basic Supergroup Connection

The connection at the SGDF shall be in accordance with the following conditions:

(i) The input and output impedance shall be 75 ohms, unbalanced and the return loss of the output shall not be less than 15 dB.

(ii) The nominal signal level in term of channel test tone shall be as follows;

- Transmitting -29 dBr

- Receiving -29 dBr

(e) Supergroup Pilot

(i) The equipment shall be capable of injecting and extracting the supergroup pilot of 411.92 kHz specified in C.C.I.T.T. Recommendation G241.

(ii) The output level of the pilot frequency shall be -20 dBm0 as specified in C.C.I.T.T. Recommendation G241. The output level of the pilot shall be adjustable with $\pm$ 0.1 dB to the nominal pilot level.

(f) Stand-by Amplifier

One stand-by transmitting amplifier shall be provided in group translating equipment together with a ready means (not involving soldering) of substituting it for a working amplifier which has failed.

(3) Supergroup Translating Equipment

(a) General

The equipment shall be capable of translating the basic supergroup corresponding to the system capacities into a baseband for the microwave links, conforming to C.C.I.T.T. Recommendation G343 Plan 1, and vice versa.

(b) Transmission Characteristics

(i) The deviation of frequency/attenuation distrotion in transmitting or receiving equipment shall not exceed 1.0 dB within the basic supergroup frequency band of 312 to 552 kHz, 0.5 dB within the basic group frequency band of 60 to 108 kHz and 0.25 dB within channel frequency band of 4 kHz, respectively.

(ii) The transmitting equipment carrier leak shall be less than -30 dBm0 on a supergroup measured at the baseband output terminal, and the receiving equipment carrier leak shall be less than -20 dBm0 measured at the basic supergroup output terminal.

(iii) The total weighted noise of one pair of supergroup modulators shall be less than 90 pW at a zero relative level point. (Refer to C.C.I.T.T. Recommendation G222).

(iv) The intelligible crosstalk ratio between two supergroups in the system measured on a combination of transmitting and receiving equipment shall not be less than 70 dB. (Refer to C.C.I.T.T. Recommendation G242)

(c) Basic Supergroup Connection

The conditions of the basic supergroup connection are specified in 3-4 (2) (d).

(d) Baseband Connection

(i) The input and output impedance shall be 75 ohms, unbalanced

(ii) The nominal signal level in terms of channel test tone shall be as follows;

- Transmitting -45 dBr

- Receiving -20 dBr

(e) Stand-by Amplifier

One stand-by transmitting amplifier shall be provided in supergroup translating equipment together with a ready means (not

involving soldering) of substituting it for a working amplifier which has failed.

3-5 Performance of Frequency Generating Equipment

(1) General

The equipment shall provide all carrier, pilot and signalling frequencies required for each translating equipment and system. The characteristics of supplied frequencies shall be such that each translating equipment and system will function with specified performance. The equipment shall conform to relevant C.C.I.T.T. Recommendation.

(2) Frequency Synchronization

The means shall be provided to ensure that the overall frequency synchronization of each channel does not exceed 2 Hz at any time. The synchronizing pilot to ensure the above prescribed stability shall be employed at 60 kHz.

(3) Carrier Frequency

(a) The carrier frequency accuracy shall be better than $\pm 10^{-6}$ at channel carrier frequencies, and better than $\pm 10^{-7}$ at group and supergroup carrier frequencies, conforming to C.C.I.T.T. Recommendation G225.

(b) The frequency stability required for one master oscillator shall be less than 1 Hz of deviation from the nominal value of the highest frequency of the baseband for a period of at least one month. If two independent master oscillators are applied to a system, the net effect shall be such that the highest frequency of the baseband remains within 1 Hz over a period of at least one month.

(4) Pilot Frequency

(a) The pilot frequency accuracy shall be within the following limits, conforming to C.C.I.T.T. Recommendations G241 and G332:

Group and supergroup pilot : $\pm$ 1 Hz relative to the nominal value

(b) The level stability of those pilots shall be within $\pm$ 0.3 dB, conforming to C.C.I.T.T. Recommendation G241 and G332.

(5) Purity

(n x fundamental) kHz impure components accompanied with the carrier and pilot currents shall be suppressed by not less than the following limits, except for harmonic components.

Channel carriers----------50 dB
Pregroup carriers (When used)---------- 75 dB
Group carriers----------80 dB
Supergroup carriers----------80 dB
60 kHz pilot current---------- 30 dB

Moreover, the harmonic component attenuation of these frequencies, group and supergroup pilots, and signal currents shall not be less than 20 dB.

(6) Duplication

(a) The equipment shall be fully duplicated in each individual frequency generating equipment.

(b) Automatic switch-over of the working equipment to the stand-by shall be applied. Restoring may be conducted manually. This switch-over shall be made in the event of level degradation by approximately 3 dB.

(c) The switching time shall not exceed 5 ms for carrier and signal currents, and shall not exceed 25 ms for pilot currents.

3-6 Level Regulating Equipment

(1) Function

The equipment shall be capable of automatically regulating the level variation with time relative to nominal level at supergroup frequency band by detecting pilot level.

(2) Characteristics

(a) The equipment shall satisfy the following conditions:

-- Pilot frequency : 411.92 kHz

-- Regulating range : At least $\pm$ 4 dB or more

(b) The level deviation shall be less than 0.5 dB relative to nominal level after the automatic regulation.

(c) Transmissible frequency band of the equipment shall be 312 to 552 kHz, and deviation of attenuation distortion in the said band shall be less than 0.5 dB.

(d) The input and output impedance shall be 75 ohm, and the return loss shall not be less than 20 dB in the said transmission frequency band.

(e) The total weighted noise of the equipment shall be less than 10 pW at a zero relative level point.

(3) Indication

Indication for operating conditions and alarms shall be provided on the equipment.

3-7 Supergroup Through Filter

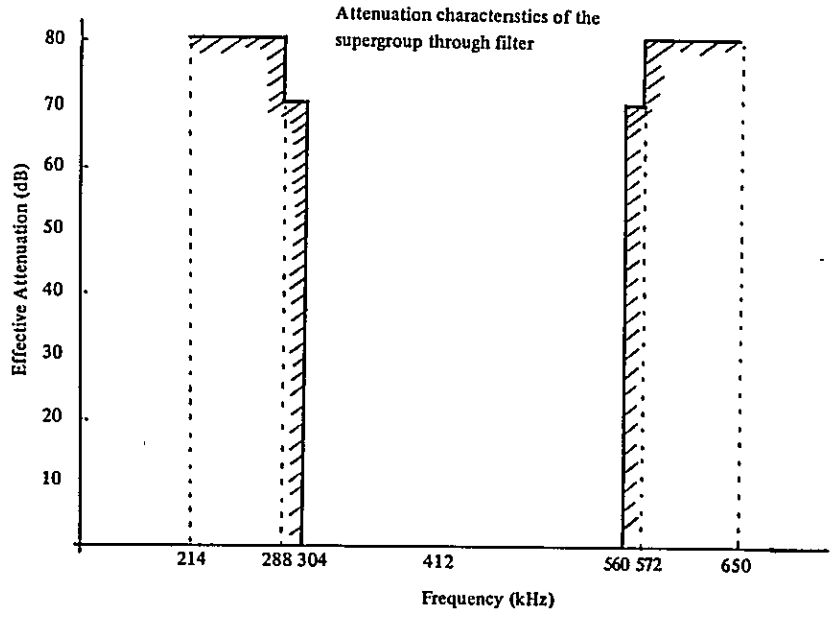
(1) Function

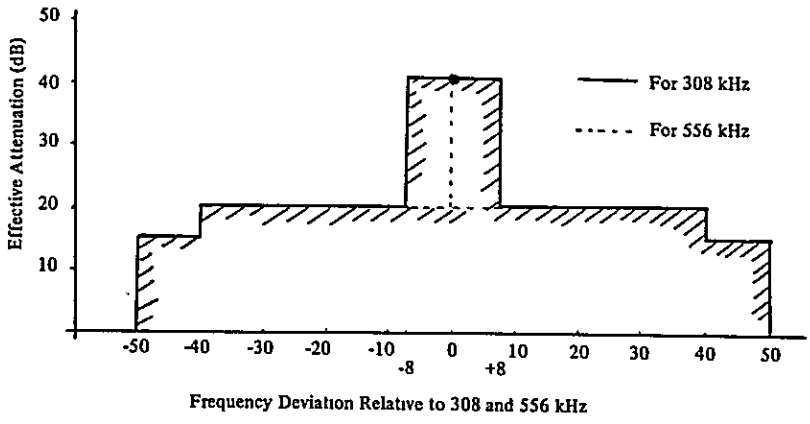
The filter shall be used for through supergroup at the basic supergroup frequency band.

(2) Transmission Characteristics
(Refer to C.C.I.T.T. Recommendation G242 and G243)

(a) The deviation of frequency/attenuation distrotion of the filter shall be within 1.0 dB at the transmission frequency bandwidth.

(b) The attenuation for out-band of transmission frequency bandwidth of the filter shall be as follows;





(c) Connection

The conditions for basic supergroup connection is specified in 3-4 (2)(d).

3-8 Program Transmission Equipment

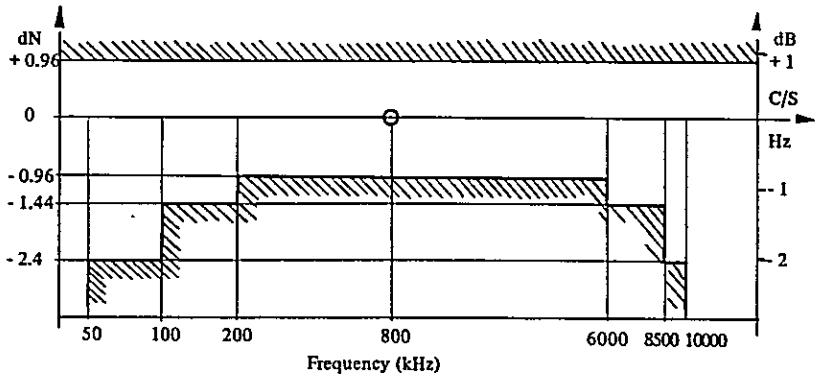
(a) General

(i) The equipment shall be utilized for transmission of broadcasting program signal between Addis Ababa and Asmara stations through the microwave and coaxial cable systems.

(ii) The equipment shall be capable of translating broadcasting program signal of 50 to 10,000 Hz band to a band of 84 to 96 kHz corresponding to 3 telephone channels in the basic group frequency band, specified in C.C.I.T.T. Recommendation J22, and vice versa.

(b) Transmission Characteristics
(Refer to C.C.I.T.T. Recommendation J.21)

(i) The frequency/attenuation distortion of the equipment, measured on a combination of transmitting and receiving equipment, shall lie within the following limits, compared with the value for 800 Hz:



(ii) The signal-to-noise ratio of the equipment, measured on a combination of transmitting and receiving equipment, shall be more than 63 dB unweighted.

(iii) The variation of overall loss of a combination of transmitting and receiving equipment shall be within $\pm$ 0.3 dB at the output level of + 15 dB (rel. 0.775V).

(iv) For non-linear distortion, the total harmonic distortion attenuation shall not exceed the following values, measured

on a combination of transmitting and receiving equipment under the condition that a sinusoidal signal of 9 dB (rel. 0.775V) be sent to the input where the nominal level is 0 dB (rel. 0.775V);

36 dB at fundamental frequency above 100 Hz;

40 dB at fundamental frequency below 100 Hz.

(v) The crosstalk ratio between transmitting and receiving equipment shall be more than 80 dB.

(c) Connection to the Line from the Origin

(i) Impedance

The nominal input and output impedance of the equipment for connection to the line from a program origin shall be 600 ohms, balanced, and the return loss shall be not less than 15 dB.

(ii) Level

The nominal level at the transmitting equipment input terminal shall be 0 dB (rel. 0.775V). At the receiving equipment output terminal, the nominal level shall be 6 dB (rel. 0.775V). The system shall be capable of handling a peak power corresponding to a sinusoidal signal of + 15 dB (rel. 0.775V) at the receiving equipment output terminal. The level at the transmitting equipment input terminal and the receiving equipment output terminal shall be adjustable $\pm$ 2 dB relative to the nominal level.

(d) Connection at the GDF

The connection of the equipment at the GDF shall be the same as that of basic group connections as described in 3-4 (1)(e).

3-9 Distribution Frame

(1) General

(a) A distribution frame shall be provided at each station so as to facilitate the terminating and joining of cables.

(b) The terminal blocks shall be provided with the capacity matching 1984 requirements.

(c) The frame shall constructed in such a manner as to be easily maintained, facilitating daily checks without deteriorating the transmission quality.

(d) Each distribution frame shall be provided with a holder for

supporting jumper.

(2) Voice Distribution Frame (VDF)

(a) The VDF shall provide audio connection among necessary equipments concerned.

(b) The crosstalk attenuation of the terminal block shall be greater than 100 dB.

(3) Group Distribution Frame (GDF)

(a) The GDF shall provide group connection among channel translating equipment, group translating equipment etc.

(b) Adequate access and test points shall be provided on both sides of GDF terminal blocks by U-link (or plug and jack) or any other suitable device.

(c) The crosstalk attenuation of the terminal block shall be greater than 100 dB.

(4) Supergroup Distribution Frame (SGDF)

(a) The SGDF shall provide basic supergroup connection among group translating equipment, supergroup translating equipment and supergroup level regulating equipment.

(b) Adequate access and test points shall be provided similarly to GDF.

(c) The crosstalk attenuation of the terminal block shall be greater than 100 dB.

3-10 Data to be Presented

The explanatory data shall be presented in the offer on the following items:

(i) Schematic diagram of each equipment

(ii) Level diagram of each equipment

(iii) Explanation of each equipment

(iv) Report stating the amount of idle noise included in the total loaded noise of each equipment.

(v) Power consumption for the carrier multiplex system at each station.

CHAPTER IV CABLE SYSTEM

CHAPTER IV CABLE SYSTEM

4-1 General

This Chapter specifies the coaxial cable system between Bete Giorgis radio terminal station and Asmara telephone office, the loaded cable system between Macalle North radio terminal station and Macalle telephone office, and the additional equipment to the existing coaxial cable system between Bete Giorgis radio terminal station and Asmara telephone office. These are entrance cables from radio stations to telephone offices.

(1) The coaxial cable system shall be used for establishing telephone circuits, telegraph circuits and program circuits together with the microwave system and the carrier multiplex system mentioned in Chapter 2 and 3, respectively.

The Contractor shall provide all facilities necessary for establishment of the coaxial cable system. However this project does not include the laying of duct.

The kind of the coaxial cable to be installed shall be as follows

Number of coaxial cable tubes	Type of coaxial cable	Approx. distance
8	2.6/9.5 mm coaxial cable	5.7 Km

A route map of the coaxial cable system is shown in Drawing 4-1.

(2) The loaded cable system shall be used for establishing telephone circuits and telegraph circuits together with the microwave system and the carrier multiplex system mentioned in Chapters 2 and 3, respectively.

In the future, this cable line shall be used for a carrier system, therefore, the contractor shall sufficiently consider the change from loaded cable system to carrier system.

A route map of the loaded cable system is shown in Drawing 4-2. The contractor shall provide all facilities necessary for establishment of the loaded cable system.

(3) Equipment in addition to the existing coaxial cable system shall be used for establishing telephone circuits, telegraph circuits and program circuits, together with the microwave system and the carrier multiplex system mentioned in Chapters 2 and 3, respectively.

As two tubes of the coaxial cable in the existing system are not occupied, in this project, only the additional equipment shall be provided and one both-way bearer for multi-channel telephone signal transmission shall be established between Bete Giorgis radio terminal station and Asmara telephone office. This bearer will be used for the stand-by for the telephone bearer of the coaxial cable

system mentioned in (1) above, for some time.

The existing coaxial cable is the 1.2/4.4 mm type conforming to C.C.I.T.T. Recommendation G342. The length of the cable is approximately 4.7 Km. A route map of the existing coaxial cable is shown in Drawing 4-1.

4-2 Coaxial Cable System

(1) System requirement for coaxial cable system

(a) The coaxial cable system shall be designed to transmit an FDM telephone baseband signal of 960 channels occupying the 60 kHz - 4,028 kHz band, and so as to satisfy the conditions recommended by C.C.I.T.T.

(b) The operation conditions of the coaxial cable system shall be supervised at the supervising station.

(c) The level deviation, including deviation with time, shall be less than 1.0 dB relative to nominal level at output of the coaxial cable system.

(d) The total weighted noise of the system shall be such that the total weighted noise of the system and the microwave system does not exceed 3 L pW mentioned in 2-6 (c) (i).

(2) Coaxial cable line (Refer to C.C.I.T.T. Recommendation G 334.)

(a) Type of cable line

(i) The inner conductor shall be a solid copper wire. The outer conductor shall be a soft copper tape, formed into a cylinder around the insulation.

The insulation shall be such that the dielectric constant is low enough to meet the requirements of this specification.

Each outer copper conductor shall be surround with two helical soft steel tapes, for crosstalk suppression reasons.

The diameter and thickness of inner and outer conductors etc. shall be in accordance with the following table.

Nominal diameter of inner conductor	2.6 mm
Nominal internal diameter of outer conductor	9.5 mm
Nominal thickness of outer conductor	0.25 mm
Nominal thickness of steel tape	about 0.13 mm

(ii) Helical lapping of natural colored insulating paper bearing the identification number of the coaxial pair shall be applied over the steel tape to form a coaxial pair.

(iii) The cable shall be sheathed with lead alloy. No remelted or scrap lead shall be used. The lead sheath shall form a perfectly continuous seamless cylindrical tube, free from pin holes, crystallization of lead, joints, mended places and other defects.

The thickness of lead sheath shall not be less than 2.2 mm.

(iv) A tape on which appears the manufacturer's name and year of manufacture, shall be laid under the lead sheath.

(v) The lead sheathed cable shall be protected with the appropriate jacket which can bear tensile strain etc.

(b) Interstitial quads

(i) The interstitial quads may be the minimum number satisfying requirements of structural strength and requirement to transmit signals for supervision, control etc.

(ii) The diameter of conductors shall be 0.9 mm.

(iii) Each conductor shall be insulated with an overlapping paper with distinguished colors for the pair.

(c) Electrical requirement for factory length of coaxial pair.

(i) Nominal characteristic impedance is 75 ohms at 2.5 MHz.

(ii) The real component of the best balance against the impedance of the coaxial cable at 2.5 MHz shall not differ by more than 1 ohm from the nominal value of 75 ohms.

(iii) Measurements of impedance regularity are carried out by means of pulse sent over the coaxial pair, echoes of these pulse being observed at the sending end.

Measurements can be made from either or both of the ends of a factory length, and the pulse used shall be an approximate sine-squared pulse having a half-amplitude duration not greater than 0.1 micro-second. The results are expressed in terms of "echo attenuation".

This, for a peak in the response curve, is the logarithmic ratio in dB of the amplitude of the transmitted pulse to that of the peak concerned.

Distortion of the pulse during transmission over the cable can be corrected by calculation, or by manual or automatic correction by means of networks.

The results of these measurements shall be at least 50 dB. These values shall be achieved on 100% of the factory lengths.

(iv) The insulating material shall withstand 2000 volts r.m.s. 50 Hz or 2800 volts DC, applied for at least one minute between the inner and the outer conductors connected to the sheath.

(v) The insulation resistance between the inner and the outer conductors of the coaxial pair, measured with a perfectly steady voltage of between 100 and 500 volts, shall not be less than 5000 megohm-kilometers after electrification for one minute, at a temperature not lower than 10°C. The measurement of the insulation resistance shall be made after the dielectric strength test.

(d) Electrical requirement for factory length of interstitial pair

(i) The conductor resistance of 0.9 mm conductor shall not exceed 29.0Ω/Km at 20°C.

(ii) Any conductor shall withstand 500 V DC applied for at least one minute between the conductor and the earthed metallic sheath connected with all other conductors.

(iii) The insulation resistance between any conductor and the sheath shall not be less than 5,000MΩ-Km at 20°C.

(e) Electrical requirement for repeater section

(i) The mean real component of the impedance of a coaxial pair, measured on a complete repeater section, shall not differ by more than 1 ohm from the nominal value.

A check can be made to see that this is so by pulse measurements. The " mean real component of the impedance" is to be taken as the resistive component of the impedance at 2.5 MHz of the best balance against the coaxial pair being measured.

(ii) The "corrected value" of pulse echo attenuation shall be as in (a) (iii), with the following difference: the measurement in this case is made using a sine-squared pulse having a half-amplitude duration not more than 0.2 microsecond. Also, there is correction of amplitude and phase. This corrected value shall be at least 48 dB.

(iii) The value of the attenuation per unit length, at 15°C and at 2.5 MHz, shall not exceed 4.1 dB per kilometer.

The coefficient of attenuation variation shall conform to C.C.I.T.T. Recommendation G 334.

(iv) The far-end crosstalk ratio between two coaxial pairs in a cable shall be at least 90 dB.

(v) The pair shall withstand a DC voltage of at least 2000 volts applied during at least one minute between the inner conductor and the outer conductor connected to the sheath.

(vi) The insulation resistance of the coaxial pair, measured with a perfectly steady voltage of between 100 and 500 volts, shall be not less than 5000 megohm-kilometer after electrification for one minute at a temperature not lower than 10°C. The measurement of the insulation resistance shall be made after the dielectric strength test.

(f) Electrical requirement for interstitial quads

(i) The nominal conductor resistance shall be 27.4 ohms.

(ii) The insulating material shall withstand, for two minutes, a voltage of 350 volts r.m.s. 50 Hz (or 500 V DC) applied between a conductor and all the other conductors connected to the sheath.

(iii) The insulation resistance between a conductor and all the other conductors, measured with a perfectly steady voltage of between 100 and 500 volts, shall be not less than 5000 megohm-kilometers after electrification for one minute. The measurement of the insulation resistance shall be made after the dielectric strength test.

(g) Miscellaneous

(i) Gas facilities fed continuously appropriate pressure air cooled and dehydrated into the cable, and the accessories such as flow meters etc., shall be supplied.

(ii) All necessary materials and particular tools for the installation, shall be supplied.

(3) Repeater equipment

(a) General

Only one both-way bearer for multi-channel telephone signal transmission shall be established in this project.

The amplifier shall be switched without interruption to the spare panel amplifier. Spare panels for equipments are described fully in Chapter 8.

Repeaters shall be provided with plugs and stub cables for connection with the coaxial cable, and shall be protected from disturbance due to surge voltage induced on coaxial pairs.

(b) Repeater equipment

(i) The transmitting input and receiving output impedance shall be 75 ohms unbalanced and return loss shall not be less than 20 dB within the working frequency band.

The nominal signal in terms of test tone shall be as follows:

Transmitting input ..... -45 dBr
Receiving output ..... -20 dBr

(ii) The impedance matching between the equipment and the coaxial pair shall conform to C.C.I.T.T. Recommendation G332.

(iii) The equipment shall equalize frequency/attenuation distortion of a coaxial pair and shall be provided with an equalizing network which compensates the level deviation due to the design and manufacturing deviation. Moreover, the equipment shall regulate line level variation, utilizing pilots specified in C.C.I.T.T. Recommendation G332. The automatic level adjusting function shall effect level variation with time in the range of 4.5 dB relative to nominal level.

(iv) The amplifier overload point shall be higher than +20 dBr.

(c) Alarm

Alarms of at least the following items shall be indicated visibly and audibly at the supervising station.

(i) Abnormal state of gas pressure in the cable.

(ii) Pilot level abnormalities.

(iii) Failure of equipments

(4) Data to be presented

The Tenderer shall submit explanatory data on the following items:

(a) Structure of the cable.

(b) Schematic diagram of each equipment.

(c) Block diagram of the system and level diagram

(d) Noise allotment with calculation for the system.

(e) Line loss characteristics.

(f) Line impedance characteristics.

(g) Equipment performance.

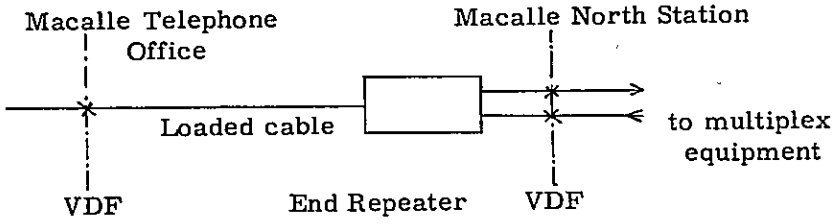
(h) Power consumption for the system at each station.

4-3 Loaded cable system

(1) Requirement for loaded cable system

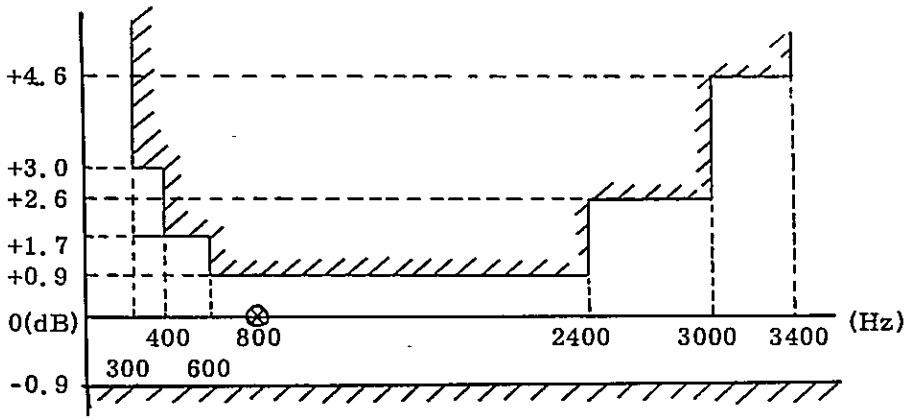
(a) Transmission loss (measuring frequency: 0.8 kHz)

Over-all transmission loss of the loaded cable system with the end repeater is hoped to be less than 4 dB,in consideration of singing stability, measured at VDF in Macalle telephone office and at the 4-wire point of VDF in Macalle North station shown below:



x: measured point

(b) Attenuation/frequency characteristics shall be within the following limits;



(c) Signal-to-crosstalk ratio shall not be less than 65 dB at 800 Hz, measured at the 4-wire point of VDF in Macalle North station shown in the above drawing of (a).

(d) Nominal impedance of the loaded cable system shall be 600 Ω .

(2) Equipment to be installed

(a) Cable line

54 pairs of Foamed Polyethylene insulated cable with conductors 0.65 mm in diameter shall be installed.

(b) Loading Coil

Loading coil shall be installed about every 1 Km, and corresponding to full pairs of the cable.

(c) Signalling equipment

It shall be installed in order to be capable of signalling from and to Macalle telephone office, and is provided corresponding to the network plan shown in Drawing 1-3-(b).

(d) End Repeater

End repeater shall be installed in order to compensate for transmission loss, and is provided corresponding to the network plan shown in Drawing 1-3-(b).

(e) VDF

The VDF installed shall be provided corresponding to full pairs of the cable, including the phantom circuits. Besides, in Macalle telephone office, the capacity of the VDF shall also include about 50 terminals for miscellaneous use.

(3) Cable line

(a) Initially, loaded cable system using side and phantom circuits shall be established. But this cable shall have satisfactory performance for establishing a carrier system, as it shall be used for carrier systems in the future.

(b) Cable whose copper conductors are insulated by Foamed Polyethylene and whose sheath material is Polyethylene, shall be established.

The cable shall be composed of layers like the following example;

	Number of quads
Center layer :	3
First layer :	9
Second layer :	15

All quads in the cable shall differ in their twist.

Nominal thickness of the sheath Polyethylene shall be 1.7 mm and the minimum thickness shall not be less than 75% from the nominal value. Moreover, a metallic tape shall be placed inside of the Polyethylene sheath. All insulations of the conductor shall be able to be identified with at least three colors.

(c) An alarm line in order to detect the water-leaked place, shall be included in the cable, and the alarm shall be indicated visibly and audibly in the supervising station.

(d) Required Performance

(i) The nominal resistance of any conductor, measured with direct current at 20°C, shall be 52.5 Ω /Km. Additionally the maximum resistance of all conductors shall not exceed 8% from the nominal value.

The resistance unbalance of two conductors of the same pair, measured with direct current, shall not exceed the loop resistance of this pair by more than 1%.

(ii) The nominal mutual capacitance, measured with an alternating current having a frequency of 800 Hz, shall be about 40 nF/Km for the side circuit and 110 nF/Km for the phantom.

The average value of mutual capacitance shall not differ from nominal value by more than 80% for the side circuit and 12% for the phantom circuit.

The maximum and minimum value of mutual capacitance shall not differ from the average value of all side circuits and phantom circuits by more than 10% and 14% respectively.

(iii) The capacitance unbalance measured with an alternating current having a frequency of 800 Hz at 20°C on manufactured length of L meters, shall not exceed the value shown below:

$$\text{Maximum value in all quads} : 105 \times \sqrt{\frac{L}{250}} \text{ pF}$$

$$\text{Average value of all quads} : 300 \times \sqrt{\frac{L}{250}} \text{ pF}$$

(iv) Any conductor shall withstand 500 volts D.C. applied for at least one minute between the conductor and the earthed metallic sheath connected to all other conductors.

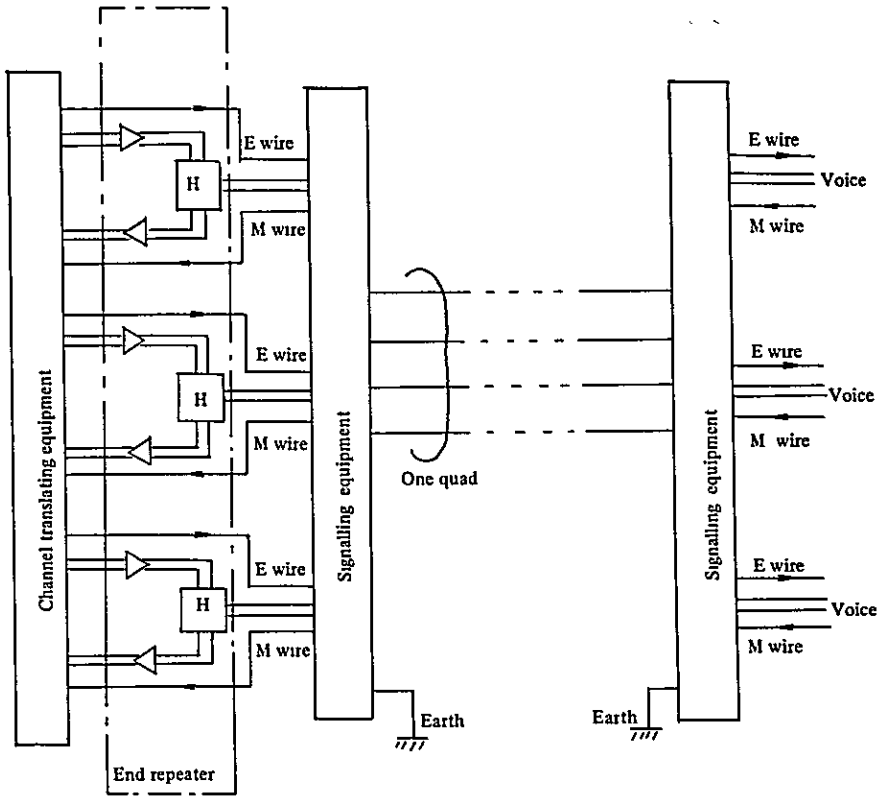
(v) The insulation resistance between any conductor and the sheath shall not be less than 10,000 MΩ -Km.

(e) The cable will be supported by the existing wooden poles which are used in the cable system.

(4) Signalling Equipment

Signalling equipment shall be capable of signalling between Macalle North terminal station and Macalle telephone office.

The function of the signalling equipment is shown in the following drawing;



The signalling equipment shall be such that the overall signalling system including that between Macalle North station and Macalle telephone office satisfy the requirements described in 3-4 (1) (c) (i) and (ii).

The value of additional distortion caused in the above signalling equipment shall be stated.

(5) End Repeater

(a) The end repeater shall be installed in Macalle North station in order to compensate for transmission loss of the loaded cable line. The end repeater shall consist of an amplifier whose gain is adjustable from 0 to 8 dB in 1 dB steps, and of 2-wire/4-wire terminating equipment whose echo loss is greater than 40 dB.

(b) The end repeater shall be connected to the loaded cable on a 2-wire basis, and to the channel translating equipment on a 4-wire basis, at VDF.

(6) Loading Coil

The loading coil shall be suitable for loading two side circuit and the phantom circuit.

The coil shall be assembled in suitable protective cases hermetically sealed. The protective case shall be installed on a pole.

(7) Data to be presented

The Tenderer shall submit explanatory data on the following items:

(a) Structure of the cable
(b) Level diagram
(c) Explanation of each equipment
(d) Power consumption for the end repeater

4-4 Additional Equipment

The existing coaxial cable system is a 1.3 MHz system used as entrance for the 2 GHz microwave link. All facilities of the existing system shall be utilized to the utmost for establishing telephone bearer by adding the additional equipment. Intermediate repeater equipment may be installed, if necessary.

Coaxial cable system using additional equipment shall satisfy the requirement described in 4-2 (1), and the additional equipment shall satisfy the requirements described in 4-2 (3) (a), (b) (i), (iii) and (iv), and (c) (ii) and (iii).

Data to be presented is applied in 4-2 (4) (b), (c), (d), (g) and (h).

CHAPTER V VOICE FREQUENCY TELEGRAPH SYSTEM

CHAPTER V VOICE FREQUENCY TELEGRAPH SYSTEM

5-1 General

(1) This Chapter deals with frequency-shift voice-frequency telegraph (VFT) system of 50 bauds for providing 24 channels on a four wire telephone circuit.

(2) VFT equipment and accessory facilities shall be installed at Asmara, Dessie, and Addis Ababa.

5-2 Requirements for VFT System

(1) The VFT system shall be designed to operate on a 4-wire audio channel of 600 ohms nominal impedance with a bandwidth of 300-3400 Hz.

(2) The VFT system shall employ frequency shift modulation. The equipment shall be designed for double current full duplex telegraph operation.

(3) VFT equipments to be provided at each station shall correspond to network plan Drawing 1-3 (b).

5-3 VFT Equipment

(Refer to C.C.I.T.T. Recommendations R 35 and R 36)

(1) Performance of Equipment

(a) Number of Channels

Equipment with a channel separation of 120 Hz between the mean frequencies shall be able to accommodate 24 channels.

(b) Modulation Rate

The nominal modulation rate of the equipment shall be standardized at 50 bauds.

(c) Frequency

(i) The nominal mean frequencies shall be 420 + (n-1) 120 Hz, n being the channel serial number.

(ii) The mean frequencies at the sending end shall not deviate by more than $\pm$2 Hz from their nominal value.

(iii) The difference between the two characteristic frequencies (corresponding to the start and the stop conditions) in the same channel shall be fixed at 60 Hz.

The tolerance permitted in this difference shall be, at most, $\pm$3 Hz.

(iv) The frequency for the corresponding transmitted condition to the start polarity shall be the higher of the two character-

istic frequencies and that corresponding to the stop polarity shall be the lower.

(d) Levels

(i) The total average power transmitted to the bearer channel by all the channels of a system shall be normally limited to 135 microwatts at relative zero level.

(ii) The mean power per channel at relative zero level shall be 5.6 microwatts at most.

(iii) The signal power shall be adjustable.

(iv) In operation, the levels of the signals corresponding to continuous stop polarity and continuous start polarity shall not differ by more than 1.7 dB in the same channel. Both of these levels shall lie between +1.7 dB and -1.7 dB with reference to the level of (ii).

(v) The Tenderer shall give details of the equipment offered concerning the send and receive level diagram (dBm) with range of adjustment (including per channel).

(e) Parking Bias

In the absence of telegraph current controlling the channel modulator, a frequency shall be transmitted, within $\pm$5 Hz of the frequency normally transmitted for the start polarity. This frequency need not be sent immediately after interruption of the control current.

(f) Level Variation

The receiving equipment shall operate satisfactorily when the receiving level falls to 17.4 dB below the nominal level. The receiving equipment shall have been restored to start polarity when the receiving level has fallen to 23.5 dB below the nominal level.

(g) Distortion

The following value shall not be exceeded for the degree of distortion on a telegraph channel, measured with text SQ9 defined in C.C.I.T.T. Recommendation R51. Before the measurement, the levels shall be adjusted to their normal value and the frequencies shall be checked to see whether they are normal value. Bias distortion shall be eliminated by adjustment in the channel receivers.

When a channel under test is operating, the other channels of the system shall be modulated with unrelated signals when the effect of interchannel interference is to be included in the measurement.

(i) The levels being normal, no frequency drift in bearer channel (artificial line), but the measured channel being subject to fortuitous distortion due to interchannel interference;

5% for degree of inherent isochronous distortion.

(ii) As in (i) above, but at a value different from the normal level, for all constant levels between 8.7 dB above and 17.4 dB below the normal reception levels;

7% for degree of inherent isochronous distortion.

(iii) In the presence of interference by a single sine-wave frequency, equal first to one and then to the other characteristic frequency, with a level of 20 dB below the signal level, the other conditions for the start of measurements being maintained;

12% for degree of inherent isochronous distortion.

(iv) By introducing a frequency drift of the signal, during transmission through the bearer channel, the initial conditions of the test otherwise being preserved;

(5+2.5 Δ f Hz)% for the degree of inherent isochronous distortion, Δ f being not more than 5.

(2) Connection to Telegraph Apparatus

(a) The DC extensions to and from the telegraph apparatus shall be available for working of double current of 20 mA. Further, the equipment shall satisfy the following conditions:

(i) The DC connections to the VFT equipment shall be earth return circuits.

(ii) Adjustable resistance shall be provided in the DC extensions for restricting the currents suitably.

(b) The Tenderer shall state the conditions and limitations necessary for connection to DC extensions.

(3) Telegraph Supplies

(a) The telegraph supplies provided shall be $\pm$60 V, capable of supplying necessary current for all the circuits simultaneously at the rate of 20 mA per channel.

(b) Telegraph supply voltage variations shall be maintained within $\pm$3 V and the difference between two supplies shall not exceed 3 V under conditions of full or partial load.

(4) Alarms

Alarms indicated by lamp and extension bell shall be provided for the following conditions:

(a) Failure of power supply.
(b) Failure of telegraph supplys.
(c) Failure of common carrier supply (if used).
(d) Failure of receive tone.

(5) Test and Monitor Facilities

(a) Test and monitoring facilities shall be provided for the following in each VFT equipment rack:

(i) Measurement of supply voltage.
(ii) Measurement of telegraph supplies.
(iii) Measurement of current in the DC extensions.
(iv) The meter for indicating reversals is to be capable of bias distortion check.

(b) All necessary test and patching cords shall be supplied.

5-4 Auxiliary Rack

For ease and efficiency of maintenance testing of VFT systems and channels, auxiliary racks shall be provided at each station. The following facilities shall be equipped on the auxiliary rack:

(1) Jack Board

(a) Jack board shall accommodate the following:

(i) Test point for VFT system line.
(ii) Test point for send and receive side of telegraph channel.
(iii) Miscellaneous circuits.
(iv) Trunks to VFT terminal rack and other racks.
(v) Facility for patching a faulty channel to a good channel.

(b) Jack board at each station shall have 200% capacity of the initial stage.

(2) Test Facilities

Test and monitoring facilities shall be able to provide the following functions:

(a) Measurement of DC extension.

(b) Measurement of teleprinter signal distortion and teleprinter speed in cooperation with the telegraph distortion measuring set (TDMS).

(c) Transmission of test signals in cooperation with a TDMS or a teleprinter.

(d) Communication with the distant terminal over any telegraph channel and local end teleprinter in cooperation with a teleprinter.

(e) Loop test through an amplifier and variable attenuator to facilitate "terminal to terminal" testing of individual channel of the VFT system.

(f) Measurement of signal levels and noise levels of the VFT system line.

(g) Test and adjusting of telegraph relay (if used).

(h) TDM specified in 7-2-(5)-(b) shall be equipped on the auxiliary rack.

(3) Miscellaneous

(a) Current control resistance of send and receive legs of telegraph channels, if these are not equipped in the VFT terminal equipment.

(b) An AC out-let with fuse for external facilities.

(c) Fuse with alarm for power supply of each VFT equipment rack.

(d) All necessary test and patching cords shall be supplied.

CHAPTER VI POWER SYSTEM

CHAPTER VI POWER SYSTEM

6-1 General

(1) This Chapter deals with the power system which supply continuous power to the radio equipment, multiplex equipment, etc. of all the radio terminal and the repeater stations except at Addis Ababa, Dessie and Asmara stations.

(2) The power systems at Addis Ababa, Dessie and Asmara stations are established by another IBTE project. Regarding those stations, IBTE has a responsibility to supply the necessary power in the radio and multiplex equipment room.

(3) The power system design and performance shall be consistent with the overall system performance, with requirements fulfilling permanent operation of the telecommunications networks in the following conditions and characteristics.

(4) The power supply system is classified into two types; one for stations where commercial power is available, and the other for stations where commercial power is unavailable. The former is for Bete Giorgis radio terminal station, and the latter is for all the other stations. Regarding Bete Giorgis radio terminal station, the power receiving system to an oil circuit breaker in the building is to be established by another IBTE project.

(5) The Contractor shall provide all necessary equipment and materials for establishing the power system, except the fuel storage tank. The Contractor shall submit design of the fuel storage tank within two months after the signing of contract.

6-2 Basic Conditions and Characteristics of Power System.

This paragraph prescribes the required characteristics and capacity of the power system.

The power system shall operate under the worst ambient conditions.

(1) The power equipment supplying power to communication loads shall be of non-break type (no momentary interruption is allowed), and fluctuation of the supplied voltage shall be within the limits allowable for radio and multiplex equipments, and for other facilities.

(2) Composition and Function of the Power System

(a) Stations where commercial power is unavailable

The power system shall consist of two engine generators with an automatic starter, an automatic switchover equipment, full floating type rectifiers and batteries as shown in Drawing 6-1

Two engine generators shall be operated to supply the AC power to the rectifier alternately at a certain period.

Any time when the AC power output of one working engine generator is interrupted, switchover to stand-by engine generator shall take place automatically, so that no interruption of DC output may occur and the voltage shall be maintained within the limit allowable for the communication load.

Even when both of the engine generators fail to operate in sequence, the batteries shall continue to supply the DC power required to the communication load during the period specified in 6-2. (3) of this chapter.

(b) Stations where commercial power is available

The power system shall consist of one engine generator with an automatic starter, automatic switchover equipment (switching the commercial power source to/from the output of engine generator), rectifiers and batteries of full floating alignment as shown in Drawing 6-2.

Under normal conditions, AC power is supplied from the commercial AC power sources, however, in case the commercial AC power fails, the AC power shall be switched to and supplied from the engine generator automatically without any interruption of the DC power supply to the communication load, maintaining the change of the voltage with the limit allowable for the load.

Even when both commercial AC power and operation of the engine generator fail, the batteries shall continue to supply the DC power required to the communication load during the period specified in 6-2.(3) of this chapter.

(c) Emergency power vehicle

An emergency power vehicle shall be provided at each attended station. The emergency power vehicle shall be loaded with one engine generator, a fuel system, etc. Therefore, receiving terminals shall be provided on the power switching board to connect the AC power supply cable from the emergency power vehicle at Bete Giorgis radio terminal station, and at all stations where commercial power is unavailable.

(3) Capacity

The power system capacity except batteries shall be sufficient to supply the power for 125% of the final capacity of the communication load, 100% of the non-essential needs (motive power, engine generator fuel pump etc.), and AC 220 V 3 KVA (lighting of station building, measuring equipments and heater) at Macalle North and MT. Furi stations or AC 220 V 2KVA at other stations. Especially, regarding to Bete Giorgis and MT. Furi stations, the communication load capacity shall be sufficient considering to the future plan shown in Drawing 2-17.

The capacity of the engine generator of the emergency power vehicle shall be sufficient to supply AC power for all stations where commercial power is unavailable and for Bete Giorgis radio terminal station instead of the engine generator of those stations.

The capacity of the batteries shall be determined as capable of holding the final capacity of communication loads concerning only Addis Ababa - Asmala route for more than 10 hours at stations where a commercial power source is unavailable, and for more than 3 hours at stations where a commercial power source is available.

The term "holding time" refers to the time in which the load voltage at the time of discharge reaches the allowable limit input voltage of communication equipment, and this holding time should be assured even at 10°C.

Each rectifier shall supply power to the 125% load of the final capacity and, at the same time, carry out the recovery charge for 20 hour-rate.

6-3 Engine Generator (except that on the emergency power vehicle)

(1) General condition & performance

(a) Minimum operational condition on which the provided engine generator at each station shall be designed are as follows:

Routine maintenance interval including any check

------ Conducted once every three months

Altitude ----------Refer to the drawing 1-1 (b)

(b) Equipments and the associated complements to be included in the offer are as follows:

Main equipment ---Engine, three phase AC generator, Engine bed.

Control equipment ----- Generator output control unit. (auto-manual voltage regulator) meters & relays, alarm & indicator, power switch board

Accessories ---------- Starting battery & charging device, fuel service system and lubricating system, air admission system, exhaust system, tools etc.

(c) The type and the capacity of power system for each station shall be determined considering the altitude and climatic conditions. Moreover, the Tenderer shall take measures to meet the long routine maintenance interval, for exemple, as follows:

(1) The lubricating system has more than two oil filters, a oil sub-tank and a pump;

(2) The air cleaner of the air admission system is heavy duty dry type.

(d) When designing equipment, their interchangeability shall be taken into account as much as possible.

(e) In case of unattended maintenance of engine generators at stations where commercial power is unavailable, it shall be possible to alternately operate engine generators at intervals of 12 hours to 48 hours by means of a timer and remote controller from a supervising station.

In case of unattended maintenance of an engine generator at stations where commercial power is available, it shall be possible to operate an engine generator for 1 hour at the regular intervals of 360 hours by means of a timer and remote controller from a supervising station.

(f) When commercial power or working engine generator fails, the stand-by engine generator shall be started immediately and automatically, and the AC power shall be switched over to it automatically.

When commercial power return to normal condition, the AC power of the engine generator shall be switched over to it after 10 minutes.

When commercial power or normal engine generator fails, the functions of above-mentioned 6-3 (e) shall be stopped.

(g) When any trouble as shown below, occurs in the engine generator and further running is presumed to cause danger, the engine generator shall be stopped automatically, and audible and visible alarms to inform the trouble shall be activated at the supervising station in case of unattended stations and shall be activated at the local supervisory equipment in case of attended stations.

Abnormal generator output voltage

Excessive generator output current

High temperature of the engine

Excessive revolution speed

Drop of oil pressure

etc.

(2) Electrical and Mechanical Requirement

(a) Rating and characteristics

Cooling ----------	Air cooling
Rated voltage ---------	220/380V ± 5% or less

Phase ---------- Three phase, four wire

Rated frequency ------- 50 Hz ±3% or less

Power factor ---------- 0.8

Revolution speed ------- 1500 r.p.m. or less

(b) Mechanical requirements

The engine generators shall have mechanical strength sufficient to assure their rated operation.

The engine shall be capable of operating continuously for more than three months, unattended.

(3) Engine Generator Equipments

(a) Starting equipment

A starting equipment, including an automatic charging device, shall be provided.

(b) A cooling or heating system is not furnished in the power room, therefore those systems shall be provided for the normal operation of the power system, if necessary, and moreover to keep the power room temperature at less than 55°C under the worst ambient conditions.

(c) Fuel system

The fuel storage tank with a capacity for 120 days (4 months) at the stations where commercial power is unavailable, or for 30 days (1 month) at the station where commercial power is available, of actual operation by one engine generator at full load plus 15% reserve shall be installed outside the power room. A daily service tank shall be installed in the power room.

(d) Engine Bed

An anti-vibration cushion shall be fixed to the engine bed of the engine generator to prevent vibration.

(e) Exhaust system

Exhaust pipes shall be attached to the engine generators with consideration to the vibration and heat resistance.

For outdoor exhaust pipe fixture, secure work shall be done so as to protect them against wind pressure and rain penetration.

6-4 Emergency Power Vehicle Mounted Engine Generator

(1) General condition and performance

(a) Minimum operational condition on which the engine generator provided for the emergency power vehicle shall be designed are as follows:

Routine maintenance interval	----------	Conducted once every month
Altitude	----------	About 3600 meters

(b) Equipments, and associated components to be included in the offer are as follows:

Main equipment	-----	Engine, three phase AC generator.
Control equipment	---	Generator output control unit (auto-manual voltage regulator), meters and relays, alarm and indicator, power switch board.
Accessories	--------	Starting batteries and charging device, fuel storage tank, power supplying cable, tools, etc.

(c) When any trouble, as shown below, occurs in the engine generator and further running is presumed to cause danger, the engine generator shall be stopped automatically, and audible and visible alarms which inform of the trouble shall be activated at the control equipment.

Abnormal generator output voltage

Excessive generator output current

High temperature of the engine

Excessive revolution speed

Drop of oil pressure

etc.

(d) The parts of engine generator shall preferably have interchangeability with those of a vehicle engine as much as possible.

(2) Electrical and Mechanical Requirements

(a) Rating and characteristics

Cooling	----------Air cooling
Rated frequency	------ 50 Hz ± 3% or less
Rated voltage	-------- 220/380 V ± 5% or less
Phase	---------- Three phase, four wire
Power factor	---------0.8

(b) Mechanical requirements

The engine generators shall have mechanical strength sufficient to assure their rated operation.

The engine shall be capable of operating continuously for more than 120 hours.

(3) Engine Equipment

(a) Starting equipment

Starting equipment, including an automatic charging device, shall be provided.

(b) Fuel system

A fuel storage tank with a capacity for 20 hours of actual operation by the engine generator at full load plus 15% reserve shall be equipped independently in the vehicle.

6-5 Emergency Power Vehicle (except the engine generator)

(1) General condition and performance

(a) Safety of the vehicle with the engine generator loaded thereon shall be sufficient and the vehicle shall be capable of traveling over rough terrain without hindrance even in a downpour.

(b) Operation and maintenance of the engine generator shall be possible even at night and during a downpour.

(c) Two or more persons shall be able to ride in the vehicle.

(2) Mechanical requirement

Vehicle type ----------	not trailer type.
Grade ability ----------	15 degree or more (Four wheel drive).
Minimum road clearance --	18 cm or more.
Minimum turning radius ---	8.0 m or less.

6-6 Rectifier and Battery

(1) General

A full floating system using rectifiers and batteries shall be adopted for supplying power to the radio and the multiplex equipment and to the other facilities with no momentary interruption, while maintaining the allowable voltage limit of the load even at the worst physical and electrical conditions prescribed in this Specification.

(2) Rectifier

(a) The rectifier receives commercial power or engine generator output,

and charges the installed batteries aligned in floating charge system, as well as supplying power to loads.

(b) Rectifiers shall be of a stationary type, and shall consist of one working and one stand-by rectifier. Each rectifier shall be sufficient to carry the designated operation in any case.

(c) In case the working rectifier fails, the load shall be switched over to the stand-by rectifier automatically.

(d) A load voltage adjusting device shall be comprised in the rectifier to control the load voltage and battery voltage automatically.

(e) The offered rectifier shall be high-quality, assuring stable service.

(f) The performance of the rectifier shall meet the requirement for the radio and the multiplex equipment and for the other facilities provided.

(3) Battery

(a) The batteries shall be the enclosed lead or alkaline type.

(b) The batteries shall be explosion proof in structure.

6-7 Alarm and Indication

Audible and visible alarms shall be indicated on the control equipment to inform of the operating conditions of the aforementioned power equipment. Moreover, those alarms shall be extended to supervising equipment according to the par. 2-11.

6-8 Earthing

The earth required for equipment, DC power line, arrester etc. shall be connected to the earthing terminal, which is prepared at the power room by IBTE.

6-9 Data to be Presented

The Tenderer shall submit explanatory data on the following items, including emergency power vehicle;

(a) Block diagram of power supply system.

(b) Explanation of each power equipment.

(c) Characteristics of each power equipment.

(d) Outline of operation and maintenance, and routine maitenance program.

(e) Calculative basis of capacity of engine generator, batteries, rectifiers and fuel storage tank.

(f) Measures for long maintenance interval and high altitude.

CHAPTER VII MEASURING EQUIPMENT AND TOOL

CHAPTER VII MEASURING EQUIPMENT AND TOOLS

7-1 General

This Chapter deals with measuring equipment and tools.

7-2 Measuring Equipment

(1) General

(a) All measuring equipment necessary for maintenance shall be supplied. At least, measuring equipment specified in the following paragraphs shall be provided.

In addition, those items the Contractor recognizes as necessary shall also be provided.

(b) Measuring equipment required for construction work only shall be offered as options.

(c) Measuring equipment shall be provided with all necessary accessories for measuring, such as attenuators, auxiliary amplifiers and filters as well as plugs and cords.

(d) Power source for measuring equipment shall be AC 220V, except for stationary type and DC -24V for stationary type equipment.

Equipment shall be capable of satisfactory operation within voltage variations of $\pm$10%.

(e) Measuring equipment shall have sufficient measuring range compatible with the system subject to measuring.

(f) Preference will be given for direct visual measuring by such method as sweeper.

(g) Measuring equipment except the stationary type shall be easy to transport.

(h) Measuring accuracy of equipment shall be sufficiently high to bear comparison with the standards of objects to be measured, and shall be such as can be calibrated as required.

(i) It shall be permissible to assort by functions the measuring equipment mentioned in the following paragraphs and rearrange them into one unit.

(j) In case a single equipment cannot measure the required range, it will be permissible to use two or more equipments.

(2) Common Measuring Equipment

At least the following shall be supplied as fundamental measuring equip-

ment to be used commonly for the systems involved. Such equipment shall be provided at each station in quantities appearing in Table 7-1.

(a) Multi-range volt-ammeter (MULT M)

This shall be the precision type volt-ammeter to measure DC and AC source voltage and current.

(b) Circuit tester (TESTER)

Being the conventional type universal volt-ammeter, this shall be qualified for use for simple checking.

(c) Megger (MEG)

This shall be used for measuring insulation resistance of a circuit. Impressed voltage shall be both 500 V and 100 V.

(d) High impedance voltmeter (HV)

This shall be capable of voltage measuring with sufficiently high impedance in the band ranging from DC to the maximum modulation frequency of the microwave system, including the continuity pilot.

(e) Oscilloscope (OSCILLO)

This shall be capable of measuring in the band specified in (4) below.

(f) Pen recorder (REC)

This shall be a multiple-pen recorder for recording characteristics continuously by connecting various kinds of equipment as required. The Tenderer shall propose the type of recorders and the number of pens per unit.

(3) Measuring Equipment for Microwave System

At least the following measuring equipment shall be supplied. Such equipment shall be provided in quantities shown in Table 7-1. The items indicated by mark * at least, shall be capable of direct visual measuring with the sweeper method.

(a) Baseband signal generator (BSG)

This shall be capable of generating a sinusoidal test signal. The frequency range shall cover 20 Hz to 10 MHz for the equipment to be delivered at the stations.

(b) Baseband level meter (BLM)

This shall be capable of measuring signal level in the band mentioned in (a) above.

(c) Noise measuring equipment (NM)

This shall be capable of measuring noise performance on the

telephone circuit according to the method using the uniform spectrum signal based on C.C.I.R. Recommendation 399-1. The sending signal level shall be variable. Further, this shall be applicable for 960 channel systems.

(d) Television test signal generator (TVSG)

This shall be capable of generating the television test signal based on C.C.I.R. Recommendation 421-1. Further, superimposition of a 4.43 MHz signal shall be available on Test Signal No. 3 of the said Recommendation.

(e) Television circuit performance measuring equipment (TVM)

This shall be capable of measuring performance of items based on C.C.I.R. Recommendation 421-1, in cooperation with the television test signal generator in (d) above.

(f) Linearity measuring equipment (LIN)*

This shall be capable of measuring linearity of modulator and demodulator.

(g) Delay measuring equipment (DELAY)*

This shall be capable of measuring IF-IF group delay in overall system and repeater.

(h) Amplitude characteristics measuring equipment (AMP)*

This shall be capable of measuring RF-IF and RF-RF amplitude characteristics in a repeater.

(i) Deviation measuring equipment (DEV)

This shall be capable of measuring frequency deviation of FM signal in the IF stage and of measuring the IF frequency also.

(j) Radio frequency meter (RFM)

This shall be capable of measuring radio frequency.

(k) Radio frequency power meter (RFPM)

This shall be capable of measuring signal power in the RF band.

(l) IF test signal generator (IFSG)

This shall be capable of generating test signal required for test and adjustment in the IF band.

(m) IF level meter (IFLM)

This shall be capable of measuring signal level in the IF band.

(n) Measuring equipment for repeater (REP)

This shall be capable of measurements necessary for test and

adjustment of a repeater. Measuring shall be conducted, as far as possible, by the direct visual method using the sweeper.

(o) Measuring equipment for service channel (SC)

This shall be capable of measurements necessary for test and adjustment of service channel transmission line and equipment.

(p) Master monitor (MM)

This shall be capable of monitoring television signal picture and waveform. Equipment shall be stationary in type and be suited for cutover connection to the necessary monitor points.

(4) Measuring Equipment for Multiplex System

At least the following measuring equipment shall be supplied. Such equipment shall be provided in quantities shown in Table 7-1.

(a) Signal generator for carrier system (CSG)

This shall be capable of generating a sinusoidal test signal in the frequency range covering the carrier system.

(b) Signal generator for audio system (ASG)

This shall be capable of generating a sinusoidal test signal in the audio frequency range covering the frequency band between 50 - 10,000 Hz.

(c) Level meter for carrier system (CLM)

This shall be capable of measuring signal level in the band mentioned in (a) above.

(d) Level meter for audio system (ALM)

This shall be capable of measuring signal level in the band mentioned in (b) above.

(e) Selective level meter (SLM)

This shall be capable of measuring signal frequency level such as carrier leak, crosstalk and distortion attenuation in a carrier system, selectively.

(f) Psophometer (PSO)

This shall be capable of measuring psophometric noise voltage on the telephone circuits and the program circuits.

(g) Impulse sender (IS)

This shall be capable of sending dialing pulses and measuring their distortion.

Note: The signal generators and level meters mentioned in (a), (b), (c) and (d) above shall be capable of measuring gain

and loss of each multiplex equipment, together with attenuator, filter, etc. attached to the measuring equipment.

(5) Measuring Equipment for VFT System

At least one set each of the following measuring sets shall be supplied to each station where VFT equipment are to be installed.

(a) VFT Transmission Measuring Set (VTM)

(i) The set shall be capable of measuring characteristics of VFT system such as level, frequency, loss and gain.

(ii) The set shall be composed of audio frequency signal generator, level meter, attenuator, amplifier, control keys, etc.

(iii) The set shall be mounted on a trolley type rack and each measuring equipment shall be of transistorized type.

(b) Telegraph Distortion Measuring Set (TDM)

(i) This shall be portable in type and shall consist of a transmitter and receiver for measuring the start-stop distortion of a continuous train of a double current signal at 50 bauds.

(ii) The transmitter shall be able to generate signals of 1:1, 2:2, 1:6, 6:1 and SQ9 for testing VFT circuits in accordance with C.C.I.T.T. Recommendation R51.

These signals shall be distorted by accurately predetermined amounts, as required.

(iii) The receiver shall be designed by a display on a cathode ray tube. The measuring range shall be 0 to 50% distortion and the measuring accuracy shall be within $\pm$0.25%.

The receiver shall be capable of measuring transmission speed in bauds.

(6) Measuring Equipment for Cable System

At least the following measuring equipment shall supplied. Such equipment shall be provided in quantities shown in Table 7-1.

(a) Measuring Pilot Frequency Generator (MPFG)

This shall be capable of generating additional measuring pilot frequency for the coaxial cable system specified in C.C.I.T.T. Recommendation G332.

(b) Measuring Pilot Frequency Level Meter (MPFLM)

This shall be capable of measuring level of pilot frequency mentioned in (1) above.

(7) Measuring Equipment for Power System

At least the following measuring equipment shall be supplied to each station:

(a)	Portable 3V voltmeter for battery checking	1
(b)	Syringe hydrometer	1
(c)	Battery thermometer	1
(d)	Tachometer	1

7-3 Tools

(1) All tools necessary for maintenance shall be supplied to each station concerned.

(2) Tools necessary for construction and installation work only shall be offered as options.

7-4 Data to be Presented

The Tenderer shall submit data on the following items:

(1) Explanatory data on the performance for each measuring equipment.

(2) Kind and quantity of each measuring equipment and necessary maintenance tools.

Table 7.1 Measuring Equipment

Station / Equipment	Addis Ababa radio and carrier terminal station	Dessie Tele. Office	Macalle North radio and carrier terminal station	Macalle Tele. Office	Bete Giorgis radio terminal station	Asmara Tele. Office	Others
MULT M	1	1	1			1	
TESTER	1	1	1		1	1	
MEG	1	1	1			1	
HV	1	1	1			1	
OSCILLO	1	1	1			1	
REC	1	1	1			1	
BSG	1	1	1		1		
BLM	1	1	1		1		
NM	1	1	1		1		
LIN	1	1	1		1		
DELAY	1	1	1		1		
AMP	1	1	1		1		
DEV	1	1	1		1		
RF M	1	1	1		1		
RF PM	1	1	1		1		
IF SG	1	1	1		1		
IF LM	1	1	1		1		
REP	1	1	1		1		
SC	1	1	1		1		
C SG	1	1	1			1	
A SG	1	1	1			1	
C LM	1	1	1			1	
A LM	1	1	1			1	
S LM	1	1	1			1	
PSO	1	1	1			1	
IS	1					1	
VTM	1	1	1			1	
TDM	1	1	1			1	

Measuring Equipment for TV Transmission

Station / Equipment	Addis Ababa radio and carrier terminal station	Dessie Tele. Office	Macalle North radio and carrier terminal station	Macalle Tele. Office	Bete Giorgis radio terminal station	Asmara Tele. Office	Others
TV SG	1						
TV M	1	1	1		1		
MM	1	1	1		1		

CHAPTER VIII SPARE

CHAPTER VIII SPARES

8-1 General

In this Chapter, spares to be supplied for the facilities under this Contract are specified.

(1) All spares necessary for stable and reliable operation of the systems involved shall be supplied.

(2) Spares shall be supplied at least in accordance with such standards as are specified in the following paragraphs. Necessary items of other than such specified standards if any, shall also be supplied.

(3) Computing of items, whose required quantity is given in the percentage of working complement shall be made for the whole of the constantly running system, including the working equipment and the stand-by equipment.

8-2 Consumable Material

Consumable materials shall be supplied in the quantities required for three years operation of the systems involved.

8-3 Spare Panels

Panels, including similar assemblies, to be used for replacement in the case of equipment failure, shall be supplied as specified hereunder. Such panels shall be fitted with all necessary crystals, relays, tubes, etc. in order that they can start operation immediately when used for replacement.

(1) Microwave System

For panels to be used at all stations concerned, at least one spare panel for each kind shall be supplied to each attended station.

(2) Multiplex System

Whole numbers including spares are stipulated in Chapter 3. In addition to the above, one set of every power supply panel for each kind shall be supplied to each attended station.

(3) Cable System

(a) Coaxial cable system

For panels to be used at all stations concerned, at least one spare panel for each kind shall be supplied to the attended station.

Moreover, all necessary materials for repairs of the cable including emergency repairs, shall be supplied in the quantities required for three years, based on the Contractor's estimation.

(b) Loaded cable system

Whole numbers of the end repeater and the signalling equipment

including spares are stipulated in Chapter 4. In addition to the above, one spare panel of power supply for each kind shall be supplied to each pertinent station.

Moreover, the 54 pairs Foamed Polyethylene insulation cable with the length of at least 200 meters, to be used for repairs in case of cable failure shall be supplied.

(4) VFT System

Whole numbers including spares are stipulated in Chapter 5. In addition to the above, every one set of power supply panel for each kind shall be supplied to each pertinent station.

8-4 Other Spares

(1) The quantities specified below in percentages of the working complements to be supplied to the Addis Ababa station by this Contract. In case the number of units to be supplied includes fractions of units, the total shall be rounded up to the next integer.

(a) Spares to be supplied in quantities equivalent to 30% of working complements:

-- Patching cords with plugs;
-- Connecting plugs;
-- Blocks and U-links;
-- Telephone sets.

(b) Spares to be supplied in quantities equivalent to 10% of the actually installed length:

-- All kinds of intra-office cables and wires, except power and earthing cable between power and equipment rooms. (Unit: 10m)

(2) Flexible feeder which is suitable for replacing any piece of wave guide in case of emergency, shall be supplied to the Addis Ababa station. Appropriate connection devices for use with the wave guide shall also be included. However, this feeder shall be quoted as optional item.

(3) Other items which the Contractor recognizes as necessary shall be supplied.

CHAPTER IX TOWER

CHAPTER IX TOWER

9-1 General

This Chapter deals with the towers to be constructed by the Contractor for mounting the antenna system.

The Contractor shall construct towers according to the following conditions at all the radio stations except the Addis Ababa station.

(1) The Tenderer shall construct the necessary towers based on the minimum antenna heights shown in Drawings 2-1 to 2-16, which satisfy at least the following clearance in each hop where "f" is the radius of the first Fresnel zone and "K" is the coefficient of the effective earth radius,

Ridge clearance ..... 1st f or more at K=4/3
..... (2/3) x (1st f) or more at K=2/3

Moreover, the tower of MT. Furi shall be designed to be able to mount the antennas for the Asmara, Dire Daua, Shashamene, and Gimma route, and to mount the two more spare antennas.

For the Bete Giorgis, the Contractor shall construct the tower which is sufficient to mount the necessary antennas for the Addis Ababa, Gondar and for Massaua route.

(2) The Tenderer shall offer self-supporting towers on the ground, except at the Dessie tele. office.

For Dessie tele. office, the self-supporting tower shall be constructed on the new building constructed by IBTE.

(3) Each tower, including the antenna system, shall be strong enough to resist winds with a velocity of 55 meters per second and to suffer no serious vibrations or torsion which may deteriorate microwave performance.

(4) The Tenderer shall submit necessary calculations in details, standards of materials, and specification data on the deflection limit of towers and the safety factor used in the design calculation, as well as necessary drawing concerning the tower for the MT. Furi radio station.

Moreover Tenderer shall submits such outline as necessary heights and side view of all the towers considering the future plan shown in Drawing 2-17.

(5) The Contractor shall submit specifications, calculations in detail and factory drawings for all towers to IBTE for their approval after signing of Contract.

(6) Certified copies of mill reports for steel materials shall accompany deliveries of the tower elements.

(7) The adoption of standards equivalent to or better than those specified herein, is permissible.

9-2 Foundations

The foundations for the towers and the passive reflector are made by another IBTE project.

However, the Contractor shall submit the detailed design of the tower foundations under the following conditions, within 2 months after the signing of the Contract.

(1) The tower foundations shall be designed by the Contractor under the designated soil bearing capacity spreads throughout for the station sites.

(2) Portland cement and concrete conforming to British Standard (BS) Code of Practice CP 114 (1957) or equivalent shall be used for foundations.

(3) Reinforcing bars for foundations shall be plain bars complied with ASTM A-615-68 or BS 785, or equivalent.

9-3 Steel Structures

(1) Fabrication and erection of steel structures shall be in accordance with the American Institute of Steel Construction "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings" adopted in 1963, "Code of standard Practice for Steel Buildings and Bridges" revised March 15, 1959 or the British Standards Institution "The Use of Structural Steel in Building", or equivalent national standard.

(2) Field connections shall be fastened with steel bolts using such methods to prevent loosening as double nuts.

(3) Structural steel for all work shall conform to ASTM A-283-67, A-306-64, A-36-67, BS 15, or equivalent.

(4) All bolts used in connection with structural steel shall conform to ASTM A-307-68, BS 15, or equivalent.

(5) Where structural joints are made by welding, the details of all joints, the welding technique employed, the appearance and quality of welds made, and the methods used in correcting defective work shall conform to requirements of the "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings" of the American Institute of Steel Construction, or equivalent, and the "Code for Arc and Gas Welding in Building Construction" of the American Welding Society, or equivalent.

(6) All steel parts and their attachments, except for portions to be encased in concrete, shall be given a protective zinc coating on all surfaces by dipping in a bath of molten zinc in compliance with the following specifidations.

(a) For parts other than nuts and bolts, and similar threaded fasteners, the zinc coating shall be carried out to the requirements of ASTM A-123-68 or equivalent.

(b) For nuts, bolts and similar threaded fasteners the zinc coating shall be carried out to the requirements of ASTM A-153-67, or equivalent.

(c) All parts shall be galvanized after fabrication, i.e. after holes, bands and welds have been made.

(d) The uniformity of the coating shall normally be determined by visual means. However, submit certified reports of the Preece copper sulphate test as specified in BS 729, ASTM A-239-41(65) or equivalent.

9-4 Associated Work

(1) Adequate access to the antenna system by authorized personnel shall be provided in the form of ladders. On each ladder, rest platforms with necessary personnel safety means shall be installed at intervals of less than 10 meters.

(2) The feeder ladders shall also be provided with the towers.

(3) Proper earthing of towers and antenna system shall be provided.

CHAPTER X INSTALLATION AND TEST

CHAPTER X INSTALLATION AND TEST

10-1 General

The installation and test will be carried out by IBTE, but the Contractor shall supervise these actions.

This Chapter describes the scope of the Contractor requirements in connection with installation and tests, such as the materials for the installation.

10-2 Installation

(1) The Contractor shall supervise the installation and shall supply all necessary materials and particular tools for the installation, including the tower construction, except for the civil construction which includes the foundations of the tower.

(2) The materials supplied for the installation shall be determined under the following conditions.

(a) Fixing and mounting shall be done in such way that they will be sufficiently stable and rigid. For the parts required to be flexible, appropriate devices shall be rendered.

(b) The outdoor section of feeder shall be protected from damage due to direct sunlight, rainstorm and falling objects.

(c) Wiring for bay-type equipment shall be performed from the upper section, using cable rack or similar means.

(d) For cable and wire termination, utmost care shall be exercised in order that the fixed terminals can be used for a long period.

(e) Each equipment shall be effectively and efficiently earthed.

(f) AC and DC power lines shall be laid in separate groups.

(g) Cable racks, holes, ducts, etc. for wiring shall be such as to allow expansion for the final scheme.

(h) Material to be used for steel work shall be high in quality and anti- corrosive in nature.

(i) For mounting of structures, etc., it is permissible to utilize fixing rails attached onto beams of buildings.

(3) The Tenderer shall submit the actual equipment layout plan.

(4) The Contractor shall, as soon as possible after the signing of contract, submit the following data to IBTE,

(a) Detailed construction plan which the Contractor considers the most appropriate.

(b) Mounting method, with drawings, of equipments etc.

(c) All kinds of inter-equipment wiring diagrams.

(d) Design of foundation for the towers and the passive reflector, and the fuel storage tanks under the ground.

(e) Necessary requirements for the building design.

10-3 Tests

(1) Tests consist of factory inspection, installation period test and continuous recording test. Those tests are carried out by IBTE under Contractor supervision. The Contractor shall prepare the methods of tests, including procedural details. All inspections and tests shall be conducted on the basis of comparing with the specifications hereby presented and data submitted by the Contractor.

(2) Factory Inspections

(a) The Contractor shall, prior to the IBTE's inspection, submit manufacturer's test data for all goods to be delivered.

In such prior inspections, the Contractor can use, if necessary, the sampling test method approved by the Inspector.

(b) When units have been made ready for inspection in considerable quantities, the Contractor shall inform the Inspector, without delay, of the time when inspection can be started. The Contractor shall reserve sufficient time for each inspection.

(c) The Contractor shall prepare, free of charge, all necessary facilities for inspections, including measuring instruments.

(d) The Inspector can, whenever he so chooses, inspect the manufacturing processes in the factory.

(e) All goods delivered, except when indicated otherwise, shall be subject to inspection by the IBTE before shipping, and an inspection certificate signed by the Inspector shall be attached to each packing.

The Contractor shall prepare suitable sheets for inspection in sufficient quantities. Manufacturer's test data, as specified in (a) above, shall be attached to the inspection certificates referred to in this paragraph. These certificates will not absolve the Contractor from his ultimate responsibility for this contract.

(f) Salaries and wages of inspectors, as well as expenses to be entailed for travel to and from the factory and their living expenses in the manufacturer's country, will be borne by the IBTE.

All other expenses shall be borne by the Contractor.

(3) Installation Period Tests

(a) The Contractor shall propose the test items considered to be necessary in addition to the test items shown in Table 10-1.

(b) The Contractor shall submit the detailed test methods and explanations thereof.

(4) Continuous Recording Test

Continuous recording test of the noise power of the radio link will be made for three months. The Contractor shall submit the detailed test method and explanation.

10-4 Staffing Schedule

(1) The Contractor shall propose an appropriate staffing schedule quoting the number of engineers, technicians and workmen, respectively, required for the installation and the test.

(2) The Tenderer shall submit the staffing schedule quoting the number of, and the expense for, supervisors.

Table 10-1 The Minimum Items of Installation Period Test

1. Station Test

1-1 Microwave System

Item	Note
(1) Level Setting (a) Baseband input & output level (b) IF input & output level	
(2) Repeater (a) Transmitter radio output power (b) Receiver radio input power (c) Squelching level setting (d) AGC characteristics (e) Radio frequency check (f) Intermediate frequency check (g) Amplitude characteristics	
(3) Modulator & Demodulator (a) Frequency deviation check (b) Linearity (c) Frequency/attenuation distortion	This will be measured in combination of a modulator & a demodulator.
(4) Space Diversity System	The data demonstrating that the operation of equipment will provide the required protection from the affection of fading, shall be submitted.
(5) Sound Channel	Same as 1-2 (4)
(6) Alarm Test	

1-2 Carrier Multiplex System

Item	Note
(1) Translating Equipment	
(a) Level setting	This shall include out-band signalling level.
(b) Frequency/attenuation distortion characteristics	
(c) Carrier level & leak	
(d) Signalling circuit operating characteriestics	
(e) Crosstalk	
(f) Idle noise	
(g) Linearity	
(h) Amplitude limiting	
(2) Frequency Generating Equipment	
(a) Frequency calibration	
(b) Level setting	
(c) Switchover test	This shall be include level variation test.
(3) Supergroup Level Regulating Equipment	
(a) Frequency/attenuation distortion characteristics	
(b) Pilot frequency selective characteristics	
(c) Level regulating characteristics	
(d) Idle noise	
(e) Crosstalk	
(4) Program Transmission Equipment	
(a) Level setting	
(b) Frequency/attenuation distortion characteristics	
(c) Noise	
(d) Harmonic distortion	
(e) Linearity	
(f) Crosstalk	

1-3 Cable System

Item	Note
(1) Coaxial Cable System	
(a) Level setting	
(b) Gain/frequency characteristics	
(c) Level regulating characteristics	
(d) Idle noise	
(e) Overload	
(2) Loaded Cable System	
(a) Level setting	
(b) Crosstalk	
(c) Signalling equipment operating characteristics	
(3) Additional Equipment	
- Terminal Repeater Equipment -	
(a) Level setting	
(b) Gain/frequency characteristics	
(c) Level regulating characteristics	
(d) Idle noise	
(e) Overload	
- Intermediate Repeater Equipment -	
(a) Level setting	
(b) Gain/frequency characteristics	
(c) Idle noise	
(d) Overload	

1-4 VFT System

Item	Note
(1) Level setting	
(2) Channel frequency calibration	
(3) Distortion	This will be measured in combination of transmitting and receiving
(4) Noise	This will be measured at output of the receiving filter, in a combination of transmitting and receiving equipments.
(5) Alarm tests	
(6) Group common carriers	Should these be used
Carrier level Carrier leak	
(7) Output DC current check	

2. Overall Test

2-1 Microwave System

Item	Note
(1) Telephone Bearer	
(a) Level setting	
(b) IF-IF group delay	
(c) Attenuation/frequency distortion	
(d) Signal-to-noise ratio	This shall be measured with & without uniform spectrum signal loading.
(e) Stability test	
(2) Television Bearer	
(a) Level setting	
(b) IF-IF group delay	
(c) Signal-to-noise ratio	
(d) Linear waveform distortion	
(e) Attenuation/frequency distortion	
(f) Envelope-delay	
(g) Differential gain characteristics	
(h) Differential phase characteristics	
(i) Stability test	
(3) Service Channel	
(a) Attenuation/frequency distortion	For every channel
(b) Signal-to-noise ratio	
(c) Gain stability	
(4) Switching System	The data demonstrating that facilities will furnish normal function, as designated, shall be submitted.
(5) Sound Channel	Same as 2-2 (1).
(6) Supervisory & Control System	Ditto

2-2 Carrier Multiplex System (between terminal stations)

Item	Note
(1) Supergroup, Group & Channel, as well as Program circuit	
(a) Level setting	
(b) Frequency/attenuation distortion characteristics	
(c) Signalling distortion & operating characteristics	
(d) Idle Noise	
(e) Crosstalk	

2-3 Cable System

Item	Note
(1) Loaded Cable System	
(a) Transmission loss	
(b) Attenuation/frequency characteristics	
(c) Signal-to-crosstalk ratio	
(2) Coaxial Cable System & Additional Equipment	
(a) Level setting	
(b) Equivalent/frequency characteristics	
(c) Line regulating characteristics	
(d) Idle noise	
(e) Overload	
(f) Crosstalk	

2-4 VFT System

Item	Note
(1) Level setting	
(2) Distortion	
(3) Noise	This will be measured at output of the receiving filter.

CHAPTER XI TRAINING

CHAPTER XI TRAINING

11-1 General

This Chapter deals with the training to be administered and the training facilities to be supplied.

The Contractor shall be responsible for necessary training of personnel designated by the IBTE in the Country and in the Manufacturer's factory.

11-2 Training of Personnel

(1) Training Program

The training program shall be proposed by the Tenderer. Final decision shall be based on the agreement between the IBTE and the Contractor.

For the training scope, IBTE expects that about 10 personnel for the training at factory, and that about 25 personnel for the theoretical and job training will be designated.

(2) Category of Training

(a) Theoretical Training

Trainings for theoretical matters, as well as installation and maintenance work, shall be administered to personnel designated by the IBTE in the Country, before the end of installation work, on the following subjects.

(i) Microwave system
(ii) Carrier multiplex system
(iii) Power supply system
(iv) VFT system
(v) Measuring techniques

(b) Training at Factory

Personnel selected by the IBTE from among trainees named as per (a) above shall be accepted by the Contractor, and their training shall be administered at the manufacturer's factory.

(c) On-the-Job Training

During the installation period, the Contractor shall accept trainees as per (a) above and shall give them on-the-job training at the sites where installation work is in progress.

(3) Language

For training to be administered in the IBTE and for training to be given in the Manufacturer's country, English shall be used.

(4) Text Book

The Contractor shall prepare all necessary text books for all trainees, and shall supply an additional 20% as spares.

(5) Cost

Salaries and wages of trainees, as well as expenses to be entailed for travel to and from the factory and their living expenses in the manufacturer's country, will be borne by the IBTE.

All other expenses shall be borne by the Contractor.

CHAPTER XII DOCUMENT AND REFERENCE

CHAPTER XII DOCUMENTS AND REFERENCES

12-1 General

This Chapter provides for technical documents and references to be submitted by the Tenderer and the Contractor.

12-2 Offering Documents

Technical documents to be submitted with the offer shall contain information on all items falling within the scope of this contract. Each document shall be submitted in five copies.

Such items shall include:

(1) System Design

Technical information concerning system design and its feasibility based on data shall be supplied together with at least the following drawings:

(a) Communications system schematic diagram;

(b) Power system schematic diagram;

(c) Routemaps and antenna heights.

(2) Data on Equipment and Materials

Technical information pertaining to equipment and materials shall be presented. Equipment specifications shall be prepared in the form appearing in Annex 1. Drawing shall also be prepared wherever necessary.

(3) Design of Towers

Design of towers shall be prepared together with necessary drawings.

(4) Staffing Schedule

The Contractor shall submit the appropriate staffing schedule of engineers, technicians, workmen and supervisors, classifying them into the installation and testing periods, respectively. This staffing schedule shall include, at least, the following items;

(a) Manufacturing schedule
(b) Shipping period
(b) Commencement of installation work
(d) Installation work period
(e) Test period

(5) Installation

Information concerning installation shall be presented. Especially, a clear description with drawings shall be presented for equipment layouts.

(6) Price Quotation

Statement shall be made in accordance with Annex 2. Total price shall be quoted for all kinds of obligations and liabilities, including associated work necessary for the completion of this project under the specifications hereby presented.

Furthermore, all details of individual prices of each unit, shall not only be for the specified items, but also for all related items.

12-3 Documents to be Approved

(1) The Contractor shall, on the earliest possible occasion after the signing of contract, submit information in full detail pertaining to design and installation, including workmanship, method of tests, and training to be administered, and shall have such information approved.

(2) Each document shall be submitted in five copies.

12-4 Instruction Manuals

(1) Manuals presenting detailed information required for operation and maintenance of the system shall be supplied. Such manuals shall be prepared severally for the system and each of its component equipment.

(2) Manuals shall cover the following items and shall be accompanied with necessary drawings, including circuit diagrams of equipment:

(a) Explanation of constitutions and functions.
(b) Description of characteristics.
(c) Instructions on operation and maintenance, including routine work, trouble shooting, and repairing.

(3) System manuals and equipment manuals necessary for maintenance of all systems under supervision, shall be supplied in five copies to each supervising station, and in one copy to each supervised station.

12-5 Text Books

Text books for the training mentioned in 11-2, (4) shall be provided prior to commencement of training.

12-6 Factory Inspection Data

Test data described in 10-3 (2) shall be presented. Five copies of such data for each equipment shall be submitted.

ANNEX AND DRAWING

ANNEX I DATA TO BE PRESENTED

The Tenderer shall submit data with the offer as follows:

(a) Equipment data shall be presented, summarizing in accordance with the attached form. (Description given in parentheses is an example.)

(b) Items which the Tenderer recognizes as necessary in addition to the listed ones, shall also be added.

(c) Explanatory data or drawings shall be presented whenever necessary.

(d) Data which are different for the respective stations, shall be presented, classified for each station.

(e) Size, weight, and power consumption of each equipment or bay shall be presented in a suitable list separate from the attached form.

(f) Summarized power consumption at initial stage and at 1984 for each station shall also be presented.

(g) Besides, estimated overall system performance and reliability shall be described.

1. Radio System

(a) Radio Repeater

(i) FM transmission band

Bandwidth	± _____ MHz
Selectivity	_____ dB attenuation at ± _____ MHz
Group delay	_____ mμs within nominal bandwidth
Amplitude characteristics	_____ dB " " "

(ii) Modulation (Telephone)

Frequency deviation	_____ kHz r.m.s./ch. test tone
Emphasis	(C.C.I.R. Rec. 275)

(iii) Modulation (Television)

Frequency deviation	_____ MHz p-p/1V p-p
Emphasis	(C.C.I.R. Rec. 405)

(iv) Radio frequency

Output power	_____ W (_____ dBm)
Receiver noise figure	_____ dB
Receiver threshold level	_____ dB
Spurious radiation	_____ dB relative to carrier level
Image suppression	_____ dB relative to nominal wanted signal level
Input VSWR	_____ within nominal bandwidth
Output VSWR	_____ " " "

(v) Intermediate frequency

Center frequency	_____ MHz
Input level	_____ V
Output level	_____ V
Input & output impedance	_____ ohms, unbalanced
Return loss	_____ dB within ± _____ MHz

(vi) Automatic gain control

IF output level variation	_____ dB for the input range of _____ to _____ dBm

(vii) Squelching and restoring

Adjustable range	Input of _____ to _____ dBm

(viii) Linearity

Modulator	____% with freq. deviation of ± ____ MHz p-p
Demodulator	____% " " " "

(ix) Baseband

Bandwidth	____to_____kHz
Input level	____dBr/ch. test tone
Output level	____dBr/ch. " "
Input & output impedance	____ohms, unbalanced
Return loss	____dB within baseband

(x) Videoband (Television)

Bandwidth	____Hz to _____MHz
Input & output level	____V p-p
Input & output impedance	____ohms, unbalanced
Return loss	____dB within videoband width

(b) Antenna System

(i) Antenna

Type	(____mφ parabolic antenna)
Isotropic gain	____dB at radio band center freq.
Front -to-back coupling	____dB relative to main beam gain
Horizontal directivity Vertical directivity	(Present pattern drawings.)
VSWR	____within the band of____ ____to_____MHz

(ii) Feeder

Type	(____mφ circular waveguide)
Standard piece length	____m
Loss per unit length	____dB/m
VSWR	____within the band of____ to____ MHz

(iii) Branching filter

Nominal branching bandwidth	± ____MHz
Branching band loss	____dB
Pass band loss	____dB
Selectivity	____dB attenuation at ± _____MHz

	Branching band VSWR	____within nominal branching band
	Pass band VSWR	____outside the band of ±____ MHz
(iv)	Hybrid or circulator	
	Pass loss	____dB
	Unwanted coupling loss	____dB
(v)	Space diversity	
	Type	(Mechanical in-phase linear adder at radio frequency controlled individually)
(vi)	Overall antenna system	
	VSWR	____within the band of____to ____MHz
	Ground level (m)	Present data in table, (including space diversity antenna)
	Antenna height (m)	
	Feeder length (m)	
	Feeder loss (dB)	

(c) Switching System

Continuity pilot frequency	____kHz
Noise detection band	±____kHz
Pilot failure detection level	Adjustable for -____ to -____dB
Switching noise level	Adjustable for S/N____to____dB
Operation time	____ms
Transfer time	____ms
Type of control signal	(Multi-frequency code)
Signal transmission band	____to____kHz

(d) Remote Supervisory & Control System

(i) Transmitter & receiver

FM bandwidth	±____MHz
Selectivity	____dB attenuation at ±____MHz
Frequency deviation	
order wire	____kHz r.m.s./ch. test tone
switching signal	____kHz r.m.s./one code frequency
supervisory & control signal	____kHz r.m.s./one code frequency

Radio output power _____W (_____dBm)

Receiver noise figure _____dB

Spurious radiation _____dB relative to carrier level

Image rejection _____dB relative to nominal wanted signal level

Squelching adjustable range Input of _____to ____dBm

Transmission band _____to ____kHz

(ii) Branching filter

Nominal branching bandwidth ± _____ MHz

Branching band loss _____dB

Selectivity _____dB attenuation at ± _____MHz

(iii) Order wire

Bandwidth _____to ____Hz

Sending level _____dBr/test tone

Receiving level _____dBr/test tone

Input & output impedance _____ohms, balanced

Signal-to-noise ratio _____dB for each hop

(iv) Switching signal

Sending level _____dBm/one code freq.

Receiving level _____dBm/one code freq.

(e) Sound Channel

(i) Frequency/attenuation distortion

Present drawings

(ii) Noise _____dB on a combination of transmitting and receiving

(iii) Linearity ± _____ dB at +_____dBm

(iv) Harmonic distortion _____dB at +_____dBm

(v) Crosstalk _____dB

(vi) Connection to line from the Origin

Input level (nominal) _____dBr

" " (adjustable range) _____dBr to _____dBr by____dB step

Output level (nominal)

" " (adjustable range) _____dBr to_____dBr by____dB step

Input and output impedance ____ohms, balanced

Return loss ____dB

2. Carrier Multiplex System

(a) Channel Translating Equipment

(i) Frequency/attenuation distortion

Average of 12 pairs

A combination of transmitting & receiving — Present drawings

A transmitting or a receiving

(ii) Carrier leak

Transmitting ____dBm0/ch. at GDF

Receiving ____dBm0/ch. at VDF

(iii) Linearity

Overall netloss deviation at input level 3.5 dB higher than nominal level ____dB

(iv) Amplitude limiting

Output level deviation at input level 20 dB higher than nominal level ____dB

(v) Noise

Total noise power ____pW in a combination of transmitting & receiving.

____pW in a transmitting only.

(vi) Crosstalk

Intelligible crosstalk ____dB

Unintelligible crosstalk ____dB

(vii) Voice frequency connection

Input level (nominal) ____dBr

(adjustable range) ____dBr to____dBr by ____dB steps

Input & output impedance ____ohms, balanced

Return loss ____dB

(viii) Basic group connection

Input level ____dBr

Output level ____dBr

Input & output impedance ____ohms, balanced

Return loss ____dB

(ix) Signalling

Signalling frequency ____Hz

Transmitting level ____dBm0

Transmitting type ____Tone-____-idle

Overall signalling distortion ____%

Also present measuring conditions.

(x) Group pilot

Pilot frequency ____kHz

Pilot sending level ____dBm0

(b) Group Translating Equipment

(i) Frequency/attenuation distortion

deviation within group freq. band ____dB at____to____kHz

deviation within channel frequency band ____dB

(ii) Carrier leak

Transmitting ____dBm0/G at SGDF

Receiving ____dBm0/G at GDF

(iii) Noise

Total noise power ____pW in a combination of transmitting & receiving,____pW in a transmitting only.

(iv) Crosstalk

Intelligible crosstalk ____dB

(v) Basic group connection

Input level ____dBr

Output level ____dBr

Input & output impedance ____ohms, balanced

Return loss ____dB

(vi) Basic supergroup connection

Input level ____dBr

Output level ____dBr

Input & output impedance ____ohms, unbalanced

Return loss ____dB

(vii) Supergroup pilot

Pilot frequency ____kHz

Pilot sending level ____dBm0

(c) Supergroup Translating Equipment

(i) Frequency/attenuation distortion

deviation within supergroup frequency band ____dB at ____ to ____kHz

deviation group frequency band ____dB

deviation channel frequency band ____dB

(ii) Carrier leak

Transmitting ____dBm0/SG at output

Receiving ____dBm0/SG at SGDF

(iii) Noise

Total noise power ____pW in a combination of transmitting & receiving,
____pW in a transmitting only.

(iv) Crosstalk

Intelligible crosstalk ____dB

(v) Basic supergroup connection

Input level ____dBr

Output level ____dBr

Input & output impedance ____ohms, unbalanced

Return loss ____dB

(vi) Baseband line frequency band connection

Input level ____dBr

Output level ____dBr

Input & output impedance ____ohms, unbalanced

(d) Frequency Generating Equipment

Master oscillator frequency accuracy

Pilot frequency accuracy

Carrier frequency purity ____dB

Pilot frequency purity ____dB

Switchover time ____ms

(e) Supergroup Level Regulating Equipment

(i) Deviation within transmission frequency band ____dB

(ii) Input & output impedance ____ohms, unbalanced

(iii) Return loss ____dB

(iv) Level adjusting range ±_____dB

(v) Total noise power _____pW

(f) Program Transmission Equipment

(i) Frequency/attenuation distortion

Present drawings

(ii) Noise ____dB on a combination of transmitting and receiving

(iii) Linearity ±_____dB at +_____dBm

(iv) Harmonic distortion _____dB at +____dBm

(v) Crosstalk ____dB

(vi) Connection to line from the origin

Input level (nominal) ____dBr

" " (adjustable range) _____dBr to_____dBr by____dB step

Output level (nominal)

" " (adjustable range) ____dBr to_____dBr by____dB step

Input and output impedance ____ohms, balanced

Return loss ____dB

(vii) Connection to the carrier transmission line

Input level ____dBr

Output level ____dBr

Input and output impedance ____ohms, balanced

Return loss ____dB

3. Cable System
- Coaxial Cable System -

(a) Repeater Equipment

(i) Gain/frequency characteristics of line equalizing amplifier — Present drawings

(ii) Range of repeaters section

Length ____km to____km by____steps

(iii) Connecting conditions of coaxial pair

- Output level ____dBr at____kHz and ____dBr at____kHz
Also present emphasis characteristics.
- Input and output impedance ____ohms, unbalanced
- Return loss — Present drawings in combination with characteristic impedance of coaxial pair.

(iv) Line frequency band connection (terminal repeater only)

- Input level ____dBr
- Output level ____dBr

(v) Input and output impedance ____ohms, unbalanced

(vi) Return loss ____dB

(vii) Line regulating function

- Pilot frequency ____and_____kHz
- Sending level ____dBm0
- Level regulating range ±____dB
- Deviation to nominal level after regulation ±____dB

(viii) Noise

Total noise power ____pW

(ix) Overload point of output level ±____dBm

(b) Additional Equipment
- Terminal Equipment -

(i) Gain/frequency characteristics of line equalizing amplifier — Present drawings

(ii) Range of repeaters section

Length ____km to____km by____steps

(iii) Connecting conditions of coaxial pair

- Output level ____dBr at ____kHz and

____dBr at____kHz

Also present emphasis characteristics.

- Input and output impedance ____ohms, unbalanced

- Return loss Present drawings in combination with characteristic impedance of coaxial pair.

(iv) Line frequency band connection (terminal repeater only)

- Input level ____dBr

- Output level ____dBr

Input and output impedance ____ohms, unbalanced

Return loss ____dB

(v) Line regulating function

- Pilot frequency ____and _____kHz

- Sending level ____dBm0

- Level regulating range ±_____dB

- Deviation to nominal level after regulation ±_____dB

(vi) Noise

Total noise power ____pW

(vii) Overload point of output level

±____dBm

- Intermediate Repeater Equipment -

(i) Gain/frequency characteristics of line equalizing amplifier Present drawings

(ii) Range of repeater section

Length ____ km to ____ km by _____ steps

(iii) Connecting conditions of coaxial pair

- Output level ____dBr at ____kHz and

____ dBr at____ kHz

- Input and output impedance _____ ohms, unbalanced

- Return loss — Present drawings in combination with characteristic impedance of coaxial pair.

(iv) Gain adjustable range

(according to temperature) _____ °C to ____ °C and ± _____ dB

(v) Noise

Total noise power ____ pW

(vi) Overload

Overload point of output level + ____ dBm

- Loaded Cable System -

(a) Cable

(i) Manufacturer's name and address _____

(ii) Factory length of cable _____

(iii) Type of quad _____

(iv) Resistance of conductor _____ Ω/km

(v) Mutual capacitance _____ pF/km

(vi) Capacitance unbalance _____ pF

(vii) Dielectric strength

(viii) Insulation resistance _____ MΩ /km

(b) Loading Coil

(i) Magnetic stability _____ %

(ii) Inductance _____ mH

(iii) Inductance tolerance _____ %

(iv) Effective resistance _____ Ω/mA x H

(v) Crosstalk _____ dB

(vi) Dielectric strength

(vii) Insulation resistance _____ MΩ

(c) End Repeater

(i) Maximum gain _____dB

(ii) Linearity

(iii) Attenuation/frequency distortion Present drawing

(d) Overall Loaded Cable System

(i) Transmission loss _____dB

(ii) Attenuation/frequency distortion Present drawing

(iii) Signal-to-crosstalk ratio _____dB

4. VFT System

Input impedance (DC telegraph leg) ____ohms

Output load impedance (-ditto-) ____ohms

Sending level to line per channel

(nominal) ____dBm

(adjustable range) ± ____ dB

Telegraph distortion to frequency drift ____%/Hz

Alarm control level ____dB below the nominal level

Output DC current

(nominal) ____mA

(adjustable range) ± ____ mA

Noise

Signal to noise ____dB at the receiving filter in a combination of transmitting and receiving

5. Power System
- Engine-generator -

The following is in case of Diesel engine-generator. In case of other type engine, the data similar to the following shall be presented.

(a) Diesel Engine _____

Manufacturer's name and address _____

Type of engine

Output at N.T.P. _____B. HP

Output at local conditions of the customer's country _____B. HP

Percent de-rating for engine _____%

Number of cylinders _____

Engine cycle of operation _____

Revolution speed _____RPM

Combustion chamber _____

Total displacement _____cc

Bore x stroke _____mm x_____mm

Mean effective pressure _____kg/cm^2

Maximum firing pressure _____kg/cm^2

Mean piston speed _____m/sec

Fuel consumption at full load _____g/kWh

" at 1/2 load _____g/kWh

Lubrication oil consumption _____g/B.HP.hr

Recommended lubrication oil _____

Sump capacity _____liter

Exhaust temperature at rated output _____°C

Type of governor _____

Starting motor _____

Number of starting motors _____

Supercharger is provided or not _____

Weight - Engine _____kg

- Generator & exciter _____kg

- Complete set _____kg

Complete set dimension _____m x _____m x _____m

(b) Generator

(i) Generator

Manufacturer's name & address _____

Rated voltage _____kV

Rated frequency _____Hz

Power factor _____

Rated output _____kVA

Rated current _____A

Efficiency _____%

Revolutional speed _____RPM

Type _____

Maximum temperature rise _____ °C

Means of lubrication _____

Type of lubricant and grade _____

Suitability for parallel operation _____

(ii) Exciter (to be filled in, where applicable)

Manufacturer's name & address _____

Type _____

Rated current _____ A

Rated voltage _____ V

Rated power _____ kW

Driving method _____

Revolution speed _____ RPM

Maximum temperature rise _____ °C

Means of lubrication _____

Type of lubricant & grade _____

Type of automatic voltage regulator _____

(iii) Overall characteristics of Generator set

Voltage regulation _____ %

Adjustable voltage range at full load _____ %

Adjustable voltage range at no-load _____ %

Waveform distortion at no-load _____ %

(iv) Starting battery _____

Manufacturer's name & address _____

Type

Nominal voltage per cell _____ V DC

Terminal voltage of battery bank when floating _____ V DC

Number of cells _____

Nominal capacity _____ Ah/10hr

Nominal charging current _____ A

Final discharge voltage per cell _____V DC

Specific gravity of electrolyte at fully charged condition & at 25°C _____

Weight per cell _____kg

(v) Battery charging device

Manufacturer's name & address _____

Type _____

Input:

Voltage _____V AC

Number of phases & wires _____ , _____wire

Power consumption at rated output _____kVA

Output:

Voltage _____V DC

At automatic voltage regulation _____V DC

Rated current _____A

Type & method of voltage co compensator _____

Dimension & weight _____m x ____m x _____m, _____kg

- Storage battery & Battery charger -

(a) Storage Battery

Manufacturer's name & address _____

Type _____

Nominal voltage per cell _____V DC

Terminal voltage of battery bank when floating _____V DC

Number of cells _____

Nominal capacity _____Ah/10 hr

Normal charging current _____A

Final discharge voltage per cell _____A

Specific gravity of electroyte at fully charged condition at 25°C_____

Weight per cell _____kg

(b) Battery Charger

Manufacturer's name & address _____

Type of rectifier _____

Input:

Voltage _____V

Number of phases _____

Power consumption at rated output _____kVA

Output:

Voltage _____V DC

At automatic voltage regulation _____V DC

Rated current _____A

Type & method of voltage compensator _____

Dimension _____ m x_____m x_____m

Weight _____kg

ANNEX 2 FORM OF PRICE QUOTATION

1. Gross Price

Gross price schedule shall be quoted, listing in accordance with FORM A attached.

2. Breakdown of Price Schedule

The Tenderer is requested to quote a breakdown of the price schedule in FORM A, compiled in the table whose the standard form is given as FORM B.

Quotation shall be made in such a manner that the cost for increase or decrease of the quantity, or for the future expansion, can be estimated easily.

Further, FORM B shall correspond to those in Column (iii) of FORM A. The relationship between FORM A and FORM B shall be clearly stated.

ITEMIZED PRICE SCHEDULE

FORM-A Sheet 1

Tender No.

Item No.	Description	Cost for Delivery at CIF Port	Remarks
1	MICROWAVE SYSTEM		
1.1	Microwave Equipment		
1.2	Measuring Equipment & Tools		
1.3	Installation Material		
1.4	Material for Towers		
1.5	(SUB TOTAL)		
2	MULTIPLEX SYSTEM		
2.1	Multiplex Equipment		
2.2	Measuring Equipment & Tools		
2.3	Installation Material		
2.4	(SUB TOTAL)		
3	CABLE SYSTEM		
3.1	Cable & Cable Equipment		
3.2	Measuring Equipment & Tools		
3.3	Installation Material		
3.4	(SUB TOTAL)		
4	VFT SYSTEM		
4.1	VFT Equipment		
4.2	Measuring Equipment & Tools		
4.3	Installation Material		
4.4	(SUB TOTAL)		
5	POWER EQUIPMENT		
5.1	Engine-generator Set		
5.2	Rectifier Set		
5.3	Battery		
5.4	Measuring Equipment & Tools		
5.5	Installation Material		
5.6	(SUB TOTAL)		

Continued :

Item No.	Description	Cost for Delivery at CIF Port	Remarks
6	TRAINING EXPENSE		
6.1	Factory Training		
6.2	Job and Theoretical Training		
6.3	(SUB TOTAL)		
7	TOTAL FOR ITEMS 1-5		
8.	OPTIONAL GOODS		
8.1	Microwave System		
8.2	Multiplex System		
8.3	Cable System		
8.4	VFT System		
8.5	Power System		
8.6	(SUB TOTAL)		

THE IBTE RESERVES THE RIGHT TO INCREASE OR DECREASE THE QUANTITY AT THE UNIT RATES QUOTED ABOVE.

Name & Addres _____

of Tenderer _____

Grand Total except for Options based on the above items: _____

(In words: Ethiopian Dollar _____)

Signature of Tenderer:

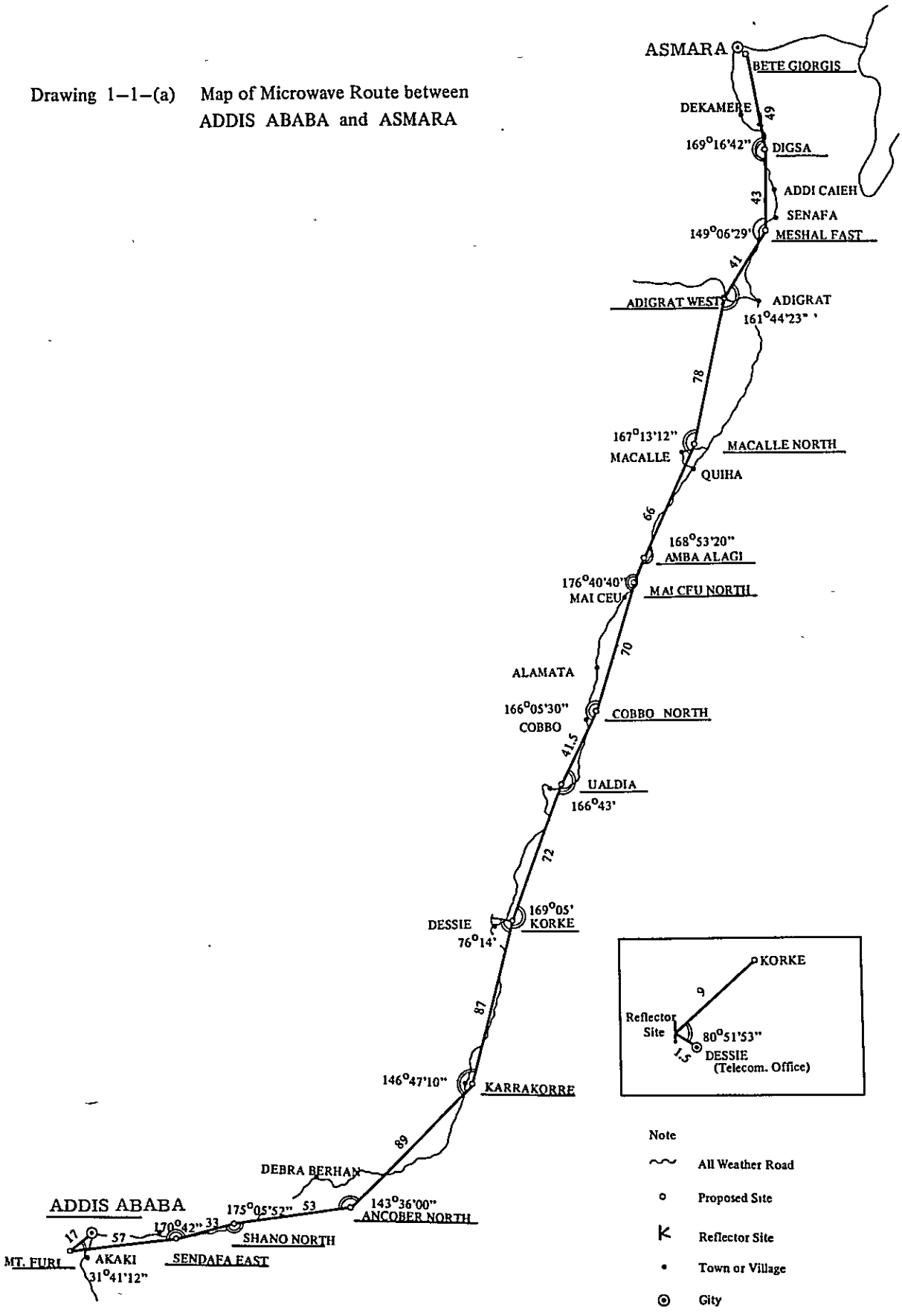
Date : _____

DETAILED PRICE SCHEDULE

FORM -B

Station		A STATION		B STATION		- - - -		- - - -		TOTAL	
Item	Unit Price	Q'ty	Total Price	Q'ty	Total Price	Q'ty	Total Price	Q'ty	Total Price	Q'ty	Total Price

Drawing 1–1–(a) Map of Microwave Route between ADDIS ABABA and ASMARA

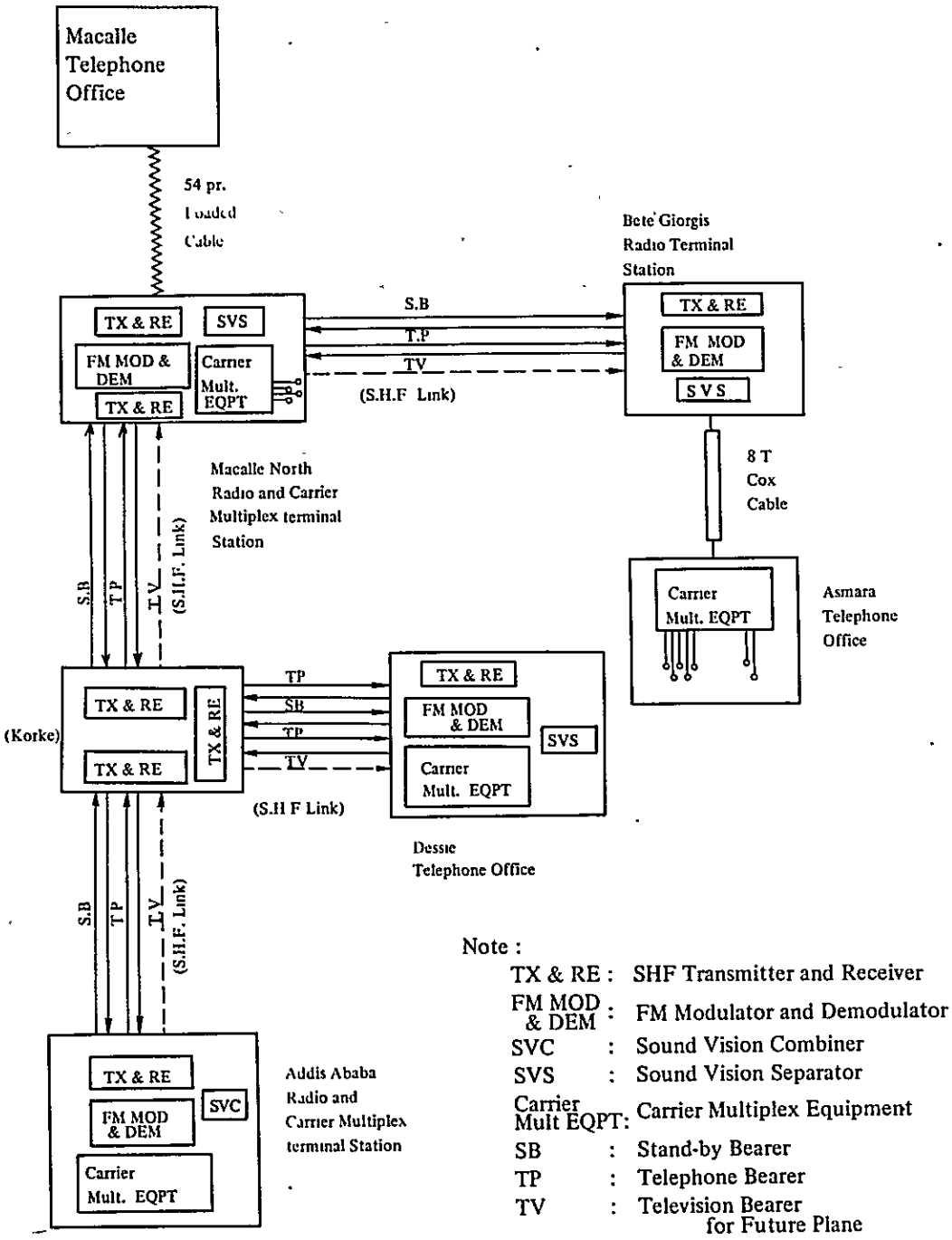


Drawing 1–1–(b) Location and Altitude of the Site and Hop Distance

Site	Latitude (° ' ")	Longitude (° ' ")	Altitude (m)	Hop Distance (km)
ADDIS ABABA * (Head Quarter)	9.01.38 N	38.45.25 E	2400	17
MT. FURI	8.52.30 N	38.42.10 E	2800	57
SENDAFA EAST*	9.10.08 N	39.08.09 E	2950	33
SHANO NORTH*	9.22.02 N	39.21.29 E	3050	53
ANCOBER NORTH	9.40.30 N	39.44.30 E	3600	89
KARRAKORRE*	10.26.50 N	39.57.30 E	1910	87
KORKE	11.11.20 N	39.42.00 E	2600	72
UALDIA	11.50.30 N	39.36.40 E	2430	41.5
COBBO NORTH*	12.13.00 N	39.39.38 E	1510	70
MAI CEU NORTH*	12.50.33 N	39.34.10 E	3260	14.5
AMBA ALAGI	12.58.10 N	39.32.40 E	3120	66
MACALLE NORTH	13.34.30 N	39.32.20 E	2360	78
ADIGRAT WEST	14.15.10 N	39.20.00 E	2830	41
MESHAL EAST	14.37.10 N	39.24.30 E	2540	43
DIGSA	14.58.10 N	39.14.10 E	2210	49
BETE GIORGIS	15.20.30 N	38.58.10 E	2460	
KORKE	11.11.20 N	39.42.00 E	2600	9
DESSIE (Reflector Site)	11.07. N	39.37 E	2700	1.5
DESSIE (Telecom. Office)	11.07.30 N	39.37.10 E	2528	

Note 1: Figures of latitude, longitude and hop distance were presumed by the maps on scale 1 to 500,000

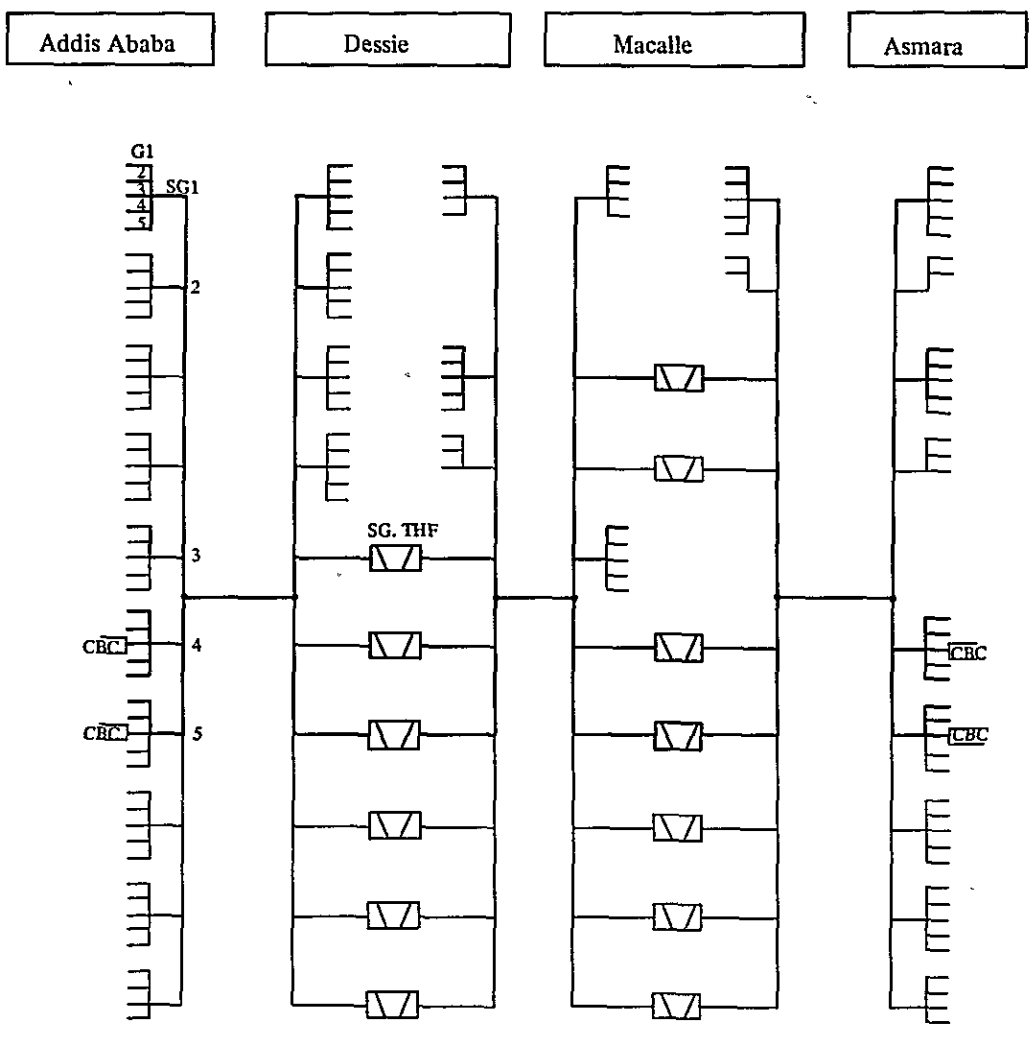
Note 2: * New Site



Note :

TX & RE	:	SHF Transmitter and Receiver
FM MOD & DEM	:	FM Modulator and Demodulator
SVC	:	Sound Vision Combiner
SVS	:	Sound Vision Separator
Carrier Mult EQPT	:	Carrier Multiplex Equipment
SB	:	Stand-by Bearer
TP	:	Telephone Bearer
TV	:	Television Bearer for Future Plane

Drawing 1.2 Network Plan

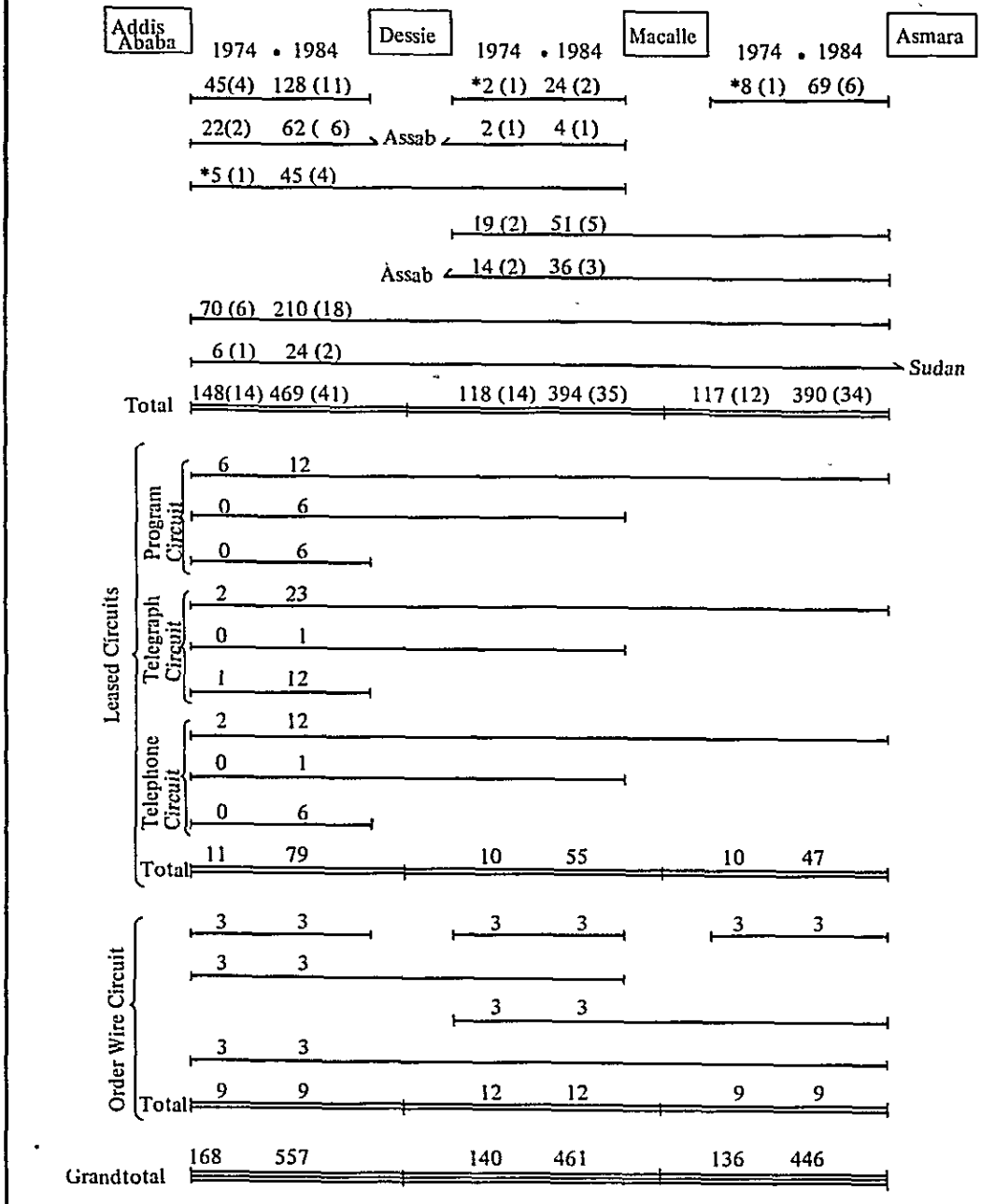


(Note)(1) Thick line means circuits in 1974. Thin line means circuit in 1984.

(2) CBC Accommodates one program transmission circuit and 9 telephone channels.

(3) G : Group Translating Equipment
SG : Super-Group Translating Equipment
SGTHF : Super-Group Through Filter Equipment

Network Plan	
	Drawing 1–3 (a)

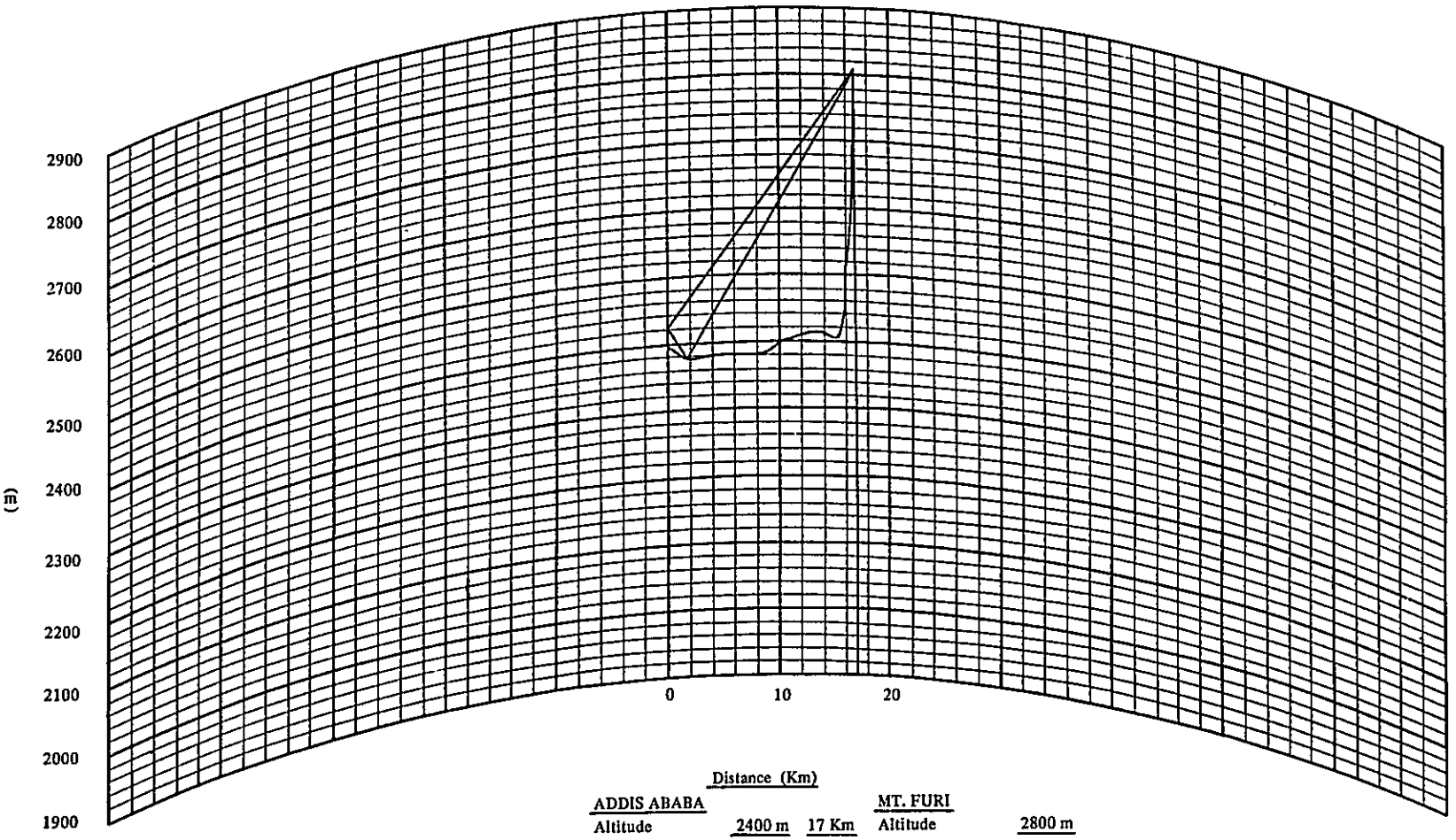


(Note) (1) * : Number of Circuits by Operator Dial at Macalle in 1974.
(2) Program and Telegraph Circuits is converted to Telephone Circuits.
(3) Showing in Parentheses Group Numbers

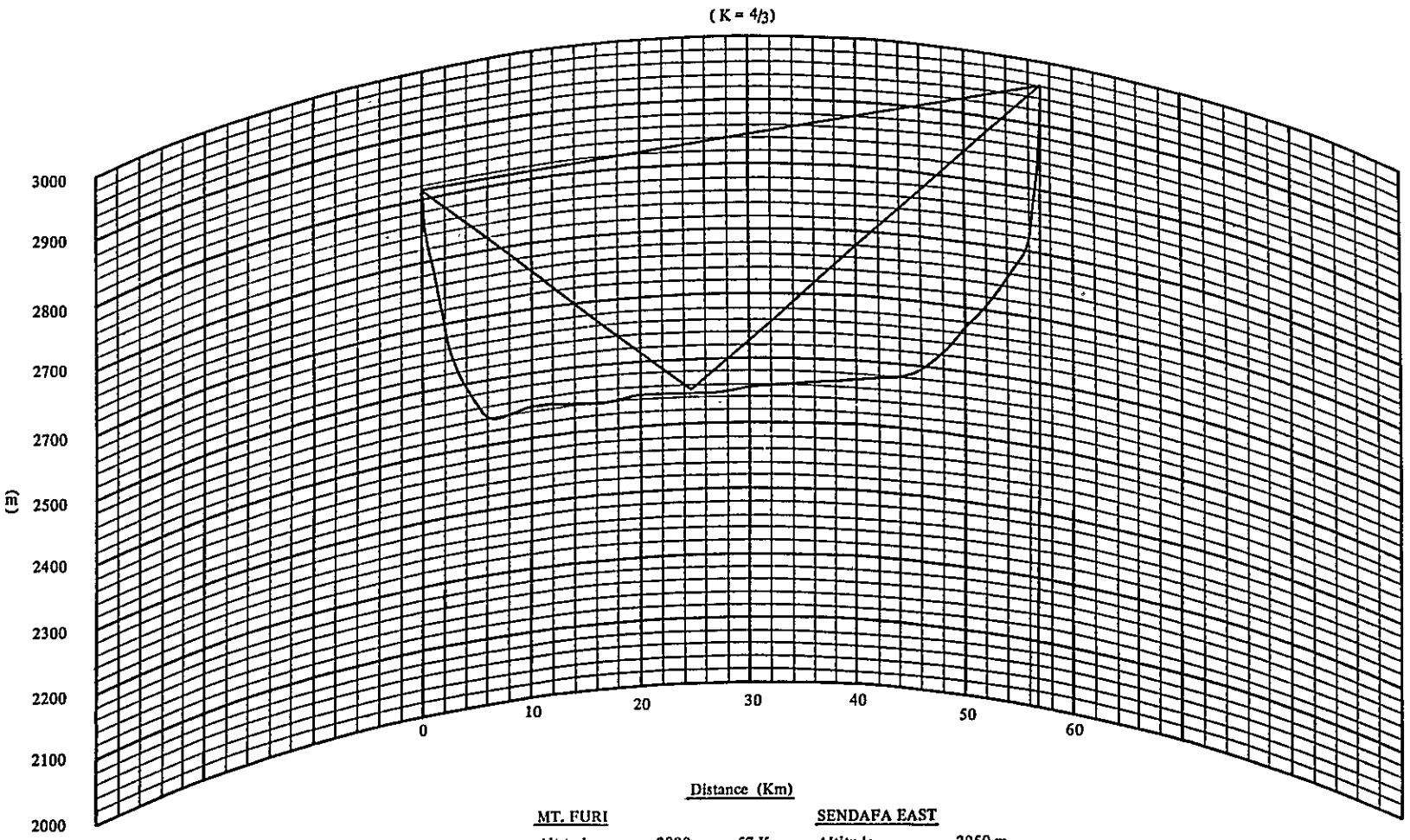
Network Plan	
	Drawing 1–3 (b)

Drawing 2–1 PROFILE MAP

(K =4/3)

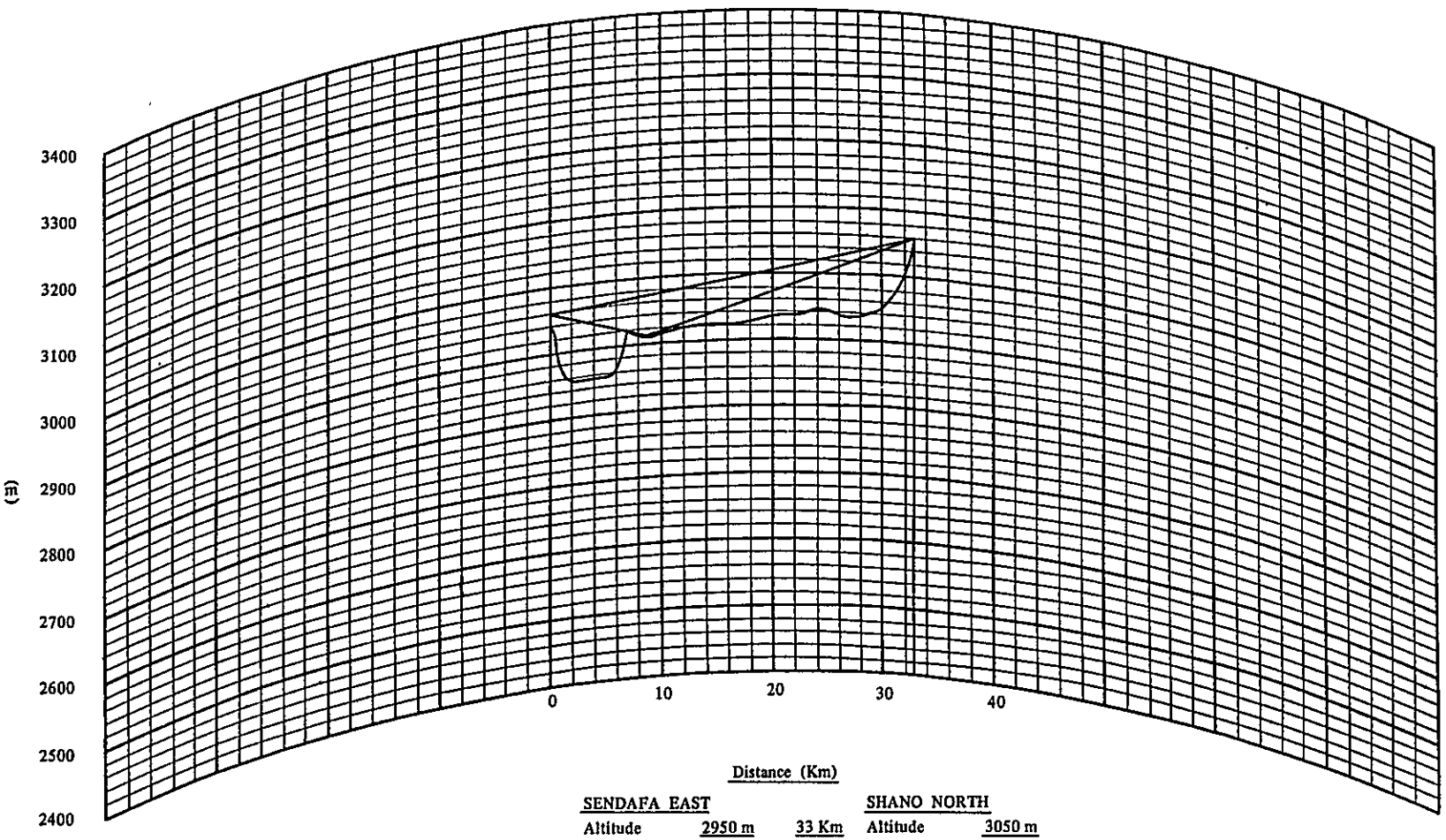


Drawing 2–2 PROFILE MAP



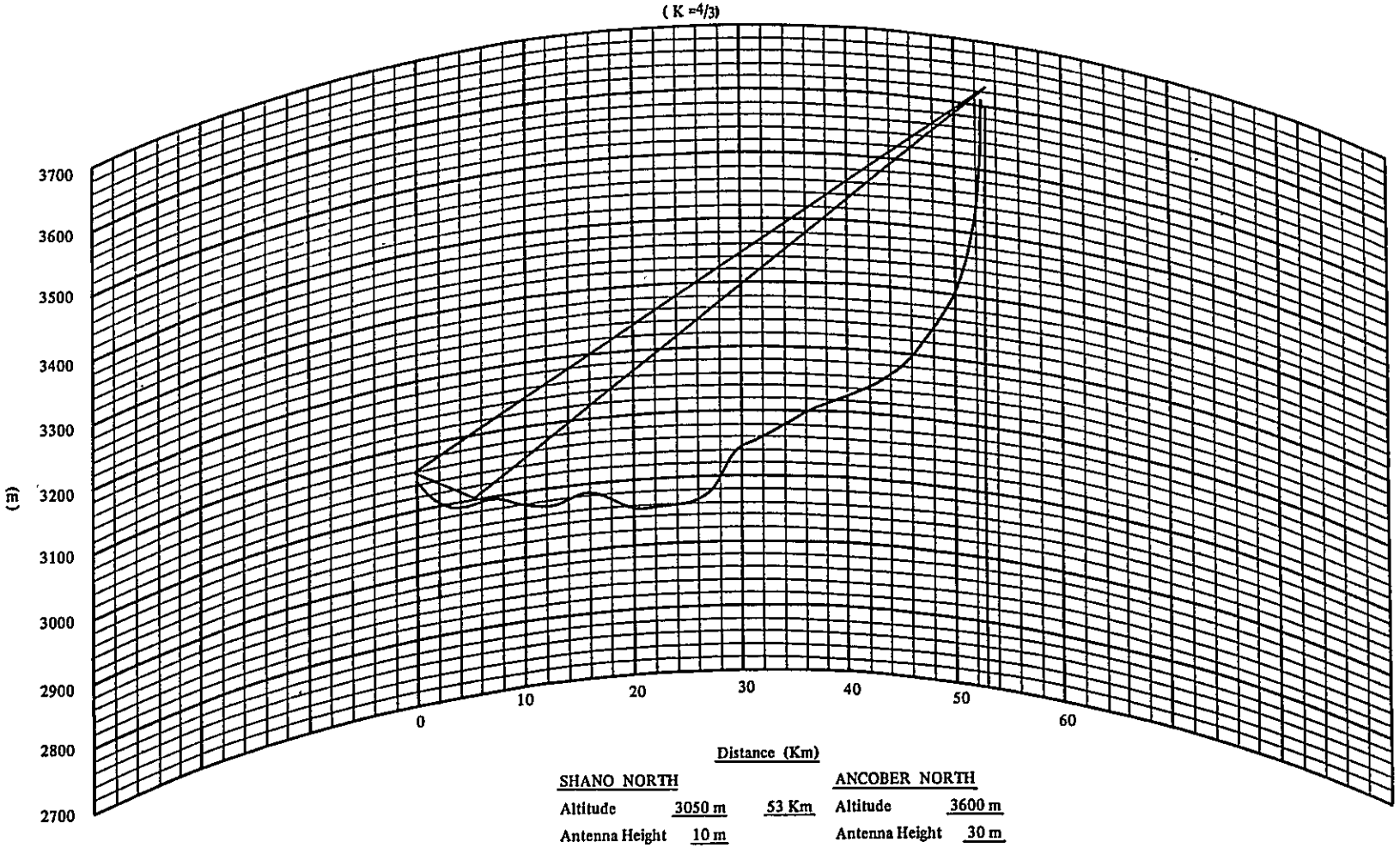
Drawing 2–3 PROFILE MAP

(K =4/3)



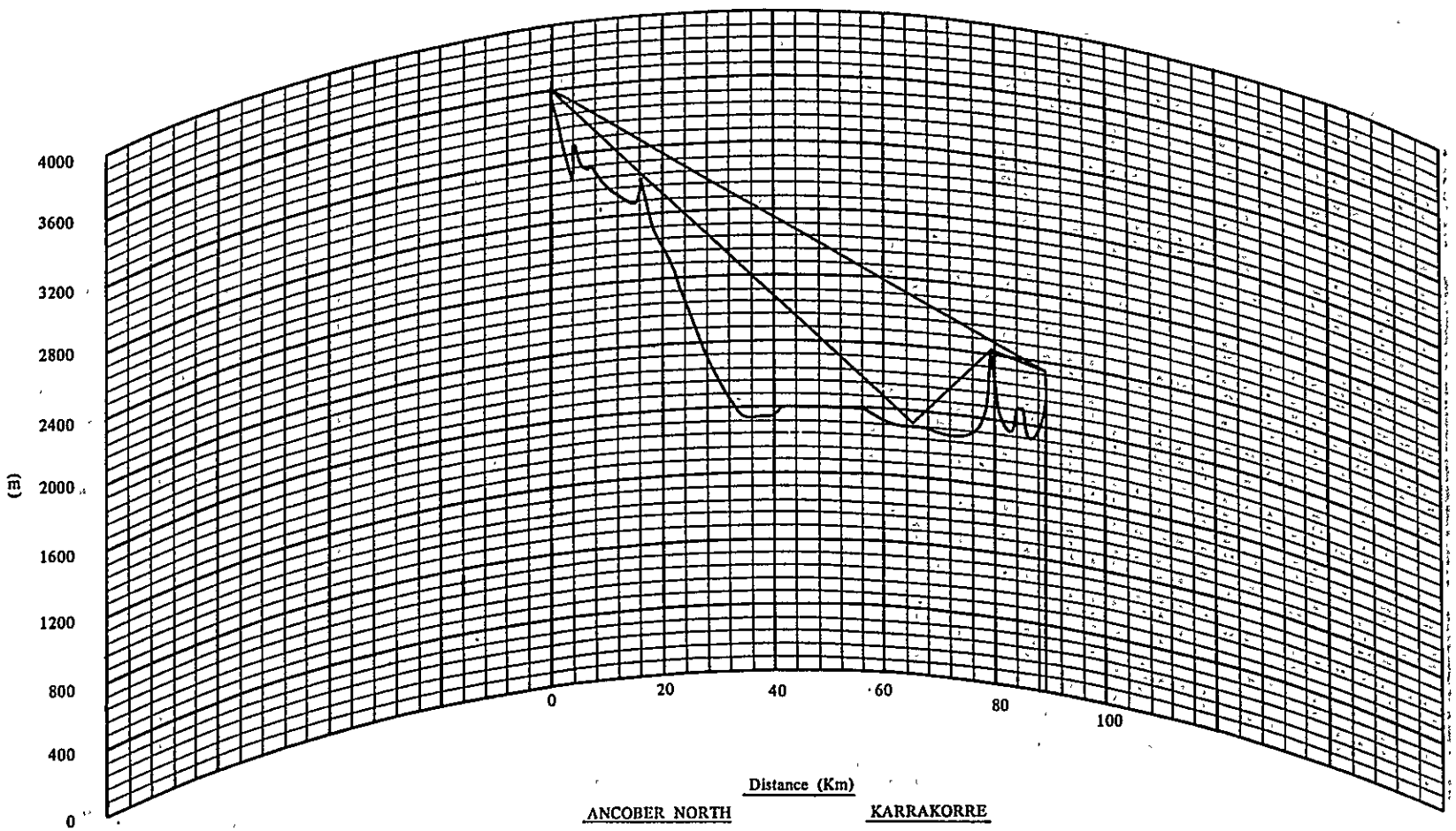
SENDAFA EAST			SHANO NORTH	
Altitude	2950 m	33 Km	Altitude	3050 m
Antenna Height	10 m		Antenna Height	10 m

Drawing 2–4 PROFILE MAP

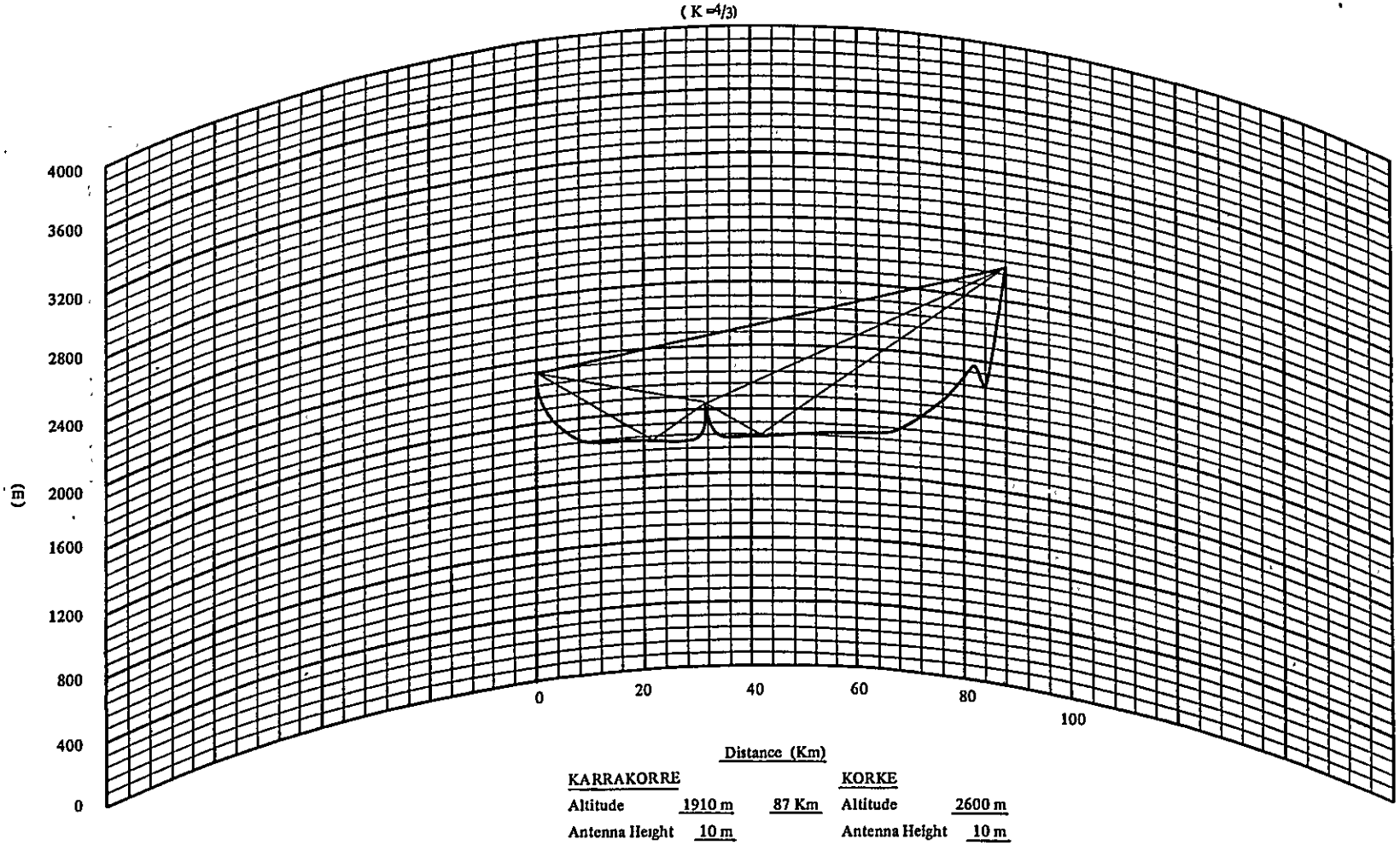


Drawing 2–5 PROFILE MAP

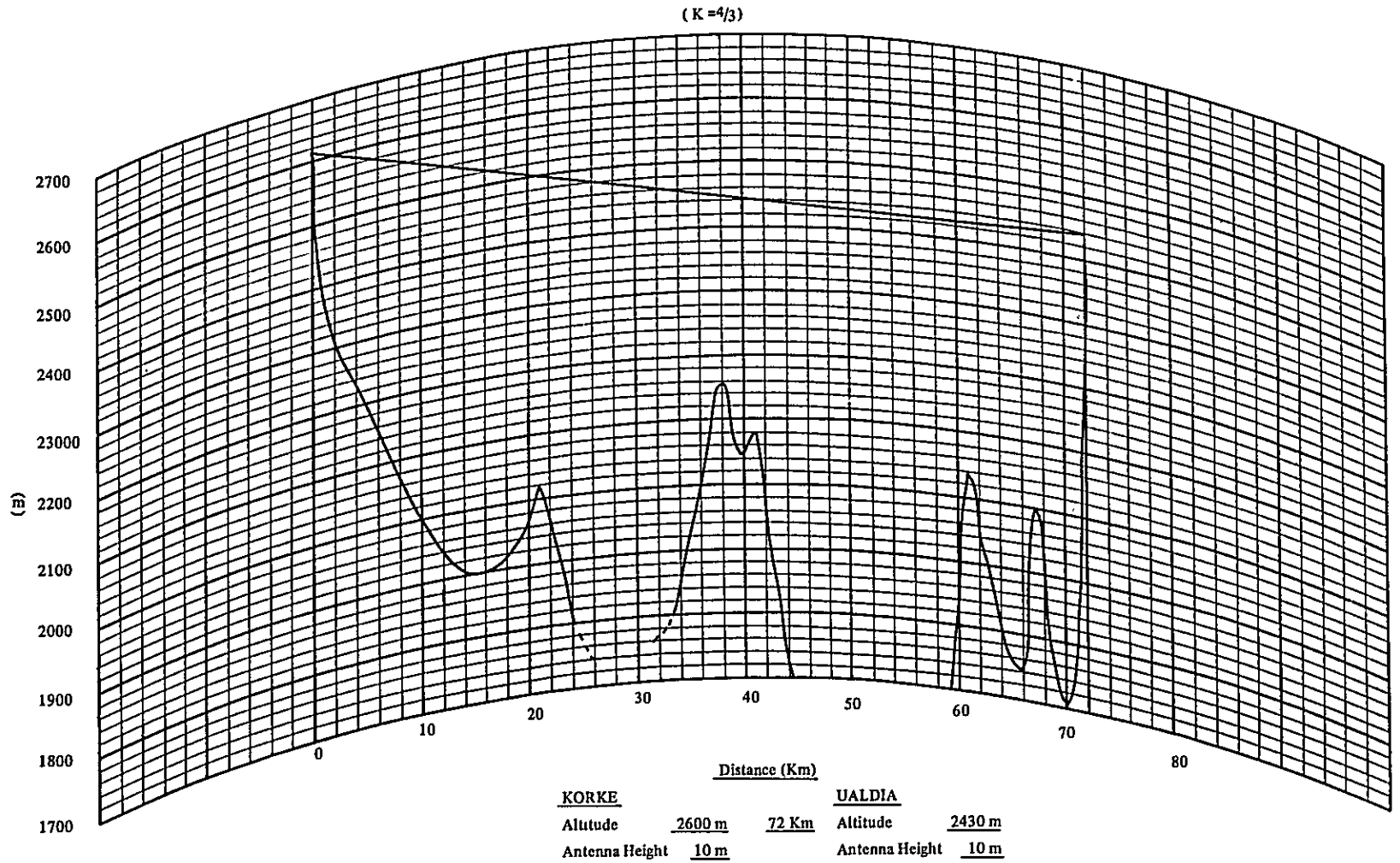
(K =4/3)



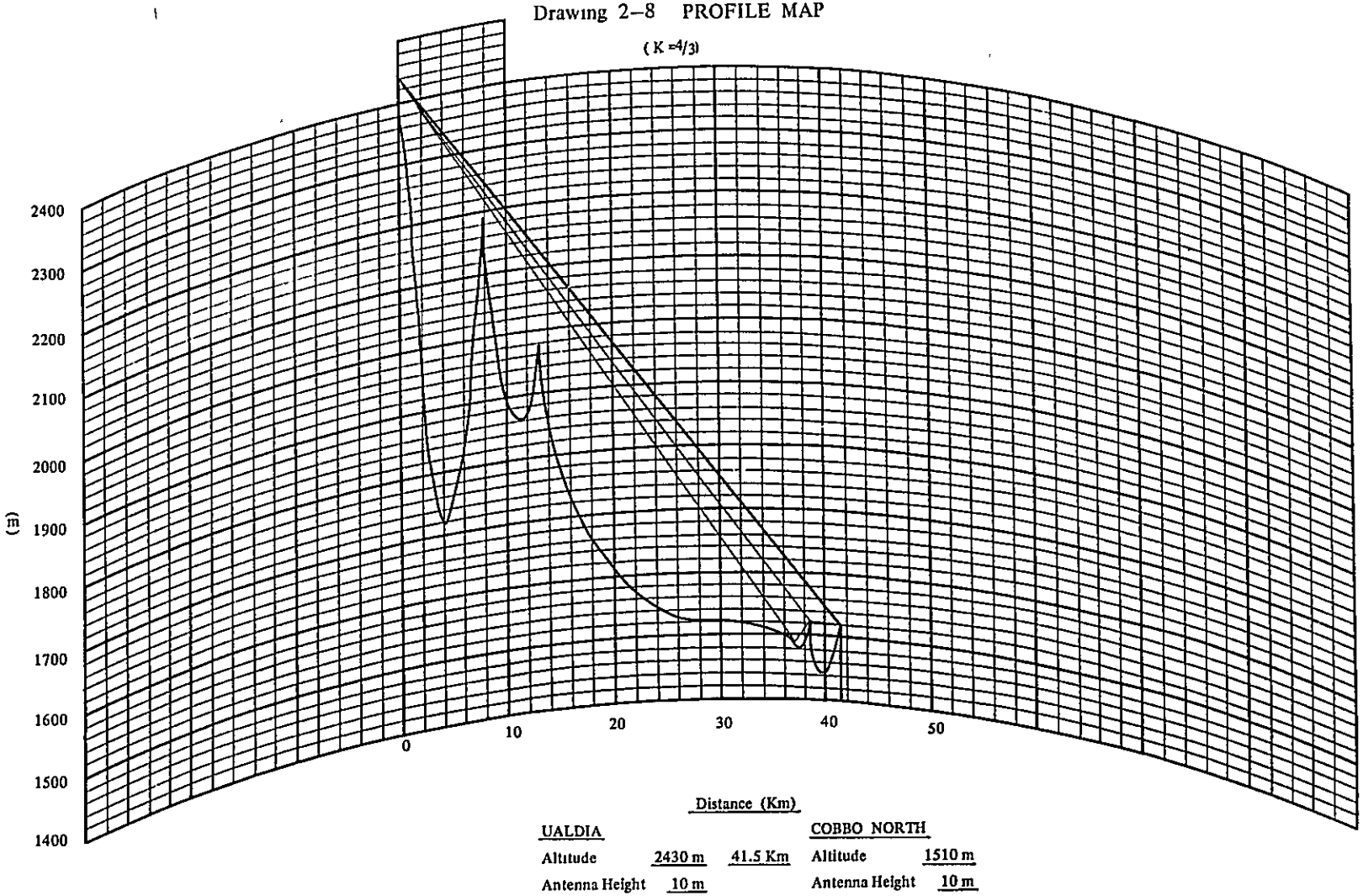
Drawing 2–6 PROFILE MAP



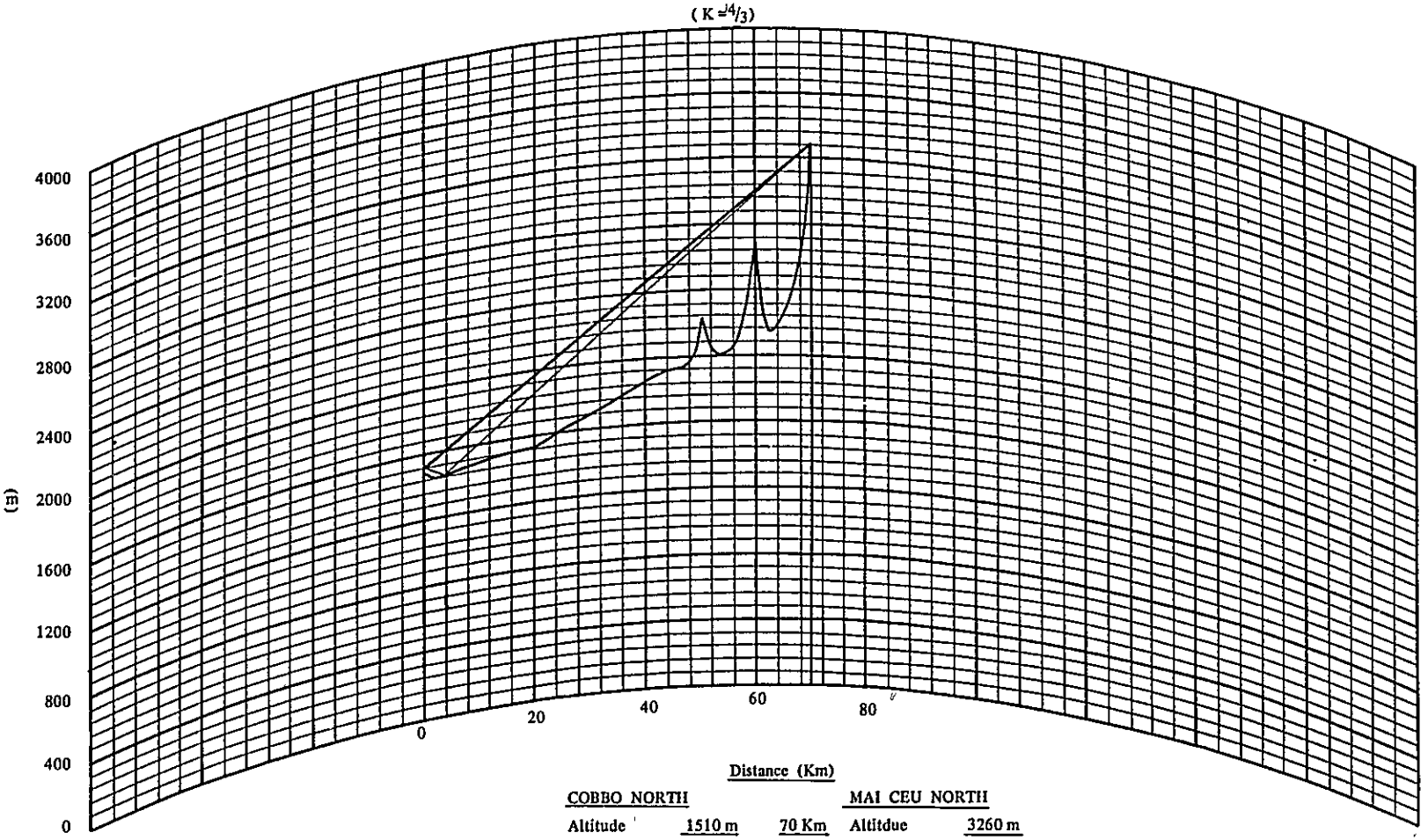
Drawing 2–7 PROFILE MAP



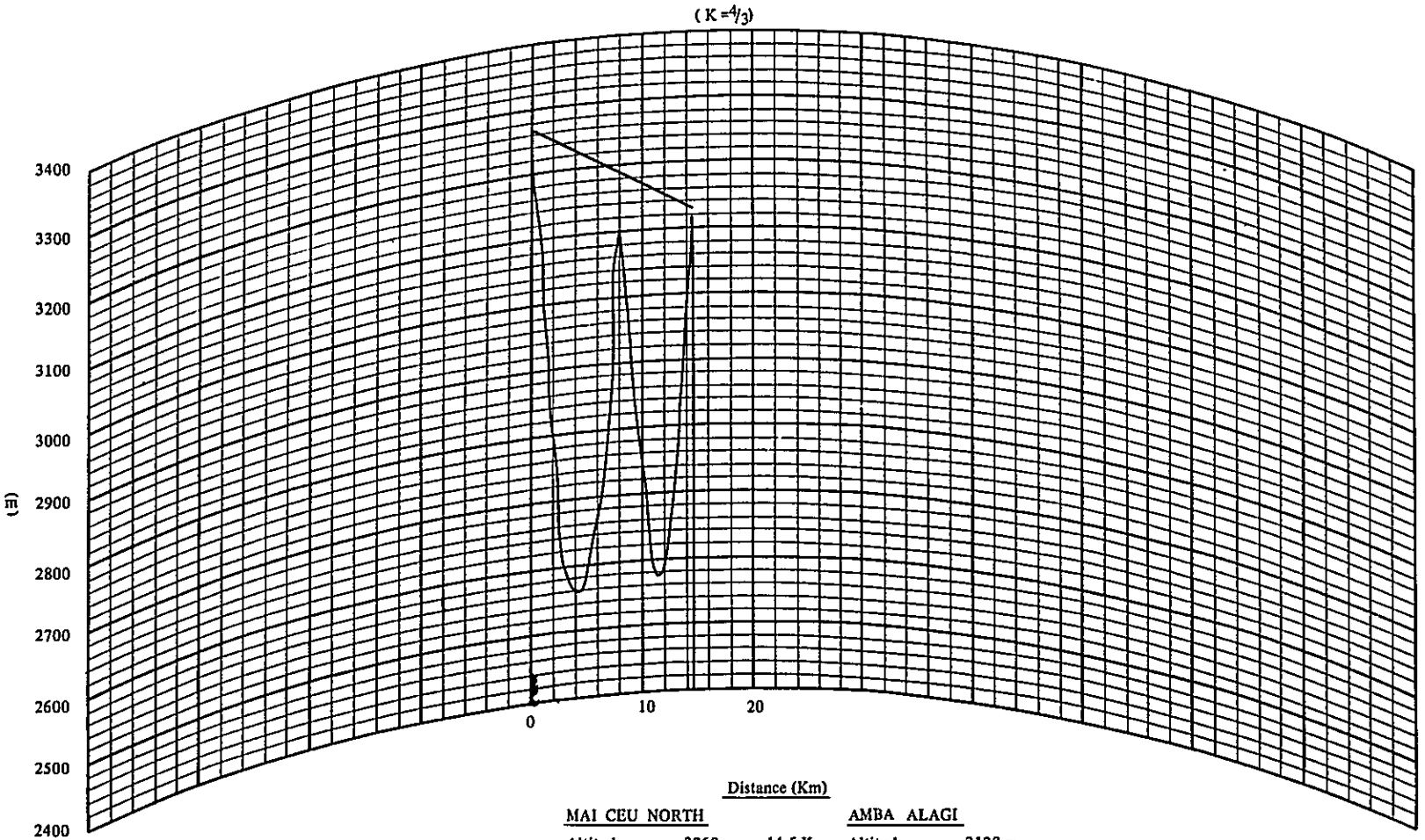
Drawing 2–8 PROFILE MAP



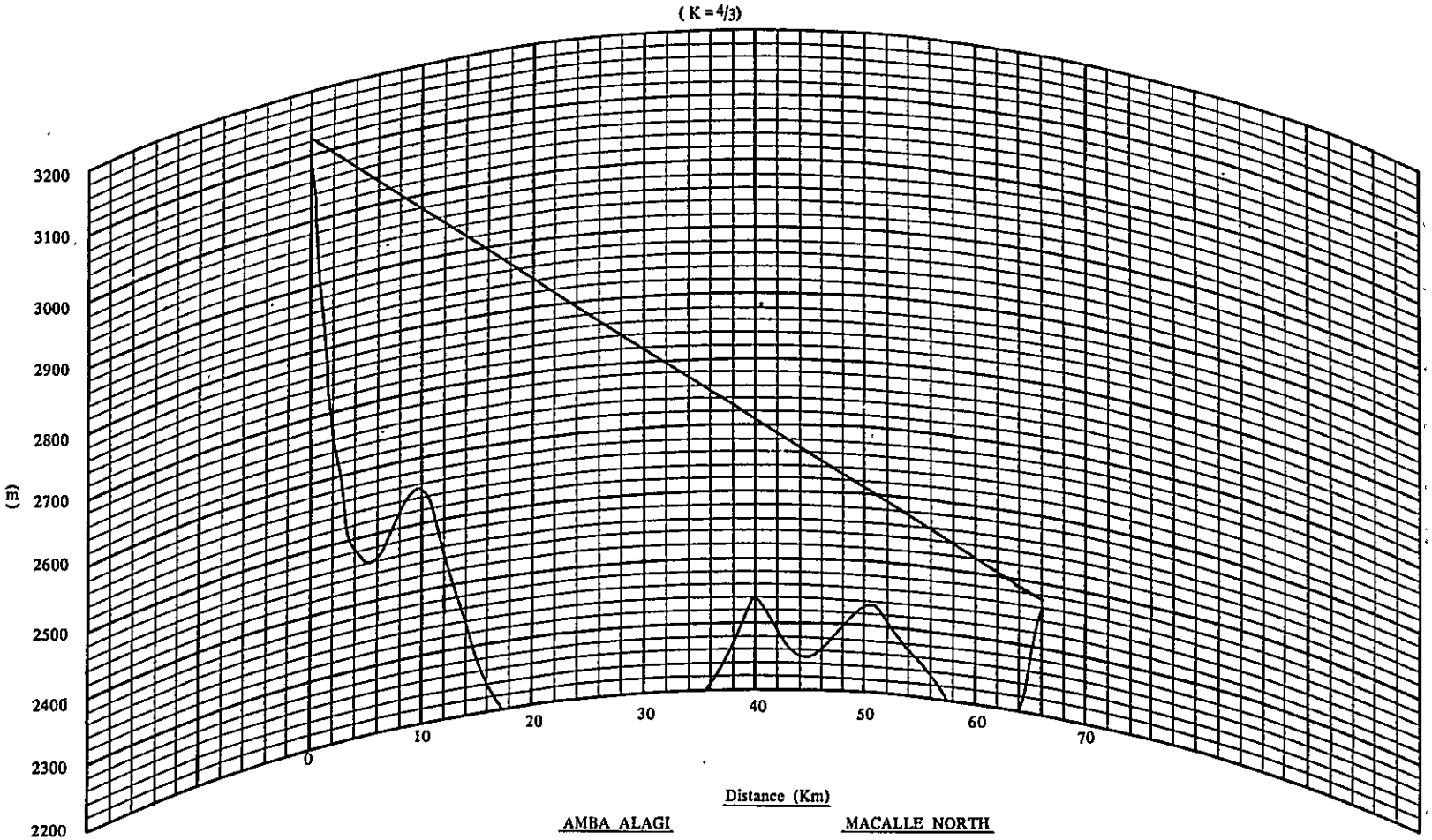
Drawing 2–9 PROFILE MAP



Drawing 2–10 PROFILE MAP



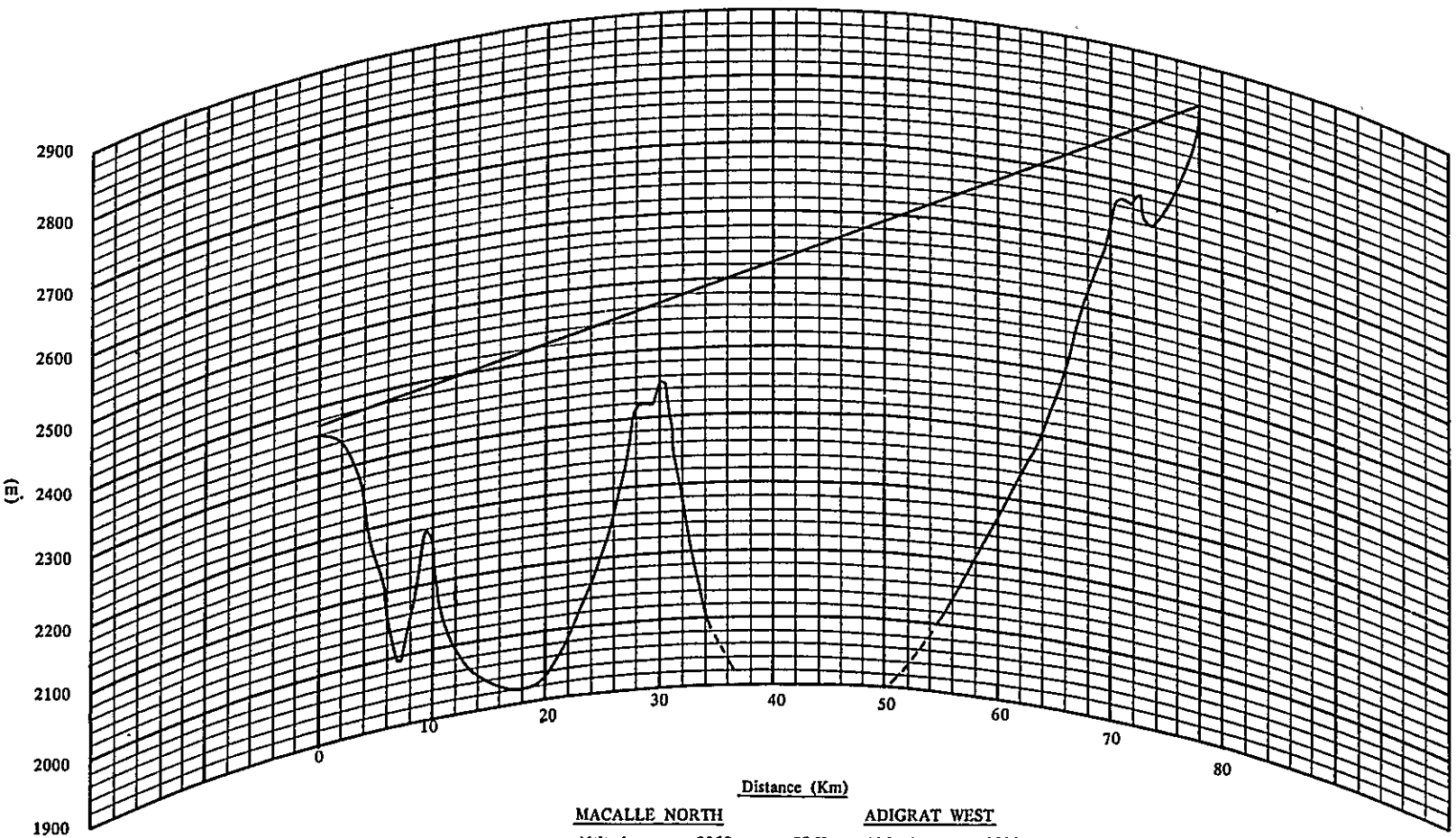
Drawing 2–11 PROFILE MAP



AMBA ALAGI			MACALLE NORTH	
Altitude	3120 m	66 Km	Altitude	2360 m
Antenna Height	10 m		Antenna Height	10 m

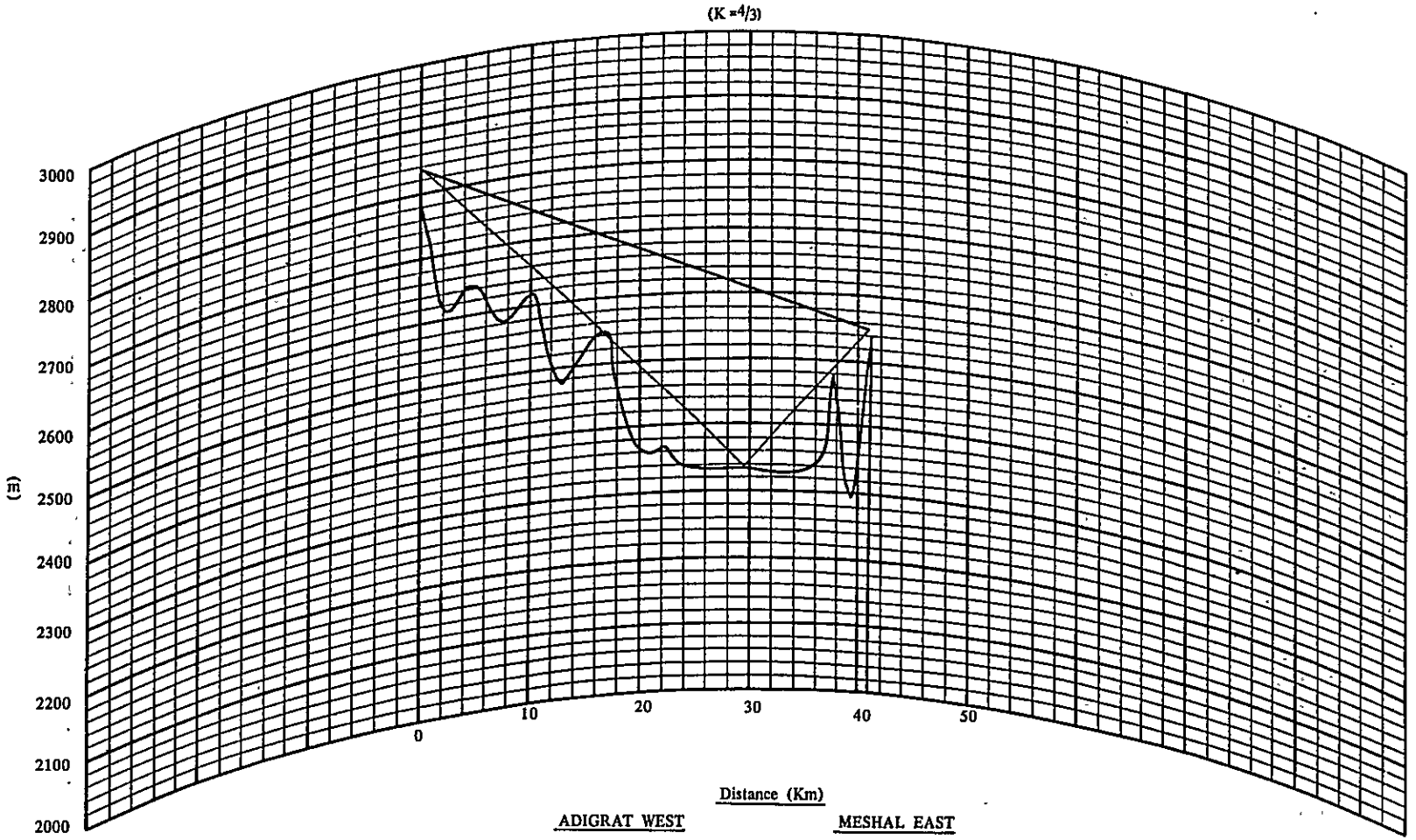
Drawing 2–12 PROFILE MAP

(K = 4/3)

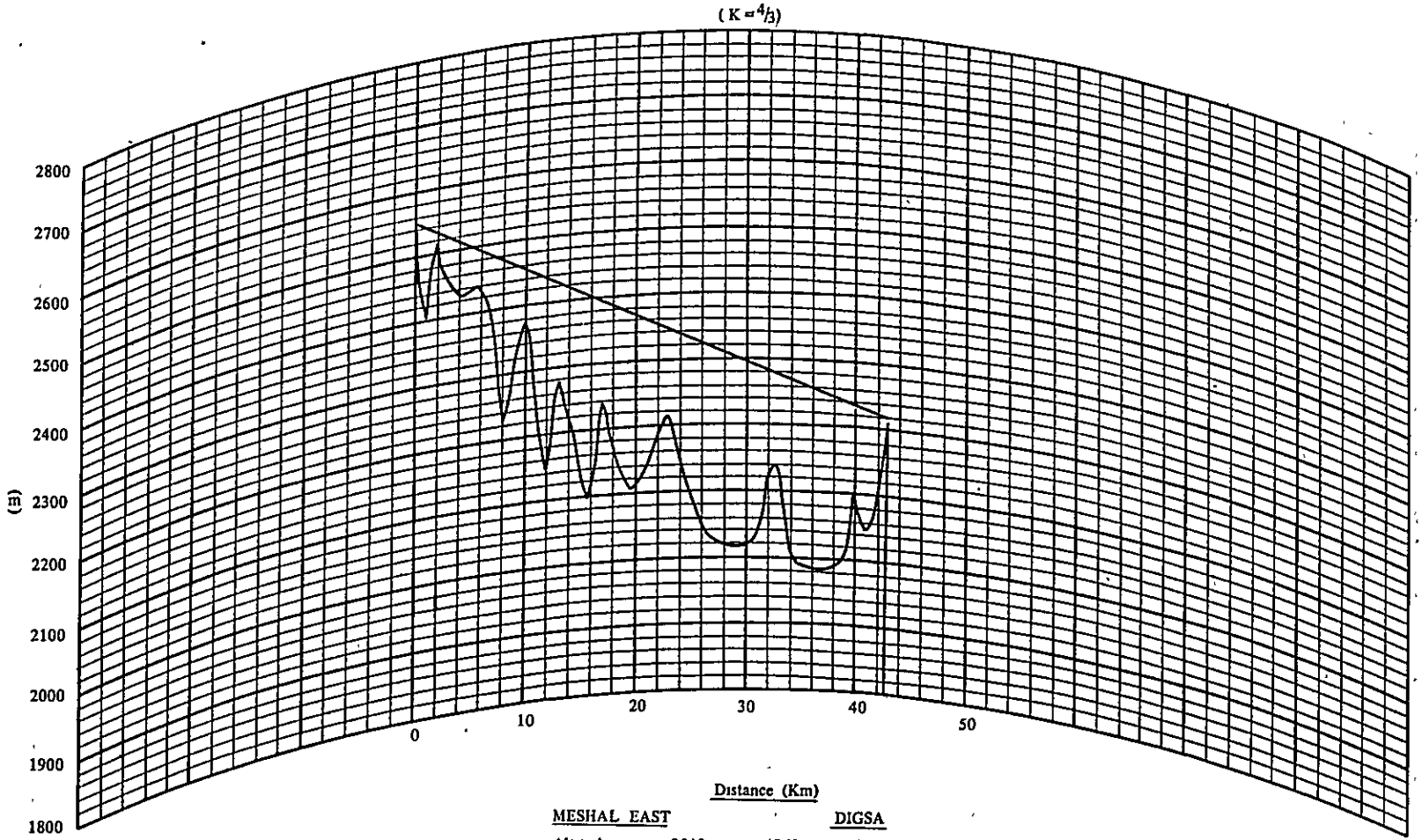


MACALLE NORTH			ADIGRAT WEST	
Altitude	2360 m	78 Km	Altitude	2830 m
Antenna Height	10 m		Antenna Height	10 m

Drawing 2–13 PROFILE MAP

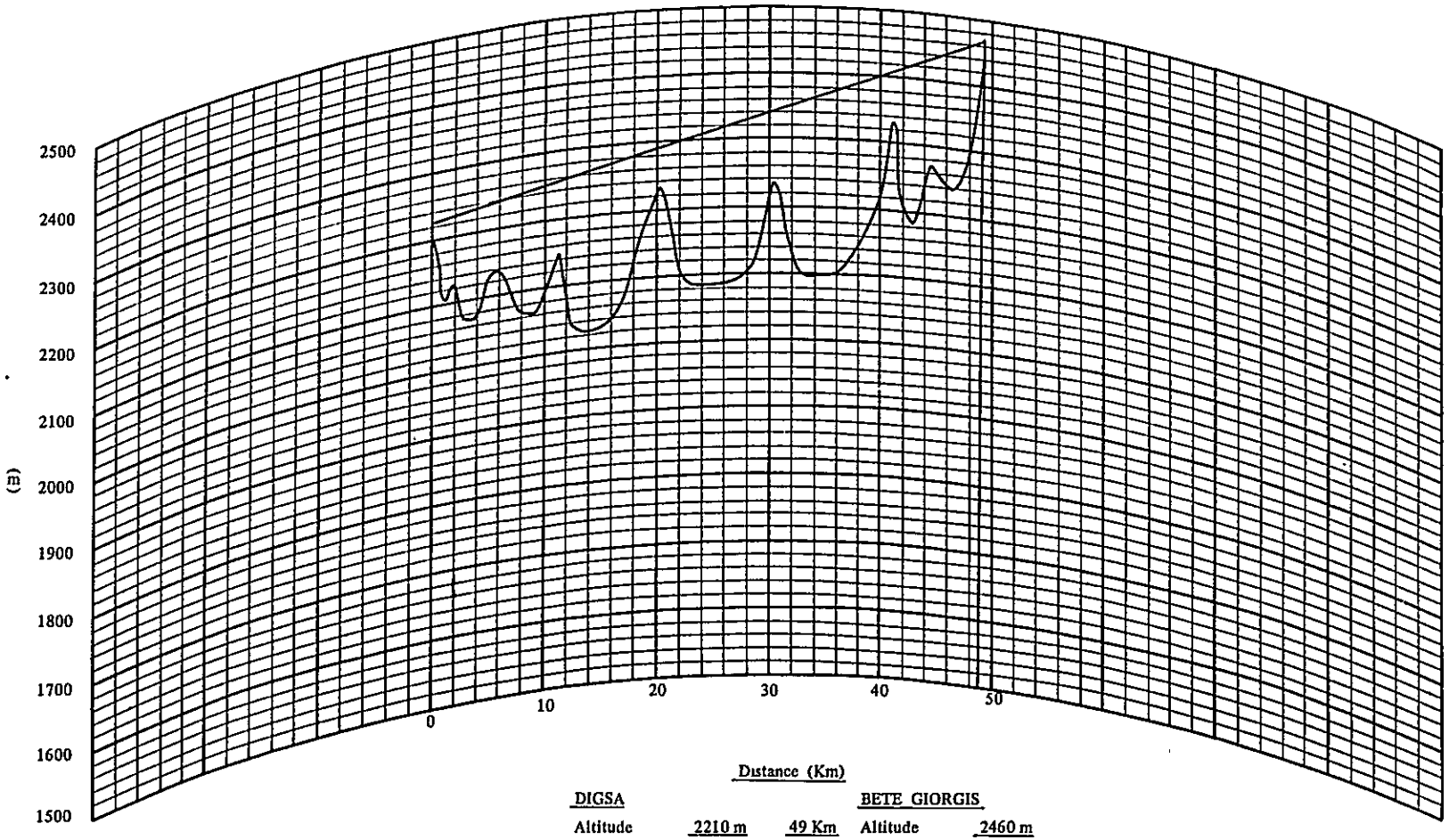


Drawing 2--14 PROFILE MAP



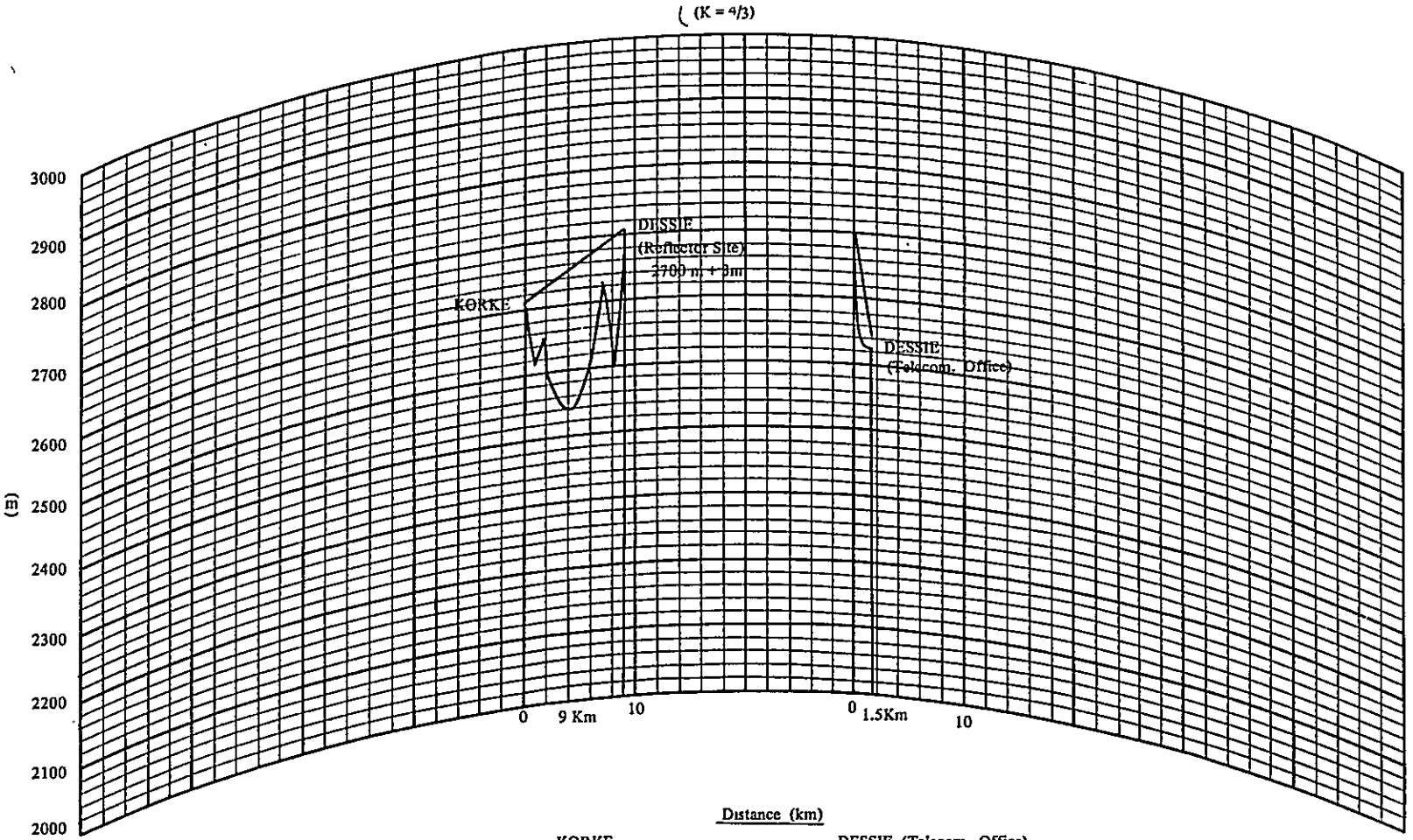
Drawing 2–15 PROFILE MAP

(K = 4/3)



DIGSA			BETE GIORGIS	
Altitude	2210 m	49 Km	Altitude	2460 m
Antenna Height	10 m		Antenna Height	10 m

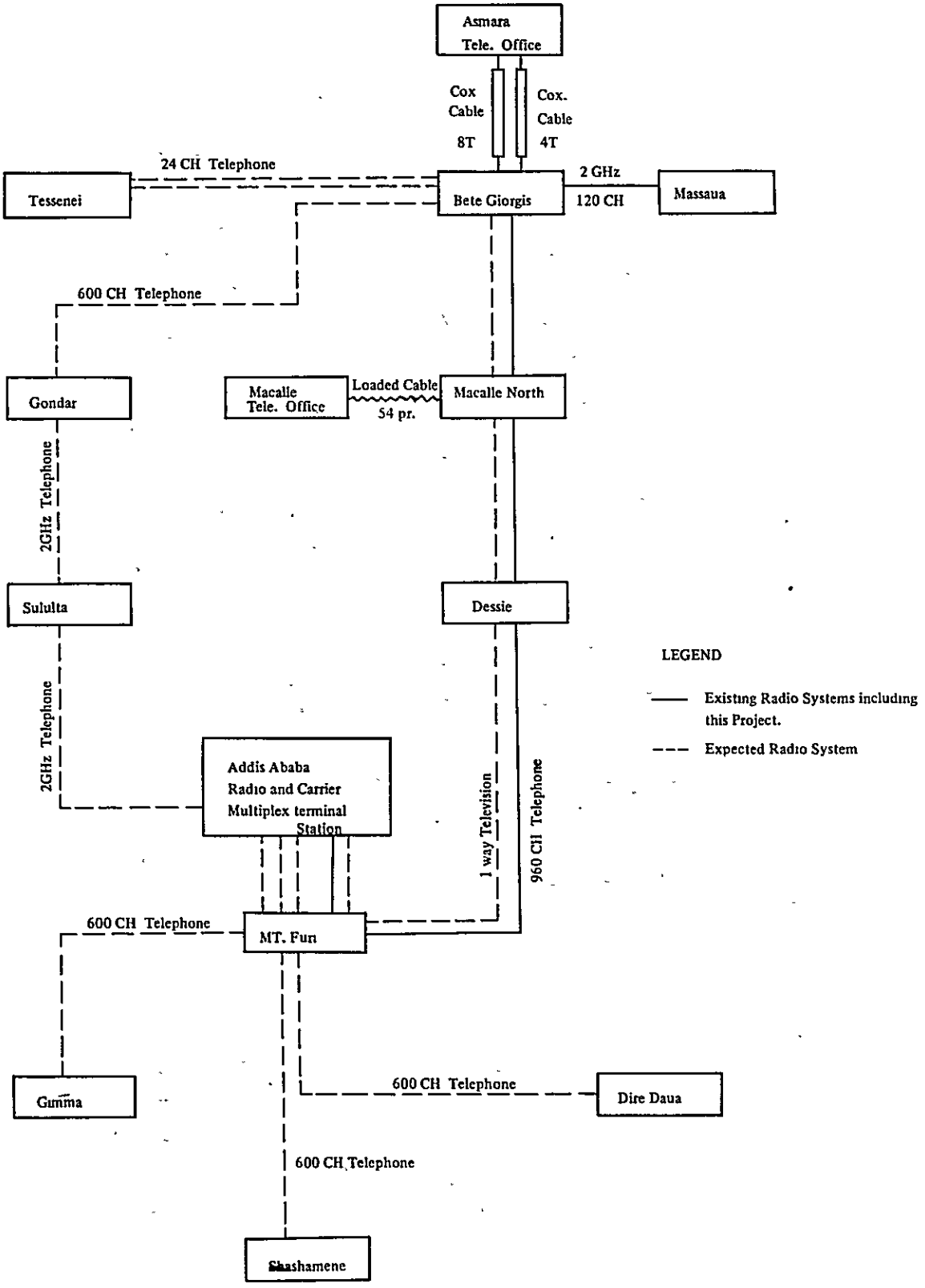
Drawing 2–16 PROFILE MAP

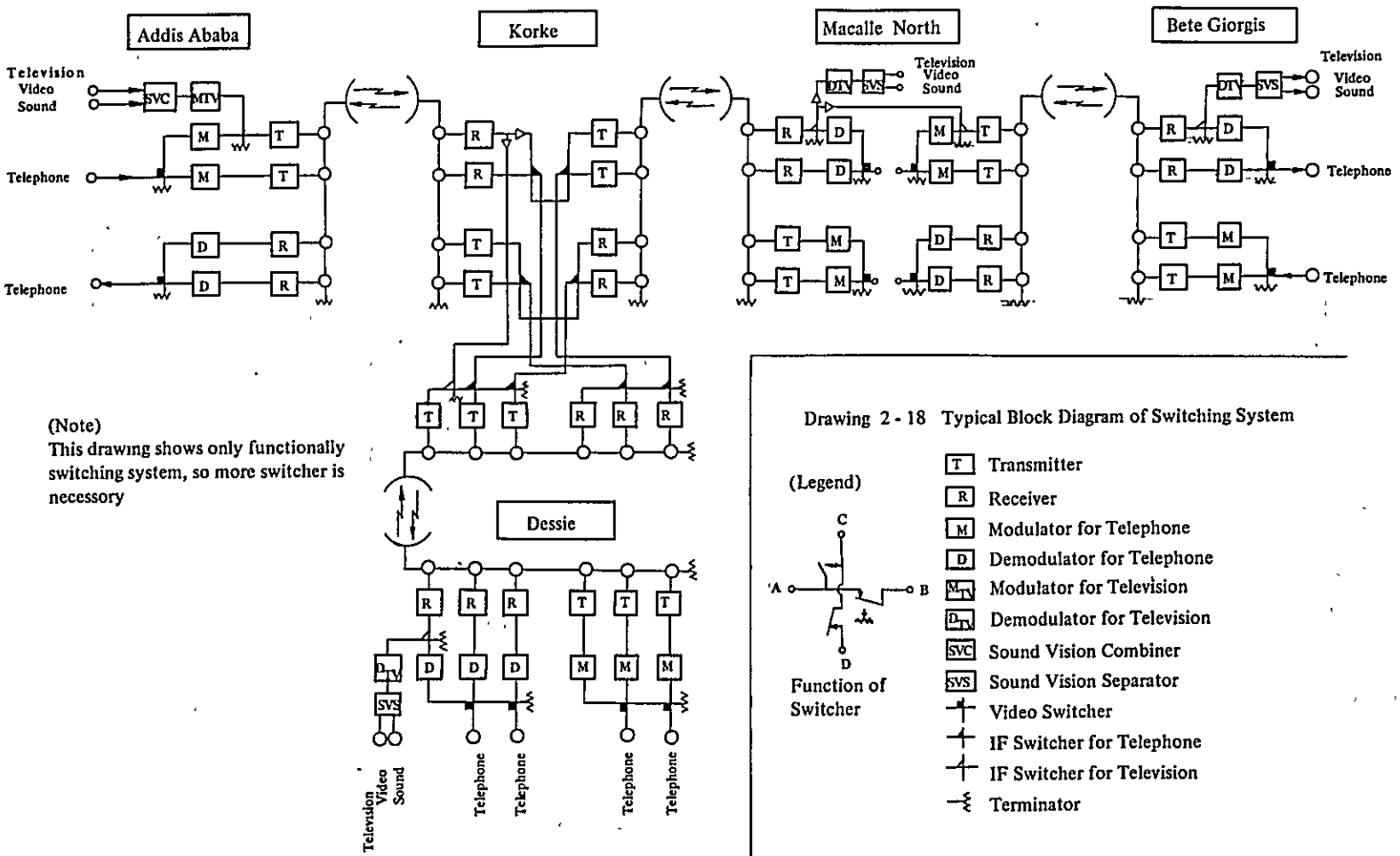


Distance (km)

KORKE			DESSIE (Telecom. Office)	
Altitude	2600 m	10.5 Km	Altitude	2528 m
Antenna Height	10 m		Antenna Height	15 m

Drawing 2-17 Future Plan





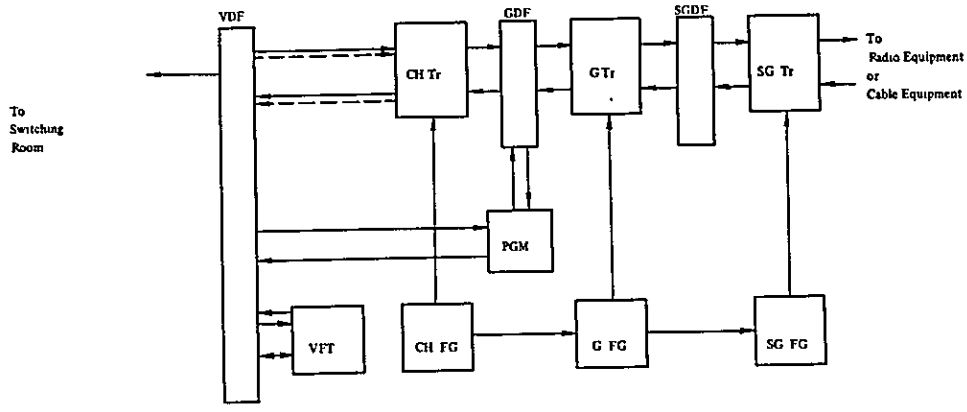
(Note)
This drawing shows only functionally switching system, so more switcher is necessory

Drawing 2 - 18 Typical Block Diagram of Switching System

(Legend)

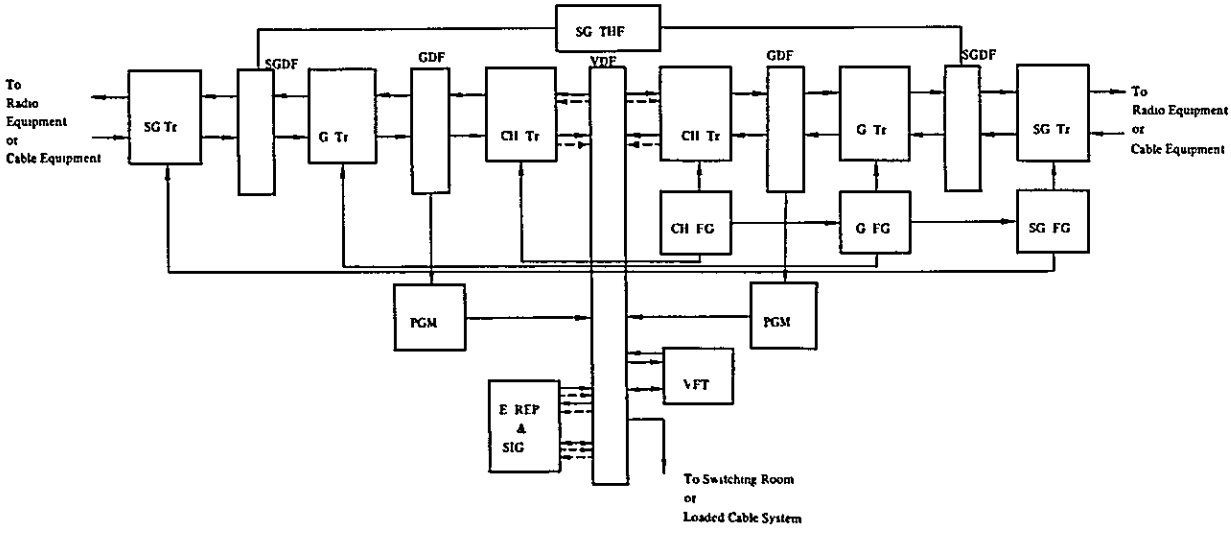
Function of Switcher

- T Transmitter
- R Receiver
- M Modulator for Telephone
- D Demodulator for Telephone
- M_{TV} Modulator for Television
- D_{TV} Demodulator for Television
- SVC Sound Vision Combiner
- SVS Sound Vision Separator
- Video Switcher
- IF Switcher for Telephone
- IF Switcher for Television
- Terminator



Drawing 3-1 Typical Block Diagram of the Carrier Multiplex System

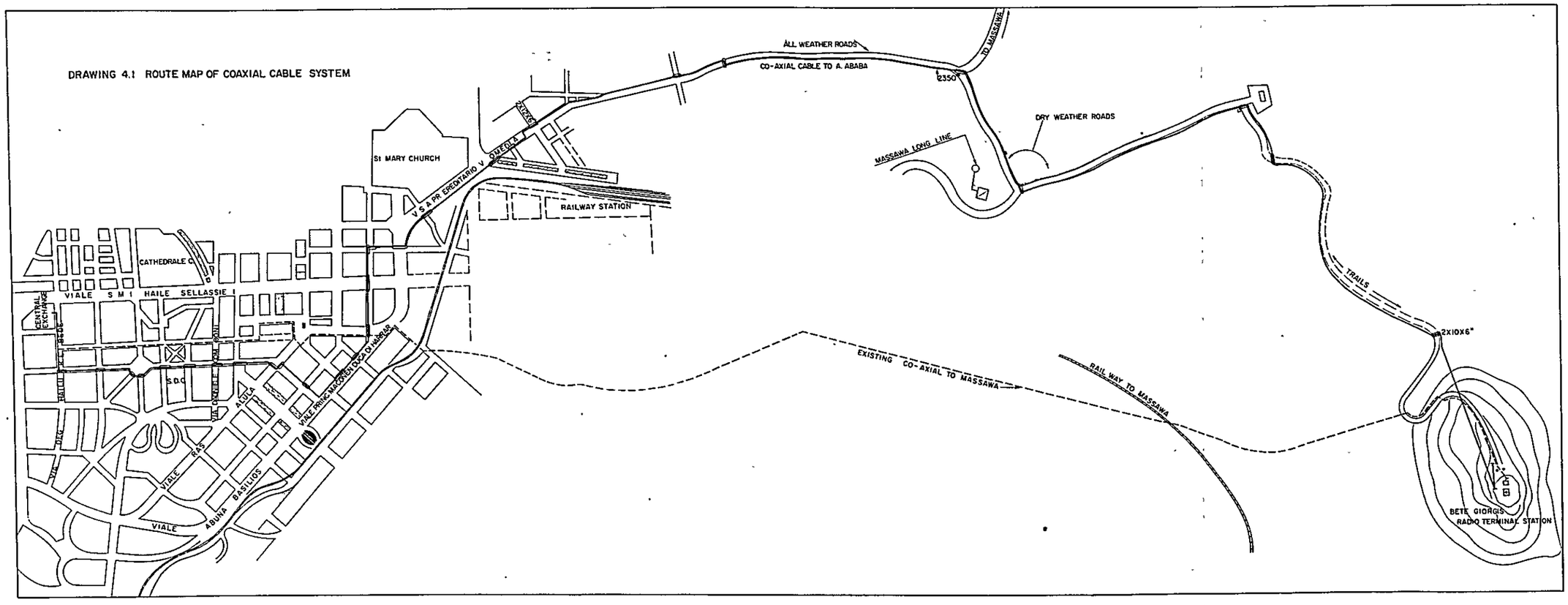
CH Tr	:	Channel Translating Equipment
G Tr	:	Group Translating Equipment
SG Tr	:	Super-Group Translating Equipment
VDF	:	Voice Frequency Distribution Frame
GDF	:	Group Distribution Frame
SGDF	:	Supergroup Distribution Frame
CH FG	:	Channel Frequency Generating Equipment
G FG	:	Group Frequency Generating Equipment
SG FG	:	Supergroup Frequency Generating Equipment
VFT	:	VFT Equipment
PGM	:	Program Transmission Equipment

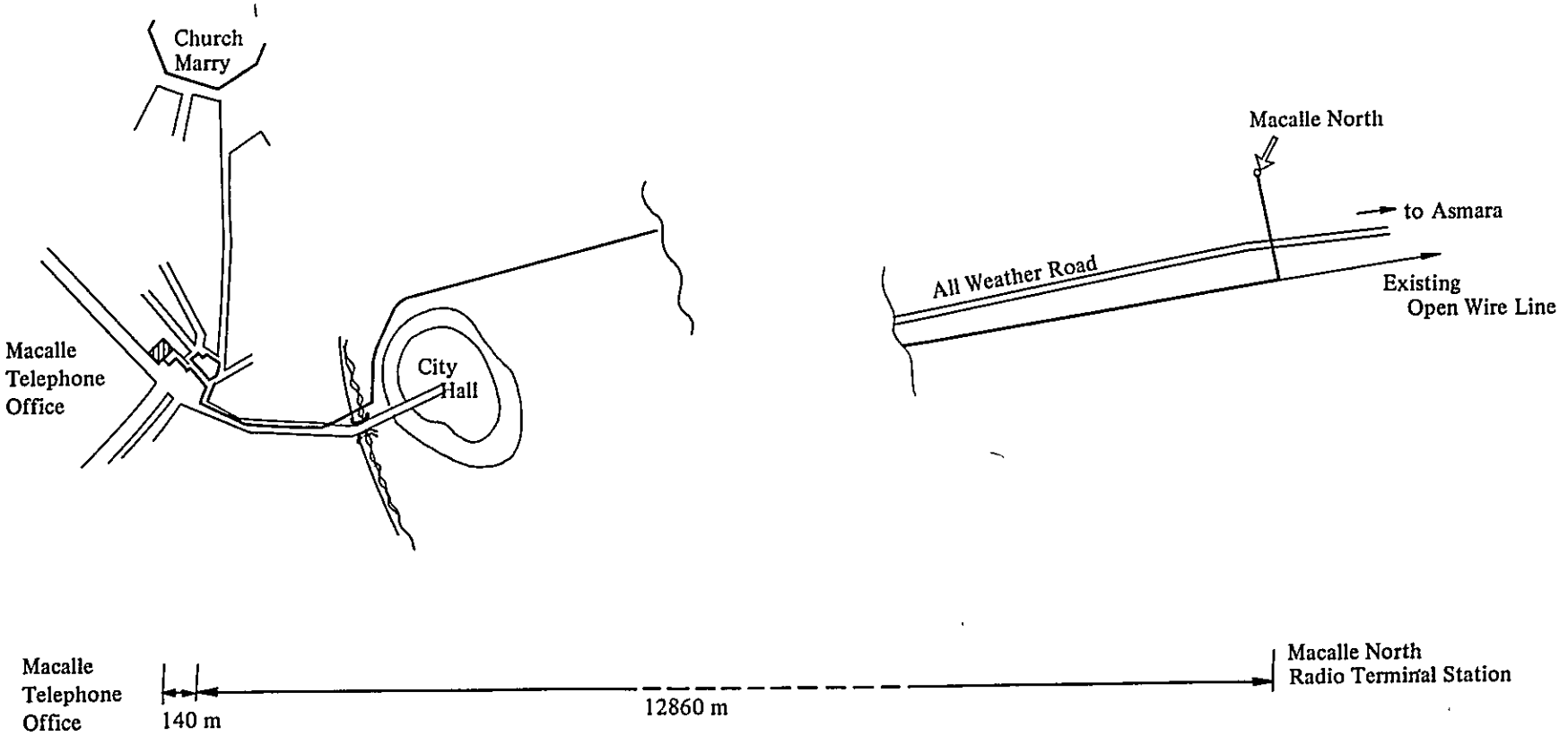


Drawing 3-2 Typical Block Diagram of the Carrier Multiplex System

CH Tr	:	Channel Translating Equipment
G Tr	:	Group Translating Equipment
SG Tr	:	Supergroup Translating Equipment
VDF	:	Voice Frequency Distribution Frame
GDF	:	Group Distribution Frame
SGDF	:	Supergroup Distribution Frame
CH FG	:	Channel Frequency Generating Equipment
G FG	:	Group Frequency Generating Equipment
SG FG	:	Supergroup Frequency Generating Equipment
VFT	:	VFT Equipment
PGM	:	Program Transmission Equipment
SGTHF	:	Supergroup Through Filter
E REP & SIG	:	End Repeater & Signalling Equipment

DRAWING 4.1 ROUTE MAP OF COAXIAL CABLE SYSTEM

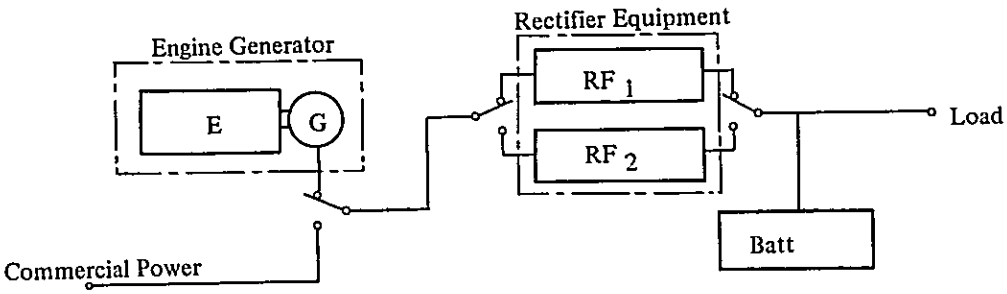




Note 140 m : Length of the underground part
12860 m : Length of the overhead part

Drawing 4. 2 Route Map of the Loaded Cable System

Drawing 6.1 Block Diagram of Power System
(for Station where Commercial Power is available)



Drawing 6.2 Block Diagram of Power System
(for Station where Commercial Power is unavailable)