REPUBLIC OF PARAGUAY

CONSTRUCTION PROJECT OF EARTH STATION FOR SATELLITE COMMUNICATIONS

Vol. III

TENDER DOCUMENT & TECHNICAL SPECIFICATION

This report is one of the following three volumes:

Volume	I	Planning Report
Volume	II	Detailed Design
Volume	**III**	**Tender Document and Technical Specification**
Part	**I**	**General Instructions for Tender**
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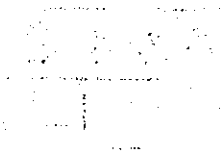
GENERAL CONTENTS



PART I

GENERAL INSTRUCTIONS FOR TENDER

TENDER NO. _____

Asuncion, 1972

ADMINISTRACION NACIONAL DE TELECOMUNICACIONES

(ANTELCO)

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1. Object

The object of this Tender is the construction of the earth station facilities, central station facilities and microwave connecting link in respect of the earth station complex.

Completion of this earth station will remarkably contribute to a speedly development in economy of Paraguay.

2. Funds

Loan funds from the Japanese government to the Republic of Paraguay have been established for the implementation of this satellite communications project and a loan agreement dated 1972 and concluded between and the Republic of Paraguay restricts and limits the participants of this Public Tender to firms, supplies and/or consortiums in Japan.

3. Scope of Work

3.1 The implementation of the project is based on the concept of a "Turn-Key" contract, which shall include engineering, supply and installation of the earth station facilities, central station facilities, microwave connecting link facilities, any other related works and services necessary for putting into service and operation of the satellite communication link, which may further be classified as follows:

(1) System design and engineering.

(2) Manufacture, supply and installation and commissioning of the satellite communications, microwave connecting link, central station equipment and their associated equipment.

(3) Supply of measuring equipments, tools necessity for operation and maintenance, manuals and spare parts for 2 years.

(4) *Training of personnel necessary for operation and maintenance.*

(5) Construction of the earth station building, communication antenna, microwave tower and their related facilities.

(6) Installation of the central station equipment and power supply equipment.

(7) Technical supervision for operation and maintenance of the system for one year.

3.2 Notwithstanding the above, the following works shall be excluded from the Tender, and shall fall on the scope of work of ANTELCO.

(1) Procurement of land for earth station construction site.

(2) Construction of access road to the earth station site, laying of power transmission line.

(3) Power equipment (including diesel engine generator, commercial power source, -24 volts DC) and microwave antenna tower of the central station.

(4) Circuit shifting arrangement between high-frequency and satellite communication circuits.

3.3 Equipments and services for the international connecting sections are excluded from this Tender, and shall be incorporated into the Contract to be concluded with the successful Tenderer.

4. Tenderer

4.1 The offers must be presented by suppliers or manufacturers of the satellite communication equipments with well recognized prestige and international fame plus experience in providing and installing satellite communication systems and be guaranteed for technical competence and economic solvency and sufficient organization for executing the works of this Tender.

4.2 The Tenderer must have a tempolary business address in Paraguay whose address should be stated clearly in the offer. All correspondence and notices dispatched to the said address shall be considered as delivered to the Tenderer in the proper manner.

The Tenderer must also notify ANTELCO, in writing, any change in his address or that of his representative's both before and after awarding the Tender.

5. Legal Aspects

It should be understood that the Tenderers are subject to all laws, regulations, ordinances, and other rules of Paraguayan Government or political subdivisions thereof, or any constituted public authority, applicable to the type of work to be performed under this project. It should also be noted that this Tender is subject to the provisions of Governmental Exchange Note and Loan Agreement referred to in the item 2 above.

6. Information

For any information or clarification concerning this Tender, address all correspondence to:

Administracion Nacional de Telecomunicaciones
Edificio Ministerio de Obras Publicas
y Comunicaciones, 4º Piso, Calle Oliva
y Alberdi, Asuncion, Paraguay.

Any explanation requested by a Tenderer concerning the meaning or interpretation on the stipulations of Tender Documents must be made in writing to the above address and with sufficient time allowed for a reply to reach Tenderers before submission of their offers. Any information given to such request will be provided to all prospective Tenderers as an amendment to or clarification on the Tender Documents.

7. Tender Documents

The Tender Documents shall be composed of the following parts:

Part I	General Instruction for Tender
Part II	Contractual Terms and Conditions
Part III	Technical Specifications
Part IV	Annex

The submitted document shall be according to the form designated in Technical specification for the satellite communication earth station of the Part III.

8. Preparation and Submission of Offer

8.1 Offer shall be prepared in accordance with the documents of this Tender which comprise Part I, Part II, Part III, Part IV, and any amendment or clarification to be added and incorporated in accordance with the procedures stated in the above Item 6.

The Tenderer is required to make one complete offer based on the scope described in item 3. Any offer having incomplete portion or not in compliance with the Specifications shall not be considered. Furthermore, any offer having defective or incomplete data of documents required to be submitted by the Tender Specifications or technical data not based on the actual field experinece, is liable to be excluded from consideration.

8.2 The Tenderer shall be considered as having understood the meaning and scope of the Tender Documents precisely and clearly and having considered them as one individual whole and the various conditions and clauses as mutually complementary and explanatory when he has submitted his offer documents to the Tender Committee.

8.3 Any offer reaching the ANTELCO's Tender Committee after the hour and date fixed for receipt of offers shall not be considered, and no counter-offers, modifications or corrections shall be permitted after the Tender deadline. Notwithstanding the above, ANTELCO reserves the right to request Tenderers to clarify their offers or to request any additional information at any time during the evaluation period.

8.4 Offers shall contain, at least, the followings;

(1) General Conditions.

(2) Technical Proposal stating detailed system design, technical data for equipments and materials as are required in the Technical specifications or any additional literature relating to the technical aspects.

(3) Resume of Prices

(4) Price schedule with detailed break-down of Prices

(5) Work schedule

(6) Management chart

(7) Documents stating other similar or larger works of similar nature which the Tenderer or supplier has executed and completed prior to the Tender including those which are in the process of execution. Effective evidence or certificate from the respective authority must be attached.

(8) Documents stating the financial status of the Tenderer and the supplier, outline of business and products, address of head office and factories, number of employees.

(9) Bid Bond

8.5 All documents submitted concerning this Tender must be written in English. As for the unit of the weights and measures to be applied in preparing offer documents, the metric system must be used.

8.6 The Tenderer must submit his offer in 6 (six) copies.

8.7 Offer documents shall be enclosed in the envelope sealed with red wax and addressed to the ANTELCO's Tender Committee, with name and address of the Tenderer.

8.8 The offer documents of the successful Tenderer shall be incorporated as a part of the Contract.

9. Evaluation of Offer

ANTELCO shall evaluate the received offers, taking into consideration the following points:
economical merits, technical merits, delivery terms, field experiences, and ability in performing the similar projects, etc. The Contract shall be awareded to that responsible Tenderer whose offer, conforming to the Tender Documents, shall be most advantageous to ANTELCO. ANTELCO shall not be bound to accept the lowest offer when other factors like field experience and managerial capacity are as such which may compensate the price.

10. Offer Validity

The offer shall remain valid and may not be withdrawn, for a period of 90 (ninety) days from the Tender closing date. For an offer of successful Tenderer, it shall remain valid until a formal Contract is concluded.

11. Bid Bond

The Tenderer is required to submit with his offer a Bid Bond for an amount of not less than 2% of the total value of his basic offer. The bid bond must be either in the form of a Letter of Guarantee or check certified by Banco Central del Paraguay. Cash guarantee or uncertified check will not be accepted. This Bond must be valid for 90 (ninety) days from the closing date of the Tender. Offers received without this Bond shall not be considered.

The Bond constitutes a guarantee by which the Tenderer promises not to modify any one of the terms of his offer during the period of validity of his quotations and to insure that, in case he should be granted with the award, the Tenderer shall establish the corresponding Contract. If the successful Tenderer fails to fulfil these obligations without any justifiable reason, ANTELCO reserves the right to forfeit the Bond immediately.

The Bond will be returned to the unsuccessful Tenderers after the official notice of award has been made and to the successful Tenderer after his submital of the Performance Bond as provided in the Article 5 of Part II.

12. Prices

12.1 All the prices, as well as the unit prices, must be quoted CIF Asuncion according to the INCOTERMS 1953. Expenses after CIF up to the work site must be quoted separately. The total price must include the supply, installation of the equipments and materials, transportation, insurance and any other expenses necessary for putting into service the total system within the concept and scope of this Tender.

12.2 Quotation must be devided into two categories, "Foreign Portion" to be quoted in Japanese Yen and the "Local Portion" to be quoted in Paraguayan Guarani. It should be understood that the Foreign Portion refers to the expenses for the equipments, materials and services to be provided from Japan and other countries, and that the Local Portion refers to the expenses for the materials and services to be procured and originated in Paraguay.

12.3 The Tenderer shall offer a "Price Variation Formula" for future orders.

13. Delivery

The Tenderer shall specify in his offer the period required for the delivery of all the equipments and materials, installed, tested, and ready for operation in accordance with the stipulations in Item 1.4 of chapter 1, PART III of Tender Specifications.

14. Contractual Terms and Conditions

The successful Tenderer is expected to negotiate and sign a Contract providing assurance to ANTELCO that all obligations stipulated in the Contractual Terms and Conditions of Part II of the Tender Documents shall be met.

PART II

CONTRACTUAL TERMS AND CONDITIONS

TENDER NO. _____

Asuncion, 1972

Administracion Nacional de Telecomunicaciones

(ANTELCO)

CONTENTS

Article 1. Definitions

For the purpose of this Contract, the following terms and definitions shall apply:

ANTELCO: (Contracting Party)	Administration Nacional De Telecomunicaciones for whom the equipments, materials and work are to be supplied. It may be referred to as the "Contracting Party".
Contractor:	The successful Tenderer who enters into Contract with ANTELCO for the supply of equipment, materials and services covered by this Contract.
Sub-contractor:	Any Contractor who carries out a local supply of materials and/or services for the Contractor.
The Contract:	The written agreement concluded between ANTELCO and the Contractor for the supply of the equipment and materials and the execution of the work, in accordance with the Contractual Terms and Conditions and the Technical Specifications of this Tender.

Article 2. Laws and Regulations

The Contractor shall be subject to all laws, regulations, ordinances, and other rules of the Paraguayan Government or political subdivision thereof, or of any constituted public authority applicable to the type of work to be performed by the Contractor and/or its sub-contractors.

This Contract is also subject to the provisions of Governmental Exchange Note and/or Loan Agreement.

Article 3. Tax and Customs Exemptions

The procurement under this Contract shall be free from any and all customs duties, taxes, stamp duties and any other taxes or liabilities. Re-export of all equipments, instruments, vehicles, supplies or any other materials imported specifically for the execution of work under this Contract, shall be also subject to the privileges specified in the foregoing paragraph.

The Government of Paraguay shall exempt non-Paraguayan Contractor and his non-Paraguayan personnel from local taxes.

Article 4. Contract Documents

The Contractual Terms and Conditions and the Technical Specifications and any details given in any document annexed hereto, together with the signed and accepted offer documents submitted by the Contractor shall constitute the Contract Documents.

Article 5. Performance Bond

The Contractor must submit, at the time of signing the Contract, a Performance Bond equivalent to 10% (ten percent) of the total value of the contracted amount in the form described in the item 11 of PART I, in order to guarantee the fulfilment of the Contract requirements.

The Bond shall remain valid until 12 months after the Provisional Acceptance of the work. ANTELCO shall have the right to deduct from the Performance Bond any amount which may arise in settlement of a fine or penalty to be paid by the Contractor under the provisions of the Contract.

Article 6. Guarantee

6.1 The Contractor shall guarantee that the equipments, materials and services to be provided under this Contract shall be free from defects in both materials and workmanship and that they shall comply with the Specifications stipulated in the Contract Documents.

6.2 The Contracting Party shall reserve the right, at any time during the term of validity of this guarantee, to reject any materials or services which should evidently be in disaccord with the above mentioned Specifications and to require the Contractor to rectify and/or replace, at his own expense, such materials or services.

6.3 If the Contractor fails to fulfil his obligations specified in the preceeding paragraph without any justifiable reasons, the Contracting Party may proceed to have such rectification or replacement made at the expense of the Contractor.

Expenses so incurred may be deducted from the Performance Bond.

6.4 The Contractor shall guarantee that, for a period of 1 (one) year the date of Provisional Acceptance of the work, the performance and reliability of the total system shall be in accordance with the specifications of the Contract Documents.

The guarantee is applicable to the defects in manufacturing and/or designing the equipments which may be imputable to the Contractor and which may appear under normal operating conditions and adequate use. This guarantee does not cover defects due to the reasons of force majeure, or due to the defective maintenance, modification or reparation on the part of the Contracting Party, or due to lack of spare parts which are subject to normal wear.

Article 7. Contractor's Organization

The Contractor shall, upon the execution of this Contract, submit to the Contracting Party a chart showing the administrative organizations and personnel to be employed in performing the work provided in the Contract, and their duties.

The Contractor shall submit, in writing, of a resident Key personnel who shall be designated as a "Project Manager", and any instructions given to him by

the Contracting Party shall be deemed to be given to the Contractor.

The Contractor shall provide sufficient technical, supervisory and administrative personnel to secure the proper execution of the work in accordance with the work schedule to be incorporated in the Contract documents.

The Contracting Party reserves the right to require the Contractor to remove any personnel whose continued employment is deemed to be undesirable.

Article 8. Permits and License

It shall be the duty of the Contractor to obtain all necessary permits and licenses required for the execution of the work under this Contract, unless otherwise provided in other articles in the contractual terms and conditions.

The Contractor shall be responsible for any damage, foreign and/or domestic, of any nature which the Contracting Party may suffer as a result of the Contractor's failure to comply with the provisions of this Article. However, the Contracting Party shall fully cooperate with the Contractor in an expeditious manner to obtain all required licenses and permits.

Article 9. Changes and Modifications

The Contracting Party may, by written notice, ask the Contractor to make changes and/or modifications within the general scope of this Contract. If any such change causes an increase or decrease in the cost of, time required for, the execution of the Contract, an equitable adjustment shall be made in the price, or delivery date or schedule, or both, and the Contract shall be modified in writing, accordingly by mutual agreement.

Article 10. Acceptance Test

The delivery referred to in this Contract shall be carried out on a "Turn-Key" basis after the corresponding acceptance test has verified the compliance with the contractual technical specifications. For this purpose, the Contractor shall give a written notice to the Contracting Party, at least 2 (two)

weeks prior to the date when the system shall be ready for commencement of the said test. The acceptance test shall be carried out in the presence of the Contracting Party and/or Inspectors and be completed within 45 (forth five) days after the commencement of the test. The Contractor shall remedy all defects which may not comply with the contractual technical Specifications, immediately after they are discovered during the test. The testing period shall not be counted as part of the installation period. However, if the Contractor fails to remedy such defects without any justifiable reason, the period from the notification as such until the completion of remedy shall be counted as part of the installation period.

Article 11. Provisional Acceptance

Upon completion of the Acceptance test in a satisfactory way, the Contracting Party shall issue a Certificate of the Provisional Acceptance within one week after the completion of the said test. The date of said Certificate shall be considered as effective date of putting the system into service. The Contracting Party reserves the right, if he deems it to be in his interest, to put into operation any partially completed portions or sections of the system even before the Provisional Acceptance of the total system, subject to the consent of the Contractor. If such prior use increase the cost of, or delays the work, the Contractor shall be entitled to such additional compensation or extension of delivery time or both, as the both parties may agree. Those portions or sections shall be deemed as provisionally accepted when they are put into operation in the way mentioned above, and the corresponding certificate shall be issued.

Article 12. Final Acceptance

If, during the lapse of 12 (twelve) months from the date of the Provisional Acceptance of the system, a satisfactory performance and reliability have been proved, the Contracting Party shall issue a Certificate of Final Acceptance. When serious defects are found to be existing in the system due to errors or negligence on the part of the Contractor, the Final Acceptance of the system shall not be carried out until they are remedied in accordance with the

contractual technical specifications.

Article 13. Penalty

If the Contractor fails to complete the work or any part of the work within the time periods specified in the Contract or any extension thereof, he shall be liable to a penalty for each calendar day, following the date specified for delivery at a rate equal to half (0.5) per thousand up to the maximum limit of 10% of the value of the unexecuted portion. Should the said period exceeds 200 (two hundred,) calendar days, the Contracting Party shall have the right to proceed to the termination of the Contract, in whole or part.'

If the delay arises out of causes beyond the control and without the fault or negligence of the Contractor, as specified in the Article 15, the delivery time shall be extended accordingly.

Article 14. Delays

The Contractor shall not be in default by reason of any failure in his performance under this Contract in accordance with its terms (including any failure by the Contractor to make progress in the prosecution of the work hereunder which endangers such performance) if such failure arises out of causes beyond the reasonable control and without the fault or negligence on the part of the Contractor. Such causes include, but are not restricted to: Acts of God or of the public enemy, acts of the Government in their sovereign or contractual capacity, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, unusually severe weather.

Article 15. Title and Assumption of Responsibility

Title for all equipments, materials and structures to be incorporated in the system covered by this Contract shall be transferred from the Contractor to the Contracting Party at the time of shipment from the Japan Port. Notwithstanding the above, the Contractor assumes all the responsibility inherent to the execution of the work in accordance with the Contract requirements and the

responsibility lasts until the Provisional Acceptance of the system.

Article 16. Transportation and Insurance

16.1 Transportation, storage and insurance of all the equipments and materials from the factories up to the work site and during the installation shall be at the responsibility of the Contractor.

16.2 The Contractor shall carry adequate liability and compensation insurance in order to assume the responsibility stipulated in the foregoing Article.

16.3 The method of transportation of any property or personnel under this Contract shall be at the Contractor's option, giving, however, the first preference to the Paraguayan flag vessel.

Article 17. Sub-contract

17.1 The Contractor shall, as soon as practicable after the signing of the Contract, notify the Contracting Party in writing of the name (s) of sub-contractor (s) proposed for the work.

17.2 The Contractor shall be responsible to the Contracting Party for all acts and omissions of his sub-contractors and of all persons directly or indirectly used by him or such sub-contractors in connection with the work required by this Contract and shall insure cooperation among all such persons and sub-contractors.

Article 18. Assignment

Any assignment of this Contract in whole or in part or of any interest herein without the Contracting Party's written consent shall be invalid.

Article 19. Patents

The Contractor shall be responsible for the consequences which may derive from the use of patents, registered marks, intellectual and/or scientific property rights of equipments or any part thereof to be provided by the Contract.

Article 20. Protection of Property

20.1 The Contractor shall preserve and protest all existing facilities that he may be required to work in or around.

The Contractor shall repair or restore any damage to facilities resulting from his failure to exercise reasonable care in the execution of the work.

20.2 The Contractor shall take all safety measures that are required by law or may be requested by the Contracting Party, or that would be taken by a prudent contractor in the circumstances.

Article 21. Obligations of the Contracting Party

The Contracting Party shall:

21.1 Execute the following works in accordance with the work schedule and the requirements of the Contractor.

(1) Procurement of land for earth station construction site.

(2) Construction of access road to the earth station site, laying of power transmission line.

(3) Power equipment (including diesel engine generator, commercial power source, -24 volts DC) and microwave antenna tower of the central station.

(4) Circuit shifting arrangement between high-frequency and satellite communication circuits.

21.2 Provide necessary information regarding the existing facilities or any other matter which the Contractor may require for the proper execution of his duties.

21.3 Provide land for all sites and give permissions to the Contractor for free access to the existing buildings and the work sites.

21.4 Provide authorization for use of the required radio frequencies including those that may be needed for temporary purposes during the execution of the work.

21.5 Assume the responsibility to obtain the following releases, exemptions and exonerations from the Government of Paraguay.

(1) Release from customs duties and taxes, including sales taxes, on the importation or re-exportation of equipment, instruments, and materials which the Contractor requires in strict and direct relation with the work assigned, and which are brought into the country for that purpose.

(2) Exemption from income taxes for the Contractor's personnel contracted outside Paraguay.

(3) Exoneration from obligations, rates or taxes related to entry and stay of personnel in Paraguay.

(4) Exemption from all kind of taxes, fees, or contributions which exist or will be created, whether national, departmental, or municipal.

21.6 Obtain the corresponding licenses for the importation and re-exportation as referred to in the sub-item 21.5.

21.7 The Contractor is liable to claim for the compensation of any loss or damage to be incurred by the non-fulfillment of any of the above mentioned obligations on the part of the Contracting Party.

Article 22. Arbitration

22.1 Any disagreement or dispute concerning an interpretation and execution of this Contract which is not disposed of by agreement shall be submitted to the Arbitration Committee consisting of three people, one which is to be appointed by the Contracting Party another to be appointed by a consulting group and the third to be appointed by the Contractor.

Article 23. Termination of Contract

The Contracting Party shall be able to terminate the Contract with 30 (thirty) days advance notice in writing to the Contractor in the following cases:

(1) When the Contractor goes bankrupt or insolvent

(2) If the quality of the equipment, materials and services do not comply with the contract requirements.

(3) If the delivery delays for more than 200 days from the specified date of delivery or the Contractor fails to replace or repair the rejected parts or materials by the mutually agreed date.

The conditions referred to in items (2) and (3) shall not be applied to the causes of force majeure and/or non-fulfillment of any of the Contracting Party's obligations stipulated in the Article 21.

Article 24. Payment

24.1 The payment of "Foreign Portion" shall be made in Japanese Yen in the following manner:

(1) Equipments & Materials

% at the time of signing the Contract

% against shipping documents

% at the time of Provisional Acceptance

(2) Services

% at the time of signing the Contract

% against monthly progress

% at the time of Provisional Accpetance

(3) Technical Service for Operation and Maintenance

% at the time of starting services

% against monthly progress

24.2 The payment of "Local Portion" shall be made in Paraguayan Guarani in the following manner:

(1) Materials and Services

% at the time of signing the Contract

% against monthly progress for services and/or against invoice for materials

% at the time of Provisional Acceptance

(2) Operation and Maintenance

% at the time of starting services

% against monthly progress

PART III

TECHNICAL SPECIFICATION

FOR

SATELLITE COMMUNICATIONS EARTH STATION

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CHAPTER 1 GENERAL

1.1 Purpose

This specification defines the technical characteristics of the satellite earth station, the central station equipment for satellite communications and the microwave connecting link between the earth station and the central station, which will be established, with the aim to have access to the INTELSAT-IV Satellite, by the ANTELCO (Administracion Nacional De Telecommunicaciones), REPUBLIC OF PARAGUAY.

The descriptions given in Part II and the separate General Conditions of Tender shall be constructed as the minimum conditions of this project.

1.2 Project Outline

Under this project the following communications equipment and facilities shall be constructed in order to establish international communications circuits which will connect Paraguay with other countries of the world by way of INTELSAT Satellites.

(a) Satellite earth station that has capability of communicating with the ATLANTIC INTELSAT-IV Satellite.

(b) Central station equipment for satellite communications.

(c) Microwave connecting link to connect the earth station and the central station.

Fig. 1.1 shows overall Block diagram of satellite communications system.

The earth station shall provide telephone, telegraph, telex and television transmission services via the INTELSAT-IV Satellite.

This station shall comprise, for initial installation, one carrier for transmission and seven carriers for reception of 24 multiplex telephony channels, three carriers for each of transmission and reception in SPADE

System and three carriers for each of Television transmission and reception. In future the carriers for multiplex telephony reception will be increased to nine carriers.

1.3 Scope

The contract of this project shall include in its scope not only the items described in paragraph 1.2 above, that is, the construction of earth station, central station equipment for satellite communications and terrestrial microwave radio link between the earth station and central station, but also the entire materials and action necessary for operating a satellite communications system including system design of auxiliary facilities and communications equipment; manufacture, supply and installation of equipment; check of operational performance of various items of equipment; training of operating personnel, etc. Station support, logistics and documentation shall also be included in the contract.

Land readjustment of the earth station site, construction of access road to the entrance of station site and laying of power supply cable to the earth station shall be provided by the ANTELCO. The requirements for these items shall thus be excluded from the scope of contract.

Construction of the Central Office Annex, Power supply system (including Diesel-engine generator) and a microwave tower for the central station shall also be excluded.

Generally, the system shall be designed within the framework of and shall be in accordance with:

1. The ITU regulations
2. The C.C.I.R. and C.C.I.T.T. Recommendations
3. The ICSC's performance requirements and in particular:
   ICSC Document 45-13E W/1/70 of 14-January 1970 and any amendment or revision in effect at E.D.N.
   ICSC Document 37-38E W/1/69 of 31 January 1969
4. Satellite systems operations Plans for the Atlantic Region in effect at effective data of notification (E.D.N.)

5. Satellite System Operations Guide in effect at E.D.N.

1.4 Completion

All the works governed by this contract shall be completed and delivered to the ANTELCO within 18 months after effective data of notification.

The Tenderer shall submit, at the time of the offer, the time schedule plan for this project.

1.5 Amendment of The Specification

Should C.C.I.T.T., C.C.I.R. and Recommendations and/or Regulations be revised, after the issue of the Specifications, modifications of the contents of the Specification will be established by the ANTELCO.

1.6 Alternative and Additional Design

The Tenderer shall submit an offer conforming with this specification. He can, however, propose a proper alternative offer, performances of which shall satisfy the specification, if he should so desire. In addition to the above, the Tenderer shall present a deviation list with red marks specifying design items in addition to tender form designated in 1.7.3 and 1.7.4.

The Tenderer may be required, as needed to present supplementary data.

1.7 Tender Form

The Tenderer is bound to submit documents in accordance with the General Condition of Tender, at the time of the offer. These documents shall be in compliance with this Specification as well. Among the items to be included in these documents, the following shall be according to the form designated here.

1.7.1 Price, Completion, etc. **Form-1**

Where matters require some alternative design, by the ANTELCO and where the Tenderer intends to offer some alternative design, pertinent data shall clarify the difference from the original, for each item concerned.

1.7.2 Dimensions, Weight, Power Consumption, etc., of Equipment quipment **Form-2**

Items listed in the "No." column shall coincide with the subsystem and item arrangement indicated in Tables 5.1 to 5.11, 7.1, 8.1, 9.1, 10.1, 11.2, 11.3.

1.7.3 Performance Calculations **Form-3**

Performance calculations shall be described according to Chapter 6 of this Specification.

Item(s) which the Tenderer desires to add shall be mentioned at the end of the statement.

1.7.4 Technical Data for Each Subsystem **Form-4**

Technical data description shall be in accordance with the order of subsystems and items dealt in Chapter 6 of this Specification.

Item(s) which the Tender desires to add shall be mentioned at the close of each subsystem. The Tenderer may give requisite explanations of separate paper if space in the forms is insufficient.

Form-1

Itemized price schedule for supply and installation completion of communications Satellite Earth Station.

(1) Equipment Price

No.	System	FOB Price ($)	CIF Price ($)	Remarks
I	Antenna System			
II	Transmitter and Receiver System			
III	Control and Monitor System			
IV	Multiplexing Equipment System			
V	SPADE Terminal System			
VI	Power Supply System			
VII	Earth Station Building and Related Facilities			
IIX	Microwave Connecting Link			
IX	Central Station Equipment			
X	International Telephone Switching System			
XI	Spare and Tools			
XII	Installation Materials			
XIII	Publications and Drawings, etc.			

(Content of CIF Price)

(i) FOB Price total _____ $

(ii) Marine insurance _____ $

(iii) Ocean freight _____ $

(iv) Customs duty _____ $

(v) Custom clearance charge, Inland transportation cost, etc. _____

(2) Personal Expenses

(i) Personal expenses per head per day

Engineer _____ $

Technician _____ $

Local laborer _____ $

(ii) Total number of persons

Classified into installation, prorivional handing-over test, guarantee period and training, respectively.

Engineer _____ men-month

Technician _____ men-month

Local laborer _____ men-month

(iii) Return airtransportation ticket for the manufacturer's engineers and technicians

Description shall include both the total number of times and the expenses for each return and total.

Engineer _____ times, _____ $/time, total _____ $

Technician _____ times, _____ $/time, total _____ $

(3) Training expenses

(i) Expenses for factory training

(ii) Expenses in Paraguay

(4) Grand total

(1) + (2) + (3) _____ $

(5) Alternative Design

For items which the Tenderer will have consideration of some alternative design in this Specification, a price schedule shall be attached to those portions which differ from the original of each item (1), (2), (3) and (4) above.

(6) Completion

INFORMATION TO BE SUBMITTED

I Antenna System

No.	Subsystem	FOB Price ($)	CIF Price ($)	Remarks
1	Antenna Foundation, Pedestal and Rotating Assembly			
2	Reflector and Primary Radiator			
3	Feed			
4	Servo-control and Drive			
5	Tracking Receiver			
6	Time Standard			
7	Miscellaneous			
	Subtotal			

II Transmitter and Receiver System

No.	Subsystem	FOB Price ($)	CIF Price ($)	Remarks
1	Transmitter			
2	Receiver			
3	Modulator and Demodulator			
4	Test Equipment			
5	Miscellaneous			
	Subtotal			

III Control and Monitor System

No.	Subsystem	FOB Price ($)	CIF Price ($)	Remarks
1	Equipment Control/ Monitor			
2	Television Control/ Monitor			
3	Data and Fault Recorder			
4	Miscellaneous			
	Subtotal			

IV Multiplexing Equipment System

No.	Subsystem	FOB Price ($)	CIF Price ($)	Remarks
1	Multiplexing Terminal Equipment for Satellite Link			
2	Multiplexing Terminal Equipment for Microwave Connecting Link			
3	Order Wire Equipment			
4	Miscellaneous			
	Subtotal			

V SPADE Terminal System

No.	Subsystem	FOB Price ($)	CIF Price ($)	Remarks
1	Terrestrial Interface Unit (TIU)			
2	Demand Assignment Signaling and Switching Unit (DASS)			
3	Channel Unit (CHU)			
4	IF Subsystem (IFSS)			
5	Time and Frequency Unit (TFU)			
6	Maintenance Center (MC)			
7	Miscellaneous			
	Subtotal			

VI Power Supply System

No.	Subsystem	FOB Price ($)	CIF Price ($)	Remarks
1	Substation			
2	Diezel Engine Generator			
3	Non-Break DC Power Equipment			
4	Non-Break AC Power Equipment			
5	Low Voltage Distribution Board			
6	Monitor/Control Board			
7	Miscellaneous			
8	Subtotal			

VII Earth Station Building and Related Facilities

No.	Subsystem	FOB Price ($)	CIF Price ($)	Remarks
1	Soil Investigation			
2	Earth Station Building and Related Facilities			
3	Building Service Equipment			
4	Others			
5	Subtotal			

IIX Microwave Connecting System

No.	Subsystem	FOB Price ($)	CIF Price ($)	Remarks
1	Radio Subsystem			
2	Antenna Subsystem			
3	Supervisory and Control Subsystem			
4	Power Supply Subsystem			
5	Miscellaneous			
	Subtotal			

IX Central Station System

No.	Subsystem	FOB Price ($)	CIF Price ($)	Remarks
1	Multiplexing Terminal Equipment (connecting to terrestrial link)			
2	Terminal Equipment for Central Station (ITMC)			
3	Miscellaneous			
	Subtotal			

X International Telephone Switching System

X-1 Manual Switching System

No.	Subsystem	FOB Price ($)	CIF Price ($)	Remarks
1	Cord Switchboard			
2	Hybrid and Ringer Equipment			
3	Hybrid and Signaling Equipment			
4	Trunk A, B and C			
5	Relay Group			
6	Miscellaneous			
7	Subtotal			

X-2 Semi-Automatic Switching System

No.	Subsystem	FOB Price ($)	CIF Price ($)	Remarks
1	Main Frames			
2	Manual Cordless Switchboard			
3	Maintenance Equipment			
4	Miscellaneous			
5	Subtotal			

Form-2 Dimensions, Weight, Power Consumption, etc., of Equipment

No.	Item	Height (mm)	Width (mm)	Depth (mm)	Weight (kg)	Classification of Power Source	Power Consumption (W)	Remarks

Form-3

Performance Calculation

(Subject shall coincide with Chapter 6)

No._____ Subject _____

or Item _____

Letter _____

Requirement : (Specified standard)

Offering : (Offered Standard)

(When it does not satisfy the specified standard, reference to the Deviation List shall be made in red.)

Form-4

Technical Data for Each Subsystem

No._____ Name of equipment _____

(The name of equipment shall coincide with the item in Form-2)

or Item _____

Letter _____

Requirement : (Specified standard)

Offering : (Offered standard)

(When it does not conform to the specified standard, reference to the Deviation List shall be made in red)

CHAPTER 2 PRODUCT ASSURANCE REQUIREMENTS

2.1 General

Equipment and materials to be supplied and work to be executed by the Contractor shall be compatible with the description given in the General Specifications of Tender and the technical requirements that appear later. They shall also satisfy the following general requirements:

(1) The most advanced, up-to-date techniques shall be employed; operation and maintenance work shall be conducted without difficulty;

(2) Operation and maintenance expenses shall be the minimum possible;

(3) The equipment shall be solidly fabricated, while sufficient consideration shall be made for the prevention of false operations and instability;

(4) Safety shall be secured for all personnel being engaged in operation and maintenance works.

(5) All the goods to be supplied shall be thoroughly subtropical treated.

(6) Characteristics of the system shall conform to this specification, as well as to the latest C.C.I.T.T., C.C.I.R. and I.C.S.C. Recommendations and to the I.T.U. Regulations;

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

2.2 Reliability

In order to procure 24 hours per day, continuous operation of the satellite communication circuit throughout the year with not less than 99.5% reliability, the individual reliability of the Earth Station facilities regulated under this Specification, shall be 99.8%.

The Tenderer shall submit calculations on the expectable reliability of the equipment.

2.3 Design Life

The design life of earth equipment shall be not less than fifteen (15) years. Said design life shall be accomplished with the aid of only normal inspection and light maintenance.

The Tenderer shall submit on the exchange period, time required for replacement and requisite expenses of consumable parts under normal operative conditions.

2.4 Requirement for Equipment

2.4.1 Equipment Unit

(1) Solid-state devices with high reliability shall be adopted as far as possibly, back up capability shall also preferably be established.

(2) Equipment will preferably be able to operate with the forced air-cooling system; if blowers are needed, considerations shall be gain to protection against blower failure.

(3) Equipment shall withstand the environmental conditions of the location.

Environmental conditions concerned are shown in Reference 1 to 5.

In addition, the facilities shall not be adversely affected by direct sun light, rainstorm, and etc.

The indoor facilities shall be such that even in case the ambient temperature and ambient relative humidity change from $2^{o}C$ to $45^{o}C$ and 40% to 90% respectively, the links shall remain in service without serious performance degradation. When the original conditions with recovery of the air-conditioner, the facilities shall once again be able to satisfy the Specifications.

(4) Equipment shall be composed of plug-in type cards as far as possible.

(5) Plug-in type cards and replaceable parts, such as electron tubes and fuses shall, in principle, be ones that can be easily replaced through the front of the equipment.

(6) Every adjustment shall be such that it operates accurately and smoothly. The adjustment points shall not shift.

(7) Every rack or cabinet shall be provided with one or more conventional power outlet(s).

The outlet(s) shall be wired to a circuit-breaker in the auxiliary switch board.

(8) In order to facilitate the maintenance and operation work, equipment assemblies shall contain test points from which all the functions can be measured.

(9) All the equipment shall operate satisfactorily with the power sources mentioned in Chapter 7.

2.4.2 Component

(1) Equipment shall consist of the least kinds of component.

(2) Part such as connectors shall make positive form electrical contact, they shall also withstand corrosion, wear and tear.

(3) Wave guides and air dielectric coaxial lines laid outdoors or in places where moisture condensation occurs, shall be pressurized with dry.

2.4.3 Finish

(1) Chassis, small metal parts and etc., shall be given anticorrosive and high quality surface finish.

(2) Enclosures, shall be sturdy, without distortion, metal made and finished neatly.

(3) Equipment shall be uniform in size and color. The equipment shall also be the minimum possible weight.

2.4.4 Protection

(1) Equipment

(a) The equipment shall be provided with dustproofing whether it is installed indoors or outdoors.

(b) Magnetic type circuit breakers that prevent primary power overload shall be adopted, in principle. The circuit breakers shall be provided with an alarm contact (remote indication).

(2) Safety of Personnel

In the design of equipment, special emphasis shall be placed on safeguarding operation and maintenance personnel moving machinery, high voltage, height, high intensity radio frequency radiation and X-ray radiation.

This article defines "high voltage" that in excess of 300 volts DC.

(a) All cabinets, racks chassis, enclosed components, motor or generator frames and all external metal parts, shall be grounded.

(b) All terminal strips containing hazardous voltage, including those containing power line voltages or high voltage wiring, shall be equipped with covers.

Covers and terminal shall be such that sufficient mechanical rigidity and clearance are ensured to prevent short circuits and other failure.

The cover shall be provided with a cautioning notice in red.

(c) Grounding devices shall, where necessitated, be provided for the equipment in which high voltage exist. Storage clips shall be provided.

(d) Equipment in which high voltage exists shall be provided with interlock safety devices and there associated indicator lamps, operating upon opening doors and removing panels and chassis.

Means shall be provided so that maintenance personnel can temporarily disable the interlock for the purpose of making tests.

When the door or panel is returned to a closed condition normal interlock operation shall be automatically restored.

Conspicuous warning lamp shall be energized automatically when any interlock is disabled.

(3) Measures for Interferences

The Tenderer shall describe adequate countermeasures against presumable interference arising within the whole earth station system as well as from systems other than the Earth Station.

The Contractor shall investigate the interference conditions, and shall take sufficient measure such as shielding to prevent harmful interference.

2.5 Indication

(1) Equipment shall be provided with lamps that indicate circuit on/off and blown, and fuse.

The visible alarms by lamps shall be indicated at a place where maintenance personnel can see them easily, some audible alarms shall, if necessary, also be provided.

Lamps shall be color-coded according to functions, and they shall be replaceable from the front of the equipment.

(2) For security against dangerous phases, high voltage areas, etc., required warning signs shall be furnished.

(3) Connectors and teminals of equipment shall have the same notations as in the circuit diagram.

(4) A tag showing appellation, date and number of manufacture, and name of manufacturer shall be attached to each equipment.

(5) Designations shall be in Spanish.

2.6 Power Supply

All the equipment dealt with in the Part shall be fed from the power distribution boards.

Both Public mains and a non-break power source will appear on these board. Failure of public mains will cause a switchover to emergency diezel engine generator to be installed in the station.

The standards of power supply obtained from the power distribution boards in the power plant block are as follows.

(1) Public mains

System;	three phase, four-wire
Line-to-line voltage;	220 *Volts* $\pm$ 10%
Frequency;	50 Hz $\pm$ 1 Hz

(2) Non-break source and emergency diezel alternator

System;	Three phase, four wire
Other factors;	same as mentioned in chapter 7

2.7 Grounding

The Tenderer's Offer shall be containing data on the grounding electrical equipment, antenna and pedestal, lightening protection and building shielding nets, reinforcing steel, etc.

The Contractor shall adopt the most effective grounding method, after close investigation of the nature of the soil.

The method adopted shall have the Ministry's prior approval.

2.8 Human Engineering

The human engineering principle shall hold for the whole equipment design; but especially for control, monitoring and indication, so that personnel can easily perform required operations.

2.9 Other Factors

(1) All the symbols used in the documents concerned with telecommunications facilities, shall conform to C.C.I.T.T. and C.C.I.R. Recommendations.

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

CHAPTER 3 SITE DESCRIPTION

3.1 Site Location

The Earth Station is to be constructed on the designated site, Longitude 57°22'10" West, Latitude 25°21'40" South, near AREGUA, east-south-east of ASUNCION, as shown in Figs. 3.1 and 3.2.

3.2 Site Plan

The Earth Station occupies approximately 7 ha site area.

The Earth Station and related facilities shall be accommodated with the entire satellite communication equipment and auxiliary equipment and facilities as well as personnel working in the station so that smooth implementation of the earth station operation will be ensured.

Sobsoil investigation should be carried out by the Contractor prior to the building construction work.

The site for station building will be determined by consultation between the ANTELCO and Contractor referring to the finding of the investigation.

3.3 Scope

(1) Subsoil investigation and determination of the site for station building including antenna pedestal.

(2) Landscaping plan for the site shall be designed. The scope of such landscaping shall include grading, terracing, planting of grass, native shrubs, and trees in appropriate spots through the areas.

CHAPTER 4 PERFORMANCE REQUIREMENTS

4.1 Operation and Maintenance

The earth station shall be so designed that operation and maintenance work can be performed safely, accurately and easily with minimum operator and maintenance personnel. The microwave connecting link and the Central Office equipment shall be so designed as same as above.

Since the antenna site and the microwave connecting link are especially designed on a full time unattended basis, every item of these equipments shall be so designed that it can operate with remote control. If adjustment points were inevitable, their operations shall be controlled from the remote main building.

The Earth Station facilities shall be, as far as possible, composed of normal and emergency equipment facilitating quick and easy routine operations. They shall also facilitate on-line maintenance during operation.

4.2 Mandatory Technical Characteristics of a Standard Earth Station

4.2.1 System Gain-to-Noise Temperature Ratio

The aim must be to achieve for the receiving system a gain-to-noise temperature (G/T) of 40.7 dB at a 5^{o} elevation angle under clear sky conditions and a gain (G) greater than 57 dB. at 4 GHz.

Approval

G/T : $40.7 + 20 \log_{10} f/4$ (dB)

G : $57 + 20 \log_{10} f/4$ (dB) f ; GHz

Operating elevation angle, under clear sky in light wind, for any frequency in the bands 3705 to 3970 MHz and 3970 to 4195 MHz.

4.22 Transmit Antenna Sidelobe Pattern

Sidelobe levels at or more than 1^{o} away from the mainlobe center shall be at least 29 dB below the mainlobe maximum.

4.23 Antenna Steerability

Antenna steerability shall be compatible with quasistationary satellites at earth station elevation angels not less than 5^{o} with up to 10^{o} orbit inclination and $\pm 10^{o}$ longitudinal drift.

4.24 Antenna Tracking Modes

Manual and auto-tracking capability shall be provided. If auto-tracking is to be achieved by a means that involves amplitude modulation of transmitted carriers, then not only must the requirement of paragraph 4.2.10 be met in respect of stability of level of e.i.r.p. but, in addition, there must be agreement with the I.C.S.C. in the frequency of such modulation.

4.25 Feed System Radio Bandwidth

Receiving feed system:	3.7 to 4.2 GHz
Transmitting feed system:	5.925 to 6.425 GHz

4.26 Feed Polarization

Circular polarization, left-hand for transmission from the earth station and right-hand for reception by the earth station.

The voltage axial ratio of transmission in the direction of the satellite shall not exceed 1.4.

4.27 Receiving System Bandwidth

3705 to 4195 MHz

4.28 Transmitting System Bandwidth and Capability

5930 to 6420 MHz

4.29 Equivalent Isotropically Radiated Power (e.i.r.p.)

Carrier Size (channels)	Required e.i.r.p. in dBW (Elevation angle = 10^{o})	
	Global bean	Spot beam
24	74.7	–
60	77.8	81.4
96	79.5	–
132	80.6	83.9
192	–	84.7
252	82.8	85.4
432	85.1	88.4
612	–	90.1
792	–	91.5
972	90.9	–
1872	–	98.6
TV	88.0	–

Required e.i.r.p. for other elevation angles shall be modified by the equation of -0.06 (α - 10) dB. (α is the elevation angle in degrees).

Provision for adjustment of e.i.r.p. over a range of 10 dB below the maximum shall be provided.

4.2.10 e.i.r.p. Stability

Within $\pm$0.5 dB of the nominal value.

(except under severely adverse weather conditions)

4.2.11 Carrier Frequency Tolerance

±150 kHz for all telephony carriers except for the 2.5 and 5 MHz global beam and spot beam carriers (±80 kHz)

± 250 kHz for TV carriers

± 200 Hz for SPADE carriers

Long-term is assumed to be at least one month.

4.2.12 RF Out of Band Emission

Less than 4 dBW in any 4 kHz band within the 5925 to 6425 MHz frequency range excluding the multicarrier intermodulation products.

Intermodulation Products

Less than $26 - 0.06\ (\alpha - 10)$ dBW/4 kHz

(the frequency range of 5925 to 6425 MHz)

α is the elevation angle of the earth station antenna in degrees.

4.2.13 Group Delay Equalization and IF to RF Gain/Frequency Response

(a) For residual group delay in the satellite transponder

Maximum range (See Fig. 5.4)

(b) For group delay in the station transmit equipment

The limits after equalized (See Fig. 5.2, Table 5.3 & 5.4)

4.2.14 Residual Amplitude Modulation

4 kHz to 500 kHz: Less than -20 $(1 + \log_{10} f)$ dB referred to the RF carrier level at the antenna output. (rms value, within 4 kHz band, f is the center frequency in kHz of the 4 kHz slot)

Above 500 kHz: Less than -74 dB.

4.2.15 Telephony Baseband Assembly

Frequencies below 12 kHz are reserved for engineering service channels and energy dispersal inputs.

4.2.16 Sense of Video Modulation ion

Positive sense of modulation of the television video carrier such that a black-to-white transition at video causes the instantaneous radio frequency of the transmitted carrier to increase.

4.2.17 RF Energy Dispersal

Energy dispersal for both telephony and television carriers shall be based in the addition of a low-frequency symmetrical triangular waveform to the baseband signal to the FM modulator.

(a) Telephony (FDM-FM) Carriers

The maximum e.i.r.p. per 4 kHz of their transmitted carriers does not exceed the maximum e.i.r.p. per 4 kHz of the fully loaded carrier by more than 2 dB.

Frequency	20 Hz to 150 Hz
Frequency tolerance	$\pm$ 1 Hz

(b) Television Carriers

A fixed-amplitude symmetrical triangular waveform capable of producing up to 1 MHz peak-to-peak deviation.

Frequency	20 or 30 Hz
Phase	The points of inflection occurring during the field blanding intervals.

4.2.18 Pre-Emphasis

(a) Telephony (FDM-FM) Basebands

C.C.I.R. Recommendation No. 275-1

(b) Television

C.C.I.R. Recommendation No. 405

(c) Program Sound Channels

C.C.I.T.T. Recommendation No. J. 21.

4.2.19 e.i.r.p. for SPADE Carriers

Maximum e.i.r.p. 63.5 dBW

(per channel, at 10^{o} elevating angle)

Corresponding operation nominal e.i.r.p.

61.0 to 63.5 dBW

Stability $\pm$ 0.5 dB of the nominal value

e.i.r.p. at other operating elevation angle earth stations

e.i.r.p. at $10^{o} - 0.06\ (\alpha - 10^{o})$ dBW

α is the elevation angle in degrees.

4.2.20 Carrier Frequency Tolerance for SPADE Carriers

Within $\pm$ 200 Hz (shall be controlled)

4.2.21 RF Out-of-Band Emission for SPADE Carriers

Less than $23 - 0.06\ (\alpha - 10)$ dBW/4 kHz

(within SPADE band, interaction among FM carriers and SPADE carriers)

4.2.22 IF to RF Gain Frequency Response for SPADE Carriers

Within $\pm$ 0.5 dB over the trnaponder passband

4.2.23 e.i.r.p. for PCM/PSK Single-Channel-Per-Carrier Preassigned Carriers

Maximum required e.i.r.p.

63.5 dBW (at 10^{o} elevation angle

Operating nominal e.i.r.p.

53.5 to 63.5 dBW

Stability Within $\pm$ 0.5 dB of the nominal value

e.i.r.p. at other operating elevation angle earth station

(e.i.r.p. at 10^{o}) – 0.06 ($\alpha - 10^{o}$) dBW

(α is the elevation angle in degrees.)

4.2.24 Carrier Frequency Tolerance For PCM/PSK Single-Channel-Per Channel-Per-Carrier Preassigned Carriers

Within $\pm$ 200 Hz of its allocated value.

4.2.25 RF Out-of Band Emission For PCM/PSK Single-Channel-Per Carrier Preassigned Carriers

Less than 23 – 0.06 ($\alpha - 10^{o}$) dBW/4 kHz (within the single channel PA carriers and FM carriers)

4.2.26 Engineering Service Circuits

Channels Inverted sidebands of virtual carrier frequencies 3 kHz and 12 kHz

Telegraph engineering service channels

Within each of the 4 kHz channels at 2.7, 2.82, 2.94, 3.06 and 3.18 kHz

Voice circuits Four-wire basis

Alighnment level at the reference point of the voice circuits

The same as for all other voice channels on the carrier

Crosstalk attenuation

Less than 60 dB

Signalling 2280 Hz, -6$\pm$1 dBmO (C.C.I.T.T. Rec. M. 61, Vol. IV, Blue Book)

Telegraph circuits

Frequency-shift modulated voice frequency telegraph system	
Main level	-24±1 dBmO
Modulation rate	50 bauds
Stop condition	Low frequency to line (Alphabet No. 2)

4.2.27 In-Service Baseband Noise Measurements

At a transmitting earth station, an attenuation exceeding 50 dB over a minimum frequency band of $\pm$ (0.005 f_c + 2) kHz shall be provided at each baseband input so as to provide adequate baseband input attenuation in the noise-measuring slot.

The center frequency "f_c" of the noise-measuring bands is specified in the following table:

Baseband Capacity (Channels)	Center Frequency (f_c, kHz)
24	116
60	277
96	448
132	607
192	884
252	1157
432	1976
612	2794
792	3612
972	4430
1872	8932

4.3 Transmission Performance

The design objective for the earth station facilities shall be in compliance with the relevant C.C.I.R. and C.C.I.T.T. Recommendations.

The links established between the earth station and other earth stations performances of which are not interior than the former, containing the INTELSAT III and IV satellites having equal or superior performances, shall satisfy the following standards.

Telephone links	:	Conform to C.C.I.R. Recommendation 353-2
Television links	:	Conform to C.C.I.R. Recommendation 354-1 and Report 208-2

CHAPTER 5 TECHNICAL REQUIERMENTS FOR THE EARTH STATION EQUIPMENT

5.1 General

The purpose of this chapter is to state the specifications and detailed design, technical and performance requirements for individual electrical, elctronic and mechanical equipment which comprise the satellite communications equipment except Power Supply Equipment (CHAPTER 7), Earth Station Building (CHAPTER 8), Terrestrial Microwave Connecting Link (CHAPTER 9), and Central Office Equipment (CHAPTER 10).

Design, fabrication and installation of the equipment shall be conducted with the aim to have access to the INTELSAT-IV series satellites.

Consideration shall also be given to such requirements that they may be placed in use for possible new satellite systems in future with minimum modification.

In addition, the equipment and their installation shall be also designed to be capable of coping with foreseeable future expansion requirements.

The systems described herein are Antenna System, Transmitter and Receiver System, Multiplexing Equipment System, Control and Monitor System and SPACE Terminal System.

Each system is composed of several subsystems as shown in each system configuration table.

The equipment included in each subsystem are not necessary for individually housing in one bay.

Frequency, channel capacity and channel arrangement of transmit and receive carriers will be noted later to the Contractor.

The Tenderer shall pay much attention to his proposal considering the latest issued Atlantic Ocean Region Satellite System Operation Plan

(S.S.O.P.) when he offers the proposal.

5.2 Antenna System

5.2.1 General

Antenna system is such that the communications antenna transmits radio signals in the 6 GHz band coming from the transmitter to a communications satellite and also receives 4 GHz signals from the satellite to supply them to the receiver in concert with the operation of tracking subsystem.

This system consists of such subsystems as the antenna foundation, servo-control and drive, tracking receiver, time standard and the other equipment.

Each subsystem shall contain equipment shown in Table 5.1, while typical system schematic example is given in Fig. 5.1.

Most of these subsystems are located at the antenna pedestal, while some of them are located in the earth station building.

Fundamental requirements for antenna system are as follows:

(1) The antenna shall be of an Azimuth (hereinafter referred to as Az) Elevation (hereinafter referred to as El) mount modified cassegrain antenna which is fed by four (or two)- reflector-beam-waveguide without a radome. And supporting structure of Az rotation is wheel-on-track mount type.

(2) The antenna shall be driven by electric motors controlled by thyristors with anti-backlash method.

(3) The modes of tracking shall principally be the autotracking detecting a satellite beacon signal and the manual tracking.

The Tenderer may optionally offer the programmed tracking equipment.

The autotracking shall be conducted by adopting the monopulse method detecting the higher modes producing in the feeder when a beacon coming direction diverges from the antenna boresight axis with a single or two channels transmission method.

Even if a programmed tracking system is not offered, the antenna system has to be taken into consideration that the programmed tracking can be introduced in future without any major modification.

(4) The antenna shall be desinged adequately to withstand the wind velocity specified in 5.2.2. (14) and any other environmental conditions.

The Tenderer shall state the design objectives of the antenna support against wind velocity.

Table 5.1 Antenna System

No.	Subsystem	Equipment	Remarks
1	Antenna Foundation, Pedestal and Rotating Assembly	Foundation Pedestal Az rotating assembly El rotating assembly Cable wrap device Other items	
2	Reflector and Primary Radiator	Main reflector Sub reflector Primary radiator	
3	Feed	Diplexer Polarizer 6 GHz rejection filter Other items	
4	Servo-control and Drive	El drive unit Az drive unit El drive motor Az drive motor El angle senser/encoder Az angle senser/encoder Servo amplifier	
5	Tracking Receiver	Down-converter Demodulator Test signal generator Other items	
6	Time Standard	Time standard equipment	
7	Miscellaneous	Portable boresight equipment Meteorological equipment Dehydrator Other items	Safety features and alarms

5.2.2 Overall Performance Characteristics

The antenna system shall have the following characteristics:

(1) Frequency Band

(a)	Transmit	5925 to 6425 MHz
(b)	Receive	3700 to 4200 MHz

(2) Polarization

(a)	Transmit	Left hand circular polarization
(b)	Receive	Right hand circular polarization

Notes; (i) Changeable to the reverse polarization within 6 hours.

(ii) Hand of polarization is defined in C.C.I.R. Report 321.

(3) Gain (including the feed subsystem)

(a)	Transmit	$63.0 + 20 \log_{10} \frac{f}{6}$ (dB)
(b)	Receive	$59.8 + 20 \log_{10} \frac{f}{4}$ (dB)

Note; f is the receive and transmit frequency expresses in GHz.

(4) Noise Temperature (including the feed subsystem)

Less than 50^{o}K at a 5^{o} elevation angle under clear sky conditions.

(5) Side Lobe Level

(a) Transmit sidelobes

(i) First sidelobe Less than -14 dB

(ii) Sidelobes at or more than 1^{o} away from the main center

Less than -29 dB

(b) Receive sidelobes

(i) First sidelobe — Less than -14 dB

(ii) Sidelobes at or more than 1^{o} away from the main center — Less than -26 dB

(6) Communications signal isolation — Less than -40 dBW (6 GHz signals appearing at the low noise pre-amplifier input when 2 kW CW is applied to the 6 HGz transmit input.)

(7) Axial ratio — Less than 1.5 dB

(8) VSWR

(a) Transmit — Less than 1.2 : 1

(b) Receive — Less than 1.2 : 1

(9) TE_{01} (or TM_{01}) mode pattern

(a) Null depth — More than 30 dB

(b) Null axis shift from the boresight axis — Less than 0.005^{o}

(c) Null axis -beam axis alignment

(i) Transmit beam axis — Less than 0.005^{o}

(ii) Receive beam axis — Less than 0.01^{o}

(10) Power Capability — More than 5 kW (CW)

(11) Antenna Steerability

(a) Azimuth — $\pm 180^{o}$ centered on an azimuth 0^{o}

(b) Elevation — 0^{o} to 90^{o}

(12) Slew velocity — From 0.005^{o}/sec to 0.3^{o}/sec both axis

(13) Slew acceleration 0.3^{o}/sec both axis maximum

(14) Wind Velocity Operation Mode and Pointing Accuracy

Wind velocity	Operation mode	Pointing accuracy
Up to 80 KMH (22m/s) steady wind, gusting to 120 KMH (33m/s)	Auto tracking	Less than 0.13 x beamwidth at 4 GHz
Up to 90 KMH (25m/s) steady wind, gusting to 135 KMH (38m/s)	Hold in any Position	Less than 0.13 x beamwidth at 4 GHz
Up to 110 KMH (31m/s) steady wind, gusting to 165 KMH (46m/s)	Drive to stow position	
Up to 160 KMH (44m/s) steady wind, gusting to 240 KMH (66m/s)	Survice in stow position and hold in any azimuth position	

(15) Angle position readout error

(a) Digital Within $\pm 0.01^{o}$

(b) Analogue Within $\pm 0.1^{o}$

(16) Locked rotor mechanical resonance frequency

Not less than 2 Hz around both axis

5.2.3 Antenna Foundation, Pedestal and Rotating Assembly

This subsystem shall consist of antenna foundation, pedestal constructed on the foundation, azimuth rotating assembly, elevation rotating assembly, cable wrap device, support structure, service platform, ladder and associated equipment.

(1) Antenna foundation

(a) The foundation shall be of reinforced concrete structure, guaranteed to be of sufficient strength to support the entire antenna system under all conditions of the imposed environment.

The antenna foundation shall be designed under the assumption that 30 ton/m^2 soil bearing capacity spreads throughout the site.

(b) The Contractor shall investigate the site soil nature prior to antenna installation. He shall submit a new design and can re-submit a quotation according to said results, if necessary.

(c) The Tenderer shall submit structural drawings and design calculations for the foundation.

(d) The antenna foundation shall have an appropriate bronze plate with a datum point inscribed on it. The Contractor shall survey the azimuth and elevation angle against the boresight antenna (optical target) from the datum point, then this results and the longitude, latitude and height above sea level of the datum point shall be marked on the plate, the relationship between the Az axis slewing center and the datum point shall also be inscribed.

(2) Pedestal

(a) The pedestal, a reinforced concrete tower or building installed on the foundation, shall be sufficiently strong to support all the structures on the pedestal.

(b) The pedestal shall be constructed adjacent to the earth station building which accommodates the communications equipment rooms, power supply equipment room, office rooms and any other necessary rooms, or shall be constructed as a part of the building.

The Tenderer shall offer the design objectives of the pedestal and the earth station building including necessary number and space of the rooms and the layout of the equipment.

(c) The Contractor shall offer the method of antenna re-leveling.

(3) Rotating Assembly

(a) Az rotating assembly is the generic name of the structures rotating around the Az axis supporting the elevation rotating assembly, main and sub reflector etc.

(b) Az rotating assembly shall not only support the whole structures vertical weight but bear the given environmental conditions especially for strong wind pressure and shall be capable of rotating without floating from the track.

(c) Az rotating assembly shall be designed as light as possible.

(d) Az rotation shall be the wheel-on-track type being capable of $\pm 180^{\circ}$ rotation centered on an azimuth of 0° at least. The Tenderer shall state the wheel-on-track type (single track or dual track) and the support configuration including the wheels, beam waveguide assembly configuration and etc.

(e) The elevation rotating assembly shall stand the whole structures supporting a reflector. It shall consist of elevation bearings, counter weight, gear assembly and etc.

(f) The elevation rotating assembly shall be rotatable over the range from 0° to 90° and a stow pin for antenna holding at zenith shall be furnished. They shall be capable of remote control from the control room.

The hold device and the stow pin shall without any permanent distortion, withstand winds with maximum velocity of 135 KMH (gust) and 240 KMH (gust) respectively.

(g) The non-orthogonality between the Az and El axes shall not exceed 0.02°.

(h) The non-perpendicularity between the Az axis and the local gravity direction shall not exceed 0.02°.

(i) The Contractor shall offer the concrete plan relating to the following items.

(i) Suitable provisions for fixed operation for both axes capable of fixing at any position (fixed mode)

(ii) Protection against antenna floating from the track by strong wind

(iii) Installation of suitable brakes

(iv) Protection against thunderbolt

(v) Installation of mechanical limit switches and buffers for antenna over-travelling

(vi) Removing provisions and/or alarms on the track

(vii) Suitable devices such as a water level for checking the Az horizontally

(viii) Total weight of the antenna rotating parts

(4) Cable Wrap Device

(a) The device shall accommodate all the cable necessary for the Az and El rotating assemblies.

(b) The device shall have the construction that can rotate at least $\pm 180^{o}$ centered on an azimuth of 0^{o} around the Az rotating axis.

(c) The cables to be used shall be a long use and have a twist proof property.

(d) The device shall easily be maintainable and checkable.

(e) The device shall have the construction, if required, capable of avoiding the baneful influences of the sun light and the rainfall.

(f) The Tenderer shall offer the construction drawings for the calbe wrap device that satisfy the requirements stated above, type, number and diameter of the afforded cables and other necessary matters.

(5) Other Items

(a) Platforms, stairs, walkways and ladders necessary for the maintenance and checking shall be provided.

(b) Lightings necessary for the maintenance at night shall be provided.

(c) Aircraft warning lights shall be provided.

(d) Lightinig rods shall be provided at the apex and on the dish edge of the antenna according to (JIS A 4201 or) the equivalent standard.

(e) Personnel Safety Devices

All personnel passage facilities shall be provided with safety devices such as on-skid walkways, steps and ladders.

(f) Condensation and Standing Water

The Contractor shall provide the means to eliminate internal condensation on enclosed portions of the building, and to prevent accumulation of standing water on the antenna and building in any orientation. Run off of rainfall shall be directed by ducts away from the building and to a ground level drainage system.

5.2.4 Reflector and Primary Radiation Subsystem

The subsystem shall be composed of main reflector, sub-reflector and primary radiator.

(1) Main Reflector and Sub Reflector

(a) The antenna shall be of modified cassegrain type with an aperture of 28 m or more. The Tenderer shall give his concept of the rear structure, framework, size and F/D radio. (F: equivalent focus)

(b) The subsystem shall be designed and fabricated to be light and rigid so that deformation caused from posture can be reduced to a minimum.

Particular care shall be paid to design and fabrication in order to reduce reflector deformations caused from strong sunlight.

(c) Means shall be provided to measure mechanical deformations and, if necessary, to correct them.

(d) The subreflector supporting structure shall seldom cause any radio blocking or scatter. Deformation caused from posture shall be the minimum possible.

(e) The main reflector surface accuracy shall be $\varepsilon/D = 6 \times 10^{-5}$ or better relative to the best fit paraboloid at the elevation angle designated to the Contractor later on. Here D is the reflector diameter and ε is the r.m.s. surface tolerance. The subreflector surface accuracy shall be 0.3 mm r.m.s. or less, relative to the ideal surface.

(f) Reflector Deformation caused from the antenna posture

The deformation amount relative to the standard surved surface design contour of the main reflector shall not exceed 25 mm (p-p) for all elevation angles between 0^{o} and 90^{o}, and the main reflector rotating axis relative to the reflector axis in the standard curved surface shall be less than 0.07^{o} (p-p) rotating component.

The displacement amount due to the angle of elevation of relative position between the main reflector and the sub-reflector shall be less than 10 mm (p-p) for the displacement of parallel component and less than 0.15^{o} (p-p) for the rotating component based on the mechanical axis in the optimum standard surface at its angle of elevation.

(g) Adequate convenience for inspections or structural regulation shall be furnished on the subreflector supporting mount.

The ladder so as to be able to access to the window for looking into the mirror face of the main reflector at the elevation angles of both 90^{o} and operation shall be provided at the supporting mount.

(h) The back-up sturcture shall be provided with the bone construction which keeps the mirror surface shape of the main reflector exactly. The back-up structure shall be designed so that its weightis as light as possible and its deformation due to the aging and vibration are minimized. Consideration shall be taken especially for the fastening and welding method of parts and components.

(i) The Contractor shall apply the white painting on the mirror surface which has long lasting, weather-proof and corrosion-proof properties.

The Tenderer shall state regarding to component and electrical properties (ε and tan δ) of the paint and its long lasting property and corrosion-proof property.

(j) The Tenderer shall state the designed objectives of the F/D ratio, structure, dimension, relative position, back-up structure material, expected values that are anticipated etc. of the main reflector and subreflector that satisfy the requested items stated above and describe the features.

(2) Primary Radiator

(a) The primary radiator shall be consisted of the primary horn and several reflector-beam-waveguide.

(b) Each reflector shall be adjustable with its location.

(d) The inner surface of the horn shall be finished with the material of high conductivity and with high surface accuracy.

(d) The horn aperture shall be covered with the appropriate sheet which is low loss and little aging and relatively easily replaceable, if necessary, even in operation.

(e) The horn shall be filled with the pressurized and dried air.

(f) The reflector-beam-waveguide shall be constructed so as to be with low loss and obtain preferred frequency characteristics over the

transmitting and receiving frequency band. The reflector mirror surface shall be painted with the same material as the main reflector.

(g) The counter measures, if necessary, shall be taken for the primary radiator in order to prevent sand, dust, wind and rain etc. And, the portion which may cause the danger to the human life shall be covered completely.

(h) The Tenderer shall submit the design objectives regarding the following terms;

(i) Structure and dimension of the horn and its technical features.

(ii) Number of reflectors, shape of reflectors surface, accuracy of the reflectors surface, structure, dimension and their technical features.

(iii) Relative location between the horn and reflectors and the technical reasons thereof.

(iv) Data for material, dimension, electrical performances, service life etc. of the horn cover.

(v) Descriptions for the movement of each reflector accompayning the Az rotation and the El rotation, and the absense or presence of the rotary joints.

(vi) Descriptions for the method of setting each reflector.

5.2.5 Feed Subsystem

The subsystem shall be composed of diplexer, polarizer, error sampling coupler, beacon signal diplexer and 6 GHz rejection filter, etc.

The subsystem shall satisfy the following items for all of the used frequency band of 4 and 6 GHz.

(a) Loss

Transmit feed:	Less than 0.15 dB
Receive feed:	Less than 0.15 dB
	(excepting the band of beacon frequency $\pm$ 4 MHz)

(b) VSWR

Transmit branch:	Less than 1.17 (The worst value within the whole band)
	Less than 1.12 (The worst value within 90% of transmitting frequency band)
Receive branch:	Less than 1.17 (The worst value within the whole band)
	Less than 1.12 (The worst value within 90% of receiving frequency band)
	Excepting the band of beacon frequency $\pm$4 MHz.

(1) Diplexer

(a) A diplexer shall feed 6 GHz bands high power from the transmitter to the feed horn, or feed the 4 GHz bands receiving singal from the feed horn to the receiver.

(b) Interference from the transmitting circuit to the receiving circuit shall be as minimum as possible, under the designated frequency band and polarizations conditions.

(c) Isolation shall be established with the aid of a combining diplexer and a 6 GHz rejection filter. The Tenderer shall determine the individual isolation performance thereof.

(d) The Tenderer shall describe the design objective for insertion loss and VSWR.

(e) The transmit and receive branches shall be well located for connecting the transmitter and receiver subsystem.

(2) Polarizer

(a) The polarizer shall be capable of changing from the right hand circular polarization to linear polarization in the receive direction, and from the linear polarization to the left hand circular polarization in the transmit direction.

(b) The polarizer shall also be possible to change from right/left hand circular to left/right hand circular polarization in the receive and transmit directions.

(c) Change of polarization from circular to linear mode shall be attained by simple change of components.

The Tenderer shall state the structures, procedures and time necessitated for changing from circular to linear mode.

(d) The Tenderer shall specify the desing objectives for insertion loss, VSWR and cross polarization ratio or axial ratio of the polarizer.

(3) Rejection Filter

(a) Working with the diplexer, the 6 GHz rejection filter shall be sufficiently capable of suppressing the transmitting signals by the value specified in 5.2.2 (6).

(b) The Tenderer shall specify the design objectives for insertion loss and VSWR across the 3700 to 4200 MHz.

(4) Beacon Signal Diplexer

(a) The beacon signal branching circuit shall pick up a beacon standard signal from a satellite, then feed it to the tracking receiver.

(b) The beacon signal input power at the horn input flange shall be estimated at -155 to -120 dBW.

(5) Error Sampling Coupler

(a) The error sampling coupler shall pick up a part of error pattern mode or higher mode produced in a feed horn as a tracking error singal, then send it into a tracking receiver.

(b) The Tenderer shall offer the blockdiagram of this circuit, the method of picking up the beacon reference singal (Σ signal) and the error signal (Δ signal), the method of composing these signals and the transmission method of the composite signal to the tracking receiver (the method of passing through the low noise receiver of the method of transmitting by providing independent transmission circuit).

(6) Other Items

(a) A rotating joint requisite for R.F. power transmission between the feed system and the transmitter or receiver, shall have lowest possible loss.

(b) The outdoor portion of the feed system subject to dew Condensation shall be pressurized with dry air. The necessary pressurizing device, including the gas barriers, shall be provided.

(c) The test circuit regarding the tracking shall be provided.

(d) Change of the beacon frequency shall be possible only by the simple adjustment and the replacement of components.

5.2.6 Servo-Control and Drive Subsystem

This subsystem transmits commands from the antenna control subsystem and steers the antenna to the required position. The subsystem shall consist of Az drive unit and drive motors, El drive unit and drive motors, Az angle senser/encoder, El angle senser/encoder, a servo amplifier, a control unit and other associated unit including auxiliary power switching boards.

(1) Az, El Drive Units and Drive Motors

(a) Az and El drive units shall consist of the transmission gear series for drive motor torque and other accessories.

(b) The drive units shall be of anti-backlash type.

(c) Drive velocity shall be as follows.

Slew velocity from 0.005^{o}/sec to 0.3^{o}/sec both axes

Slew acceleration $0.3/sec^{2}$ both axes maximum

(d) Two removable handles (for Az, El) to steer the antenna by hand shall be provided. Insertion of the handle shall make the drive power transmission system disenergized from the power.

(e) Limit switches shall be furnished to prevent antenna angular traveling.

(f) Az and El drive torque shall be fed from electric motors.

The motor should be free from any harmful interference to the telecommunication system.

(g) The drive motor shall usually provide anti-backlash type.

(h) The Tenderer shall offer the method of single motor drive and auxiliary motor drive considering the normal drive failure.

(i) Drive motors shall be used for each axis independently.

(j) For smooth operation, the drive systems shall be provided with an automatic lubrication device.

(k) All the pinion and bull gears in the drive system shall be provided with dust proof and protective covers.

(2) Angle Senser/Encoder

(a) Az and El angle senser/encoder shall be able to function detecting Az and El axis angle informations either directly or indirectly.

(b) Unless senser units are directly jointed to the antenna axis, special precautions shall be taken to reduce backlash.

(c) The resolution of the senser/encoder shall be 0.01^{o} or better. The output shall be in digital form.

(d) The analogue angle information senses by the angle senser shall be converted into digital form by the encoder necessary for the display and programmed control.

(e) The limit switches shall be provided to indicate that the pointing angle of the antenna exceeds a certain limitted range and to turn the driving off.

(f) All of the digital signals shall be sent out in BCD (Binary Coded Decimal).

(g) The Tenderer shall offer the angle sensing method and digital conversion method etc. He shall, in addition, specify the accuracy of

the angle detection of the whole system considering also of the case of programmed tracking.

(3) Servo Amplifier and Control Unit Subsystem

(a) This subsystem shall have necessary functions for receiving the error signal from the tracking receiver (or programmed tracking equipment) or manual control signal from the antenna control/monitor bay to correctly drive the antenna.

(b) It shall be provided with the logic circuit and display circuit that can be driver with each operation mode of the autotracking, (programmed tracking) and manual tracking and also with the servo-loop that can stably and accurately operate in each operation mode.

(c) It shall be provided with the secant correction network and co-ordinates conversion network.

(d) It shall be able to stop the drive motor and to switch-over between the normal drive by 2 motors and emergency drive by the single and/or auxiliary drive motor alternately.

(e) It shall be taken into consideration that step response characteristics of the drive system including mechanical system of the antenna can be checked.

(f) Stand-by system shall be provided at the important parts and switch-over shall be possible automatically.

(g) The Tenderer shall state the following.

(i) Configuration and schematic blockdiagram of the subsystem.

(ii) Step response characteristics for the entire driving system' in the autotracking mode.

(iii) Drive servo loop frequency characteristics.

5.2.7 Tracking Receiver Subsystem

This subsystem shall receive and demodulate a beacon signal from a satellite, then produce a tracking error signal for antenna driving. Higher modes detection, mono-pulse tracking method shall be adopted.

The subsystem shall consist of down-converter, demodulator, test (or beacon) singal generator including coupling circuit and accessory devices.

(1) Down-converter

(a) A tracking signal input level is estimated as -155 dBW to -120 dBW relative to the level at the horn input flange.

(b) Beacon frequency shall be easily changed by the replacement of components and with simple adjustment. For the time being, The Contractor shall prepare the parts so as to be able to receive the beacon signals of 3947.5 MHz and 3952.2 MHz.

(c) Frequency capable of being tracked shall be the beacon frequency of $\pm$ 150kHz.

(d) The Tenderer shall state the design objectives regarding the following terms:

(i) Noise figure and receivable level (threshold level)

(ii) Output frequency and frequency bandwidth

(iii) Output level

(iv) Frequency stability and frequency setting accuracy of the local oscillator.

(v) Changing method of beacon signal frequency.

(vi) Image rejection characteristics (spurious of the local oscillator).

(vii) On proposing 2 channels transmission system, amounts in the gain variation and phase variation between both channels and the counter measures therefor shall be stated.

(2) Demodulator

(a) The demodulator shall have the funcitons of receiving IF signal from the down-converter and detecting the Az error voltages and El error voltages.

(b) The demodulator for reference channel shall provide with a voltage controlled local oscillator (V.C.O.) and shall be capable of frequency searching; therefor the phase lock demodulator is required. The V.C.O. shall be suitable for receiving a signal with doppler effect.

(c) Sweep range shall be at least $\pm$ 200kHz. It shall be possible to remotely control the width from the antenna control bay. The sweep shall be possible both automatically and manually.

(d) The phase lock demodulator shall be employed that has a coherent AGC circuit in ouder to reduce the effect of the level variation due to the error signal and to improve the threshold level.

(e) Equivalent noise bandwidth shall be varied in accordance with the input signal to noise ratio.

(f) The demodulator shall send out the signals necessary for the display for operation to the antenna control/monitor bay.

(i) Lock on and lock off

(ii) Angle error amount

(iii) AGC output voltage

(iv) Other necessary items (beacon frequency etc.)

(g) The test circuit of the subsystem shall be provided.

(h) The Tenderer shall specify the following characteristics.

(i) Input level and threshold level

(ii) Relative gain and relative phase shift between reference channel and error channel

(iii) Reference channel signal leakage to error channel

(iv) Phase lock loop characteristics

(v) Acquisition characteristics

(vi) Other necessary characteristics

(3) Test signal Generator

A test signal generator including coupling circuit suitable for maintenance checking shall be provided.

(4) Other Items

Miscellaneous units necessary for the subsystem shall be provided.

5.2.8 Time Standard Subsystem

(a) The time standard equipment shall be capable of generating accurate standard timing signals and timing signals of other kinds.

It shall then distribute these signals to the clocks, both local time and universal time, in the monitor room, control/monitor bay and/or console and other places required.

The time shall be displayed in digital form and shall be indicated on clock panels.

(b) Capability of receiving the standard radio wave (frequency of which will be given to the Contractor later) and of calibrating the time standard signal shall be provided.

(c) A crystal oscillator shall be adopted for the timing signal master oscillator.

Normal and emergency oscillators shall be provided, which shall be capable of automatic mutual changeover.

(d) Frequency accuracy and stability

frequency setting accuracy	:	$\pm 2 \times 10^{-8}$
frequency stability	:	$\pm 5 \times 10^{-8}$/day
	:	$\pm 7 \times 10^{-8}$/month

(e) Holding circuit for power interruption shall be provided.

(f) The output signals shall be the binary coded decimal timing signals for programmed Tracking, the slave clock driving signals for 1

second, 30 seconds and digital slave clocks, the reference timing pulse signals for programmed tracking. The timing pulse signals for precipitation measuring equipment reset pulse signal and any other necessary signals for the earth station equipment.

(g) This equipment shall have the monitoring and/or time resetting slave clocks for both 1 second and 30 seconds.

(h) The Contractor shall furnish at least the following clocks in the earth station.

(i) Master clock shall be installed in this equipment with digital display.

(ii) Slave clocks shall be installed in the monitor room (Local time and universal time with digital display), at television control/monitor console and antenna control/monitor bay (Local time with digital display respectively), in the station master room and office rooms (1 second-slave clock) and in the other equipment rooms (30 seconds-slave clock).

3.2.9 Miscellaneous

(1) Portable Boresight Equipment

(a) This equipment shall have the functions of receiving the signal of 6 GHz band (5925 to 6425 MHz) from the earth station, converting them into the 4 GHz band (3700 to 4200 MHz) to send it to the earth station, and generating the beacon signal in order to be employed mainly for the test of the earth station antenna (including tracking receiver) and radio communications equipment.

(b) This equipment shall be possible to install in any locations apart from the earth station site by about 10 km and shall have the structure which can easily be transported by vehicles such as jeep etc. and withstand thoroughly vibration, wind and rain.

(c) This equipment shall be able to operate by both AC 220 Volts and batteries power sources.

(d) It is desirable that the equipment can also be used as both the beacon test signal generator specified in 5.2.7 (3) and 6 GHz – 4 GHz translator specified in 5.3.6 (1).

(e) The antenna shall be the conical horn capable of simultaneous operation over the 3700 to 4200 MHz and 5925 to 6425 MHz bands and easily sending and of receiving both linear and circular polarized waves.

The Tenderer shall state antenna gain, pattern, VSWR, axis ratio, cross coupling (circular polarized).

(f) The output of the equipment shall be the frequency lower than that of the input signal by 2225 MHz and the output level shall be possible to be varied by at least 2 dB step over the range or -150 dBm to -80 dBm when calculated at the earth station receiver input.

(g) The beacon frequencies shall be 3947.5 MHz and 3952.2 MHz for the time being and the output level shall be possible to vary by at least 2 dB over the range or -125 dBm to -90 dBm when calculated as the earth station antenna horn input.

(h) The Tenderer shall state the following items:

(i) Gain/frequency response

(ii) Transmitter harmonics, receiver local oscillator signal leakage

(iii) Receiver spurious and image response

(iv) Transponder and beacon frequency stability(per hour and per day)

(v) Transponder input and output level

(vi) Receiver noise figure

(i) The Contractor shall furnish one set of VHF transmitter and receiver for the communication between the earth station site and boresight.

(2) Meteorological Equipment

(a) This equipment shall measure, record, and display of wind direction, wind velocity, precipitation amount and barometric pressure in the earth station necessary for the antenna operation.

(b) The mast to be furnished with the wind measuring equipment shall be installed at the location where is considered equivalent in measuring the direction and velocity of the wind blowing to the antenna and where also do not affect to antenna performances.

The wind measuring equipment shall be mounted at the appropriate height to it.

The precipitation measuring equipment shall be installed on the ground where no disadvantages are given to the routine works and the measuring of the precipitation is not affected.

(c) The recorder that records and displays the wind direction, wind velocity and precipitation amount shall be provided in the control room and a barometric pressure measurement equipment that measures the barometric pressure shall also be provided in the control room.

(d) Measuring items and measuring ranges are as follows:

(i)	Wind direction	All direction (360^{o})
(ii)	Wind velocity	Instantaneous velocity (up to 200 kMH)
		10 minutes average velocity (up to 160 kMH)
(iii)	Precipitation	Accumulated precipitation recording for 10 minutes, one hour and 24 hours by 1 mm unit/min.

(e) Indication meter shall be provided for the wind direction and instantaneous wind velocity.

(3) Dehydrator

(a) This device shall fill the antenna feed and wave guide with dried and desulphurized air at a constant pressure.

(b) The regeneration and the filling of the dried air shall be performed automatically.

(c) Air storage tank shall be provided as the buffer for loads.

(d) Abnormal increase and decrease of the pressure shall be alarmed by providing a pressure gauge.

(e) Compressor shall be the type of non-oil supplying.

(f) Continuous operation for 24 hours shall be possible.

(g) The Tenderer shall state the following items:

(i) Switching cycle time schedule for filling and regeneration.

(ii) Filling pressure

(iii) Dew point of the dried air

(iv) Other necessary items

(4) Other Items

(a) Safety Features and Alarms

The antenna system shall be provided with the following safety means and alarms:

(i) Interlock and alarm for antenna drive

(ii) Limit switch and alarm for antenna angular travel

(iii) Buffer capable of stopping the antenna without any structual deformation of the reflector, against overriding beyond the the limit switches with the maximum speed and torque.

(iv) Microwave power cut out at low elevation angle (adjustable between 0^{o} to -5^{o}) complete around the Az circle, except for the direction of the boresight.

(v) Az, El axes hold control

(vi) Stow pin control

(vii) Brake for drive motor

(viii) Handle for manual hand drive

(ix) Minor and major alarms for failures of each equipment in the servo control and drive subsystem

(x) Alarm for power failure including stoppage

(xi) *Other items necessary for safe operation of the antenna* system

5.3 Transmitter and Receiver System

5.3.1 General

This system shall consist of such subsystems as transmitter, receiver, modulator and demodulator and test equipment to be located in the antenna pedestal and/or communications equipment room. Table 6.2 shows the subsystems and equipment to be consisted of.

This system shall convert the baseband signals coming from the multiplexing equipment and television control and monitor console into the IF signals by the FM modulator and further convert the IF signals into the RF signals of 6 GHz band and amplify them by the power amplifier to the necessary level. Then the carriers are combined with other carriers amplified in the same way and sent to the antenna system.

The RF signals of 4 GHz band coming from the antenna system shall be amplfied by the low noise pre-amplifier and wideband RF amplifier, converted into the IF singals and further converted into the baseband signals by the FM demodulator and then sent to the multiplexing equipment and television control and monitor console.

The test equipment is one which shall perform in-station test at IF band and RF band loop, line up test via satellite and the maintenance work.

The transmitter subsystem is composed of 3 routes for transmitting the telephony carrier, SPADE carriers and television video and associated audio carriers.

The television video and associated audio carriers tansmitter shall be on hot standby for the telephony or SPADE transmitter when the television transmission is out-of-service. If the telephony or SPADE transmitter is failed, the television transmitter shall automatically back up for it.

The receiver subsystem shall commonly amplify the all received carriers. The subsystem shall be composed of 2 routes which are normal (operation side) and emergency (standby side) respectively. If the normal side is failed, the emergency side shall automatically back up for keeping the communications.

The modulator and demodulator subsystem is desirable to be consisted of fully duplicated system except the television video and associated audio chains capable of automatically switch-over with each other.

The Tenderer shall state the configuration and redundancy of this system and the method of the switch-over referring to the concept of the switch-over stated in 5.3.2 (4) in this proposal.

Table 5.2 Transmitter and Reveiver System Configuration

No.	Subsystem	Equipment	Remakrs
1	Transmitter	Power amplifier Carrier combiner Associated equipment	telephony (1) SPADE (1) television (2)
2	Receiver	Low noise pre-amplifier Wideband RF amplifier RF divider RF pilot oscillator and RF pilot detector Associated equipment	telephony (9) SPADE (1) television (2)
3	Modulator and Demodulator	Up-converter Down-converter Transmit system equalizer Receive system equalizer FM modulator FM demodulator Baseband distribution unit Associated equipment	telephony (9) SPADE (1) television (2)
4	Test Equipment	6 GHz - 4 GHz translator Test up-converter Test down-converter Test modulator Test demodulator Test baseband distribution unit Telephone test bay Associated equipment	

5.3.2 Overall Performance Characteristics and Switch-Over

This article stipulates the main overall performance characteristics for the base band to base band (transmitter and receiver loop), base band to RF band (Transmitting BDU to transmitter) and RF band to base band (Receiver to receiving BDU) measured with the 6 GHz-4 GHz translator, the boresight equipment and other proper measuring equipment or devices.

In addition, this article also stipulates the main performances concerning the switch-over of the transmitter and receiver system.

(1) Baseband to Baseband Performance Characteristics

(a) Telephone Circuit

(i) Noise

In adopting pre-emphasis and de-emphasis conforming to C.C.I.R. Recommendation 275-1, the thermal and distortion noises Psophometrically weighted in any 3.1 kHz bandwidth telephony channel shall not exceed 1500 pWp. This value includes noise due to the satellite group delay.

(ii) Gain/Frequency Response

The performances for various number of channels in accordance with the C.C.I.R. emphasis, shall be as follows;

For carriers of 252 channels or less in the range of 12 kHz to f_{top} ; $\pm$ 0.5 dB referred to 0.608 f_{top}.

For carriers greater than 252 channels in the range of 12 kHz to f_{top} ;

1. $\pm$ 0.1 dB referred to 0.608 f_{top}.
2. Variation in any 250 kHz baseband range are not to exceed $\pm$ 0.5 dB.

For all carriers in the range of 4 kHz to 12 kHz ; + 1.0 to -1.5 dB referred to 0.608 f_{top}.

(iii) The non-linearity response for all carriers shall not exceed 3 % or 0.3 dB. The adding level will be the conventional load plus peak-factor (10 dB) plus pre-emphasis correction (4 dB) plus peak-to-r.m.s. factor (3 dB) for a sine wave.

(iv) Signal-to-Noise Ratio

The signal to noise ratio shall be better than 50 dB, psophometrically weighted, in the condition of operation C/T.

(v) Impulsive Noise

The impulsive noise limit for channels shall not be more than 6 counts in 15 minutes at a threshold level of -21 dBm0 in the condition of operation C/T.

(vi) Baseband Noise Spectrum

The level of any spurious signals in the baseband frequency range from 4 kHz to f_{top} shall not exceed -60 dBm0.

(vii) Input and Output Level

The Tenderer shall specify the input and output level at the baseband distribution unit input and output.

(b) Television Video Circuit

The following items are specified including the television control/monitor subsystem in 5.4.3. As for the measuring conditions, C.C.I.R. Recommendation 421-2 and S.S.O.G. Vol. II shall be referred to.

(i) Input and Output Signal Level

1 volt peak-to-peak nominal (picture signal 0.7 volts, sinch-ronizing signal 0.3 volts)

(ii) Input and Output Impedance

75 ohms unbalanced, return loss shall be 26 dB or more.

(iii) Level Stability

Within $\pm$ 0.2 dB/sec for short time, $\pm$ 0.6 dB/hour for medium term and $\pm$ 1.0 dB/day for long term.

(iv) Signal-to-Noise Ratio

1. Continuous Random Noise

The signal-to-weighted random noise ratio shall not be less than 58 dB.

2. Periodic Noise

The signal-to-noise ratio shall be as follows;
Noise below 1 kHz 50 dB (p-p/p-p)
Noise in the range 1 kHz to the top video frequency
55 dB (p-p/p-p)

The periodic noise is defined as single-frequency noise such as power supply hum including fundamental and lower order harmonics.

(v) Gain/Frequency Response

The gain/frequency response shall be not more than $\pm$ 0.6 dB referred to 15 kHz in the range of 50 Hz to f_{top}.

(vi) Group Delay Response

The group delay response shall be not more than $\pm$25 ns referred to 0.04 f_{top} in the range of 100 kHz to 0.75 f_{top}, and not more than $\pm$ 50 ns referred to 0.04 f_{top} in the range 0.75 f_{top} to f_{top}.

(vii) Synchronizing Signal Non-Linearity Distortion

The-amplitude of the synchronizing pulse measured at its midpoint shall be between 105% and 90% of nominal pulse amplitude.

(viii) Linear Waveform Distortion

1. Field Time Waveform Distortion

With C.C.I.R. test signal No. 1, the variations of the test signal bar top about its midpoint do not exceed $\pm$ 1%.

2. Line Time and Short Time Waveform Distortion

With C.C.I.R. test signal No. 2, The performance objectives shall be satisfied by the following values or better.

line bar	$\pm$ 1.0 %
2T pulse/bar ratio	0.94 to 1.06
1T pulse/bar ratio	0.75 to 0.95
1T pulse leading or lagging lobe/1T pulse ratio:	
1st negative lobe	0.14
1st positive lobe	0.09

(ix) Differential Gain

The differential gain distortion shall not exceed 5 %.

(x) Differential Phase

The differential phase shall not exceed $\pm$ 3 degrees.

(2) Baseband to RF band Performance Characteristics

(a) IF (baseband to baseband) to RF Amplitude Response

(i) For the telephony and television video carriers, the IF (baseband) to RF amplitude response shall be within the limits given in Fig. 5.2 and Table 5.3.

(ii) For the SPADE carrier, the IF to RF amplitude response shall be flat within $\pm$ 0.5 dB over the transponder passband.

(b) IF (baseband) to RF Group Delay Response

The group delay response shall be within the limits given in Fig. 5.3 and Table 5.4.

(c) Output Power Level

(i) FDM-FM telephony carrier ; Maximums e.i.r.p. shall be 80.6 dBW or more.

(ii) SPADE carriers ; Maximum channel capacity shall be 12 channels and maximum e.i.r.p. for each carrier shall be 63.5 dBW.

(iii) Television video carrier ; Maximum e.i.r.p. shall be 88 dBW or more.

(iv) Television associated audio carrier ; Maximum e.i.r.p. shall be 74.7 dBW or more.

(d) Output power level control range shall be continuously adjustable for + 5 dB to -5 dB from the nominal value which will be noted later to the Contractor.

(e) Output power level stability shall be within $\pm$ 0.4 dB in any 24-hour period.

(f) Spurious Output

Spurious outputs shall not exceed the following e.i.r.p. value in any 4 kHz band in the 5925 to 6425 MHz when transmit the carriers specified in 5.3.2 (2)-(c).

(i) Multicarrier intermodulation products;

$26 - 0.06 (\alpha - 10^{0})$ dBW
But within the SPADE band, this value shall be $23 - 0.06 (\alpha - 10^{0})$ dBW

Where X is the elevation angle of the earth station antenna in degrees.

(ii) Other spurious and noise ; 4 dBW

(g) Residual amplitude modulation shall not exceed the following value in any 4 kHz band.

(i) Below 4 kHz ; -32 dB

(ii) 4 kHz to 500 kHz ; $-20 (1 + 10 \log_{10} f)$ dB
Where f is the center frequency in kHz.

(iii) Above 500 kHz ; -74 dB

(h) Carrier frequency tolerance (maximum uncertainty of initial frequency adjustment plus long-term drift)

(i) Telephony carriers ; within $\pm$ 80 kHz/month

(ii) SPADE carrier ; within $\pm$ 200 Hz/month

(iii) Television video carrier ; within $\pm$ 250 kHz/month

(i) Baseband gain/frequency response shall satisfy the Paragraphs 5.3.2 (1) (a) (ii) and 5.3.2 (i) (b) (v).

(3) RF to Baseband Performance Characteristics

(a) RF to IF (Baseband) Amplitude Response

(i) For the telephony and television video carriers, the RF to IF (or baseband except the threshold extension demodulator) amplitude response shall be within the limits given in Fig. 5.4 and Table 5.5.

(ii) For the SPADE carrier, the RF to IF amplitude response shall be flat within $\pm$ 0.5 dB over the transponder passband.

(b) RF to IF (Baseband) Group Delay Response

The group delay response shall be within the limits given in Fig. 5.4 and Table 5.6.

(c) Noise temperature shall not exceed $23^{o}K$.

(d) Baseband gain/frequency response shall satisfy the paragraphs 5.3.2 (1) (a) (ii) and 5.3.2 (1) (b) (v).

(4) Switch-over

(a) Automatic switch-over between normal and emergency operation shall, as a rule, take place, in the condition that connects the transmitter BDU to up-converter in tandem, similarly the down-converter to the receiver BDU in tandem except the television routes. However, if the Tenderer considers it proper to switch-over independently each equipment for normal and emergency use, he may offer such design.

(b) In failure of the telephony or SPADE transmitter, the television transmitter shall automatically back up to it while television transmission is out of service.

(c) Failure of the series of normal (operation) low noise pre-amplifier and wideband RF amplifier shall automatically cause switch-over to the similar series for emergency use.

(d) Switch-over from normal to emergency shall be conducted by the following causes.

(i)	Transmitter subsystem ;	Automatic power control malfunction or output power level abnormal
(ii)	Receiver subsystem ;	RF pilot signals level abnormal
(iii)	Modulator subsystem ;	60 kHz pilot signal level abnormal or AFC malfunction or UP-converter output power level abnormal.
(iv)	Demodulator subsystem ;	60 kHz pilot signal level abnormal and/or out-of -band noise increase.

(e) The Tenderer shall submit detailed switching functions including transit time.

Table 5.3 IF to RF Amplitude Response

Carrier Size (MHz)	A (MHz)	B (MHz)	C (MHz)	D (MHz)	a (dB)	b (dB)	c (dB)	d (dB)	e (dB)
2.5	1.8	2.25	2.75	8.0	0.7	1.5	2.5	25	0
5	3.6	4.5	5.25	13.0	0.5	2.0	3.0	25	0
7.5	5.4	6.75	7.75	17.0	0.4	2.5	4.0	25	0
10	7.2	9.0	10.25	19.0	0.3	2.5	5.0	25	0.1
15	10.8	13.5	15.5	25.0	0.3	2.5	5.5	25	0.1
20	14.4	18.0	20.5	28.0	0.3	2.5	7.5	25	0.1
25	18.0	22.5	25.75	34.0	0.3	2.5	8.0	25	0.2
36.0	28.8	36.0	45.25	60.0	0.6	2.5	10.0	25	0.3
Video	24.0	30.0	45.25	60.0	0.5	2.5	10.0	25	0.3

Table 5.4 IF to RF Group Delay Response

Carrier Size (MHz)	A (MHz)	H (MHz)	f (nS)	g (nS)	h (nS)
2.5	1.8	2.1	16	16	20
5	3.6	4.1	12	12	20
7.5	5.4	6.2	12	12	20
10	7.2	8.3	9	9	18
15	10.8	12.4	6	6	15
20	14.4	16.6	4	5	15
25	18.0	20.7	3	5	15
36.0	28.8	33.1	3	5	15
Video	24.0	30.0	5	5	15

Table 5.5 RF to IF Amplitude Response

Carrier Size (MHz)	A' (MHz)	A (MHz)	B (MHz)	C (MHz)	D (MHz)	a (dB)	b = c (dB)	d (dB)	e' (dB)	e (dB)
2.5	0.5	1.7	2.4	3.4	8.0	1.0	3.0	20	0	0
5	1.1	3.2	4.6	6.0	13.0	0.7	3.0	20	0	0
7.5	1.6	4.6	6.8	8.8	17.0	0.5	3.0	20	0	0
10	2.1	6.2	9.0	11.6	19.0	0.4	3.0	20	0	0.1
15	3.6	9.6	13.6	18.0	27.0	0.4	3.0	20	0	0.1
20	5.1	12.8	18.0	24.6	28.0	0.4	3.0	20	0	0.1
25	6.6	16.2	22.6	31.0	34.0	0.4	3.0	20	0	0.3
36.0	16.2	25.8	36.0	50.0	60.0	0.6	3.0	20	0.3	0.3
Video	12.0	22.2	30.0	43.0	*	0.5	3.0	*	0	0.5

Note * mark will be noted later to the Contractor.

Table 5.6 RF to IF Group Delay Response

Carrier Size (MHz)	A' (MHz)	A (MHz)	f (nS)	g (nS)
2.5	0.5	1.7	10	60
5	1.1	3.2	10	40
7.5	1.6	4.6	10	30
10	2.1	6.2	6	25
15	3.6	9.6	4	15
20	5.1	12.8	4	8
25	6.6	16.2	3	6
36.0	16.2	25.8	3	5
Video	12.0	22.2	3	5

5.3.3 Transmitter Subsystem

This subsystem shall consist of the power amplifier, the carrier combiner and associated equipment.

The transmit carriers coming from the up-converters are amplified in the exciter traveling wave tube (TWT) amplifiers and the klystron power amplifiers. After that, these carriers shall be combined by carrier combiners after passing through waveguide switches, and be supplied to the antenna system.

(1) Power Amplifier

(a) The power amplifier shall consist of klystron power amplifier, exciter TWT amplifier with 500MHz bandwidth, power source, dummy load, waveguide switch and their associated devises or units.

(b) The power amplifier, the exciter TWT amplifier and associated circuits shall be provided with 3 routes, telephony transmitter, SPADE transmitter and television transmitter (including both video and associated audio carriers).

(c) The power amplifier shall finally be possible to transmit the following carriers. The television transmitter and SPADE transmitter

shall be designed considering the intermodulation products.

(i)	Telephony transmitter	132 channels carrier
(ii)	SPADE transmitter	12 carriers
(iii)	Television transmitter	Television video and associated audio carriers

(d) The Tenderer shall offer the Type of klystron and TWT and state the main characteristics.

(e) The klystron power amplifier shall be possible to be preset by more than 3 carriers in any frequency band between 5925 and 6425 MHz. The frequency band select shall be possible at both remote and local site.

(f) The travelling wave tube (TWT) shall be used for the exiter amplifier that can amplify the RF signals between 5925 and 6425 MHz simultaneoustly.

(g) The klystron and TWT to be used for the power amplifier and exiter amplifier shall be of the forced air cooling type if possible.

(h) The power amplifier shall be possible to be turned its main power and high tension voltage on and off from the control room. Emergency off, RF output power level control, waveguide switch-over and transmitter modes (television, SPADE and telephony modes) shall be possible by remote control.

(i) The power amplifier shall be provided with protection circuits, such as arc, tube oscillation, reflected output power, body overcurrent etc. The Tenderer shall state its operative principle, cut-off time and handling method.

(j) In order to keep the output power level stability of each transmitter within $\pm$ 0.4 dB/day, the automatic power control circuit shall be provided if necessary.

(k) The dummy load which terminates each power amplifier shall be provided and it shall be the forced air cooling type.

(l) The power amplifier and exiter TWT amplifier shall be provided with the test circuit for measuring the RF performance characteristics and output power level.

(m) The electrodes voltages and currents of the klystron and TWT and those of the other necessary circuits shall be indicated to the power amplifier and exiter TWT amplifier.

The Contractor shall state the details of these items.

(n) Each power amplifier shall be provided with a power meter which shall indicate both the traveling and reflected power level.

It shall also detect reflected power increase and make a protective device operate.

(o) Radiation Hazard

Design shall be made to protect the human body from all hazardous radio frequency and X-ray radiations from the racks. Such leakage from the racks shall not exceed 5 mW/cm^2 and 5 mm roentgen/hour, respectively.

(p) The Tenderer shall state the ways of air and/or water cooling system for the power amplifier and the dummy load.

(q) The Contractor shall offer the following:

(i) Power supplying sequence and protection for surge current from switch on

(ii) Alarms and interlocks

(iii) Type, ratings, efficiency, expectable life, annual cost, replacement time, treatment of stock and any other terms of klystron and TWT to be adopted

(iv) Power amplifier operating buttons or switches and adjusting terms

(v) Restoring circuit for power interruption

(2) Carrier Combiner

(a) Carrier combiner shall cover over 5925 MHz to 6425 MHz frequency range. (In case of adopting the filter combiner unusable

bandwidth shall be as narrow as possible)

(b) Isolation between any pair of parts shall be not less than 40 dB.

(c) The Tenderer shall state the type of carrier combiner and its insertion losses and attenuation/frequency response and delay characteristics.

(3) Other Items

(a) This subsystem shall be provided with at least the following safety provisions.

(i) Protection circuits for power amplifier overload, such as overload relay and no fuse brealer.

(ii) Waveguide switch interlock

(iii) Door interlock and earthening rod

(b) Major alarms and status display of this system shall be indicated at the control and monitor system described in 5.4.2 (2).

(4) Expected Performance Characteristics

(a)	Input VSWR	less than 1.1 : 1
(b)	Output VSWR	less than 1.2 : 1
(c)	Load VSWR	less than 1.5 : 1
(d)	Frequency range	any 36 MHz frequency band over 5925 MHz to 6425 MHz
(e)	Bandwidth	36 MHz at -1.0 dB point
(f)	Saturated output power	Offer
(g)	Output power control range	In conformity with the paragraph 5.3.2 (2) (d).
(h)	Total gain	not less than 70 dB
(i)	Output power stability	within $\pm$ 0.4 dB
(j)	Gain slope	within $\pm$ 0.07 dB/MHz

(k) Group delay

linear	within $\pm$ 0.3 ns/MHz
parabolic	less than 0.04 ns/MHz^2
ripple	less than 2 ns

(l) RF out-of -band emission

in conformity with the paragraph 5.3.2 (2) (f)

(m) Residual amplitude modulation

in conformity with the paragraph 5.3.2 (2) (g)

(n) AM to PM conversion coefficient

less than 3/dB for a single carrier 3 dB below the saturated output power.

5.3.4 Receiver Subsystem

This subsystem shall consist of the low noise pre-amplifier, the wideband RF amplifier, the RF divider, the RF pilot oscillator, the RF pilot detector and associated equipment.

The receiving signals shall be amplified by a low noise pre-amplifier with a associated refrigeration equipment and a wide band RF amplifier, to the required level, then divided into each carrier at a RF divider and supplied to the corresponding down-converter respectively.

The RF pilot oscillator and the RF pilot detector shall be employed for switch-over from normal to emergency.

(1) Low Noise Pre-amplifier

(a) This amplifier shall be a helium gas cooled parametric amplifier with solid state pump source and cryogenic system.

The low noise pre-amplifier shall be composed of a pair for normal and emergency use.

(b) The refrigerator shall be a continuous-duty, closed cycle system.

The Tenderer shall state the design objective for the following.

(i) Type of cryogenic device

(ii) Desing life

(iii) Estimation of helium consumption and supply guarantee

(iv) Maintenance periodic time

(v) Time required for maintenance

(vi) Maintenance annual cost

(vii) Cool down time

(c) The frequency and power stability of the pumping source shall be sufficient to maintain the electrical performances mentioned after.

(d) The meters indicating the pumping power and the power supply voltage shall be equipped. A frequency check terminal shall also be provided if necessary.

(e) Control and monitor for every equipment composing the low noise pre-amplifier shall be remotely carried out from the control and monitor equipment.

(f) The low noise pre-amplifier input shall be capable of switch-over to test circuit by remote control operation.

(2) Wideband RF Amplifier

(a) This amplifier shall amplify the output signals from the low noise pre-amplifier and feed the signals to the RF divider through hybrids and/or waveguide or coaxial switches.

(b) This amplifier shall be composed of a pair for normal and emergency use; each shall be respectively connected with the normal and emergency low noise pre-amplifier in tandem, so that change-over shall be taken place in tandem.

(c) This amplifier shall be a wideband microwave transistor amplifier surpassing in linearity and noise figure characteristics.

(d) The Tenderer shall state the type and performance characteristics of the proposing amplifier such as gain/frequency response,

gain stability, noise figure, third order distortion etc.

(3) RF Divider

(a) This divider shall accept a single composite input signal and provide 16 outputs which will interconnect with down-converter, and if necessary with spectrum analyzer and tracking receiver.

(b) This divider shall be composed of a pair for normal and emergency, and if necessary of test divider.

(c) The level at any outputs of this divider shall not vary with frequency by more than 1 dB peak-to-peak over the frequency band of 3700 MHz to 4200 MHz.

(d) The Tenderer shall state the input and output VSWR, isolation between any pair of ports and insertion losses.

(4) RF Pilot Oscillator and RF Pilot Detector

(a) RF pilots shall be used for the automatical switch-over between normal and emergency of this subsystem as stated in 5.3.2 (4). It shall insert two RF pilots of 3702.5 MHz and 4197.5 MHz at the receiving frequency band edge into the inputs of the both low noise preamplifiers by using the directional couplers, and detect them at the outputs of the wideband RF amplifiers.

The switch-over shall be done if these pilots of the normal side become the abnormal level which shall be preset at the suitable level.

(b) The Tenderer may propose other switch-over systems due to the economical and technical reasons. In such cases, the summary of the proposed system shall be stated by the Tenderer.

(5) Other Items

(a) This subsystem shall be provided with the test circuit for measuring the performances such as noise temperature, gain/frequency response etc., and with the test components such as direc-

tional couplers, precise variable attenuator, waveguide switches, cold load, standard liquid nitrogen dummy load for noise temperature calibration and so on.

(b) The complete status and alarms of this subsystem shall be indicated to the control and monitor equipment.

(c) The Tenderer may offer simple noise temperature measuring system which may always measure the system noise temperature using the out of service route and frequency band with the accuracy of less than $\pm 5^{o}K$.

(d) The Tenderer shall state the following

(i) Summaries of an offering pumping source of the low noise pre-amplifier

(ii) Protections means and alarms of this subsystem such as rotary compressor overheat, pressure abnormality, cryostat temperature rise etc.

(iii) The terms that the Tenderer regards as necessary for safe, reliable operation and test of the subsystems.

(6) Expected Performance Characteristics

(a)	Input and Output VSWR	Less than 1.25 : 1
(b)	Frequency Range	3700 MHz to 4200 MHz
(c)	Bandwidth	Not less than 500 MHz at the -1.5 dB point
(d)	Noise Temperature	Less than $22^{o}K$
(e)	Total gain	Not less than 65 dB
(f)	Gain stability	Short term (up to 1 hour) less than + 0.1 dB
		Long term (up to 24 hours) less than $\pm$ 0.3 dB
(g)	Gain slope	Within $\pm$ 0.5 dB/40 MHz
(h)	Group delay	
	Peak value	Within $\pm$ 3 ns/40 MHz
	slope	Within $\pm$ 0.1 ns/40 MHz
	Ripple	Less than 1 ns

(i)	Intermodulation	Less than -51 dB with -73 dBm two equal amplitude carriers applied to the input
(j)	Dynamic Range	Gain compression shall be less than 0.2 dB over the range of -60 dBm to noise level
(k)	Desensitization	Desensitizetion by -20 dBm signal in the 5925 MHz to 6425 MHz band shall not exceed 0.1 dB
(l)	Spurious signals	Less than -120 dBm
(m)	Cool down time	Less than 4 hours including evacuation time

5.3.5 Modulator and Demodulator Sybsystem

This subsystem shall consist of up-converters, down-converters, transmit system equalizers, receive system equalizers, FM modulators, FM demodulators, baseband distribution units (BDU) and associated equipment.

This subsystem, with respect to the transmit system, shall convert the baseband signals from the multiplexing equipment and the television control and monitor console into the IF signals by the FM modulator and further convert the same into the RF signals of 6 GHz frequency band by the up-converter and then send out to the transmitter subsystem.

With respect to the receive system, this subsystem shall select each of desired carriers by each down-converter out of the RF signals of the 4 GHz frequency band from the receiver subsystem, convert it into an IF signal and further convert into the baseband signal by the FM demodulator and then send out to the television control monitor console and multiplexing equipment.

In the SPADE route, they shall be interconnected with SPADE equipment with the IF signals.

(1) Up-Converter

(a) The up-converter shall consist of the IF band-pass filter the IF amplifier, the local oscillator (s), the mixer and associated circuits.

(b) Up-converters shall be provided for four chains, telephony SPADE, television video and television associated audio.

(c) The telephony and SPADE up-converters are desirable to be composed of a pair for normal and emergency use.

(d) The up-converter output shall be capable of switch-over to the test down-converter by remote control.

(e) On changing transmit frequency, it is desirable to enable it only with the change of the local frequency. If parts adjustment other than that is necessary, it shall be possible with the simple adjustment by the operational personnel without purchasing new parts.

(f) The local oscillator of up-converter shall be of all wave type capable of converting IF signal into any RF signal within 5925 to 6425 MHz. The method shall be explained by the Tenderer.

(g) The up-converter for television associated audio shall have two local oscillators, one for Cue carrier and another for sound carrier respectively. The selection of the local oscillators shall be capable of remote controlling by equipment control/monitor subsystem described in paragraph 5.4.2 (4).

(h) IF band-pass filter shall be possible to replace easily on changing the channel size.

(i) The up-converter shall be provided with the circuit which can adjust the output power level continuously +5 to -5 dB from the nominal value. The output power level setting shall be possible to perform by the equipment control/monitor subsystem. This function may be provided with the transmitter subsystem.

(j) The Tenderer shall state the following

(i) Configuration of the up-converter and IF signal centre frequency

(ii) Local oscillator frequency and frequency stability (for telephony, television video and SPADE).

(iii) Type, design philosophy and performances of IF BPF

(k) The Contractor shall state the following

(i) Input and output impedances and VSWR

(ii) Input and output power level

(iii) IF to RF gain/frequency response (with IF BPF and without IF BPF)

(iv) IF to RF group delay response (with IF BPF and without IF BPF)

(v) Input and output linearity

(vi) Spurious output level

(vii) Alarms

(2) Down Converter

(a) The down converter shall consist of the RF band-pass filter, the mixer, the local oscillator (s), the IF amplifier, the IF band-pass filter and associated circuits.

(b) Downconverters shall be provided for 12 chains, 9 for telephony, 1 for SPADE, 1 for television video and 1 for television associated audio.

(c) Each chain except television video and television associated audio is desirable to be composed of a pair for normal and emergency use.

(d) The down converter input shall be capable of switch-over to the test up-converter by remote control.

(e) On changing recieve frequency, it is desirable to enable it only with the change of the local frequency. If parts adjustment other than that is necessary, it shall be possible with the simple adjustment by operational personnel without purchasing new parts.

(f) The local oscillator of down-converter shall be of all wave type capable of converting any RF signals of the frequency band within 3700 to 4200 MHz into the IF signal. The method shall be explained by the Tenderer.

(g) The down converter for television associated audio have two local oscillators shall be remotely controlled by equipment control/ monitor subsystem described in paragraph 5.2.4 (4)

(h) On changing channel size, the IF band-pass filter shall be possible to replace easily.

(i) The down-converter shall be provided with the carrier detector circuit in order to monitor the receive carrier level and the output shall be sent to the equipment of control/monitor subsystem and recorder subsystem.

(j) Spurious

Any spurious shall be not less than 50 dB below the level of the desired carrier.

(k) Noise Figure

In any 40 MHz band, the down-converter shall have a noise figure of not greater than 10 dB.

(l) Intermodulation

With two equal amplitude carriers having the -30 dBm total level applied to the input, the third order intermodulation products measured at the IF output shall be at least 45 dB below either.

(m) The Tenderer shall state the following.

(i) Configuration of the down-converter and IF signal center frequency

(ii) Local oscillator frequency and frequency stability (for telephony, television video and SPADE)

(iii) Type, design philosophy and performances of IF BPF

(n) The Contractor shall state the following

(i) Input and output impedance and VSWR

(ii) Input and output power level

(iii) RF to IF gain/frequency response (with IF BPF and without IF BPF)

(iv) RF to IF group delay response (with IF BPF and without IF BPF)

(v) Alarms

(3) Transmit System Equalizer

(a) This equalizer shall compensate the amplitude and the group delay distortion from the FM modulator input to the transmitter subsystem output and satellite transponder group delay distortion.

(b) Residual IF to RF gain/frequency response and group delay response except satellite transponder group delay shall be equalized to the limits given in Fig. 5.3 and Table 5.3 and 5.4.

(c) The maximum range of satellite group delay to be equalized at the earth station can be derived from Fig. 5.5.

(d) The Tenderer shall state the followings.

(i) IF signal center frequency

(ii) Desing philosophy and method

(e) The Contractor shall state the followings.

(i) Input and output impedance and VSWR

(ii) Input and output level

(4) Receive System Equalizer

(a) This equalizer shall compensate the amplitude and the group delay distortion from the receiver subsystem input to the FM demodulator input.

(b) Residual RF to IF gain/frequency response and group delay response shall be equalized to the limits given in Fig. 5.4 and Table 5.5 and 5.6.

(c) The Tenderer shall state the followings.

(i) IF signal center frequency

(ii) Desing philosophy and method

(d) The Contractor shall state the followings.

(i) Input and output impedance and VSWR

(ii) Input and output level

(5) FM Modulator

(a) The FM modulator shall convert the baseband signal from the baseband distribution unit into the IF signal and feed it to the up-converter via the transmit system equalizer.

(b) FM modulator shall be provided for 3 chains, telephony, television video and television associated audio.

The telephony FM modulator is desirable to be composed of a pair for normal and emergency use.

(c) The FM modulator shall be capable of applying to both telephony and television video modulation.

(d) The FM modulator shall have a reverse switch of the sense of video modulation.

(e) Input impedance shall be 26 dB or better.

(f) Output impedance shall be 75 ohms unbalanced and VSWR shall be 1.10 : 1 or better.

(g) Maximum frequency deviation shall be $\pm$ 18 MHz or more.

(h) The modulator input shall have a continuous level adjuster.

The adjustable range shall be not less than $\pm$ 5 dB relative to the standard input level, which shall be determined by the Contractor.

(i) Non-linearity shall be within the limits given in Fig. 5.6.

(j) Base band to IF amplitude and group delay response shall be within the limits given in Fig. 5.7.

(k) Output frequency stability shall be within $\pm$40kHz per month.

(l) The Tenderer shall state the followings.

(i) Input level for telephony and television video signals

(ii) Output IF center and level adjusting range

(iii) Output level and level adjusting range

(iv) Alarms and monitors terms

(6) FM Demodulator

(a) The FM demodulator shall convert the IF singal coming from the down-converter into the baseband signal and feed it to the base-band distribution unit.

(b) FM demodulator shall be provided for 11 chains, 9 for telephony, 1 for television video and 1 for television associated audio. The telephony demodulator is desirable to be composed of a pair for normal and emergency use.

(c) The conventional FM demodulator shall be able to be applied to both telephony of more than 252 channels and television video signals.

Furthermore, the FM demodulator for 24 to 252 telephony channels shall be the threshold extension demodulator.

(d) The threshold extension demodulator shall be able to be replaced with the conventional demodulator easily by the replacement of panels.

(e) The channel size shall be able to change easily by the replacement of panels and/or switching etc.

(f) The FM demodulator shall have the reversing switch of the sense of video modulation.

(g) Input impedance shall be 75 ohms unbalanced and VSWR shall be 1.10 : 1 or better.

(h) Output impedance shall be 75 ohms unbalanced and return loss shall be 26 dB or better.

(i) Input maximum frequency ranges are $\pm$ 20 MHz for conventional demodulator and $\pm$ 7.5 MHz for threshold extention demodulator.

(j) Non-linearity shall be within the limits given in Fig. 5.8.

(k) IF to BB group delay shall be within the limits given in Fig. 5.9.

(l) The threshold improvement characteristics of the threshold extension demodulator shall conform with Table 5.7.

(m) Output level shall be capable of continuous adjustment over the range between $\pm$ 10 dB to the nominal output level.

(n) Each characteristics of this equipment shall be satisfied even if the input frequency varies for $\pm$ 500 kHz.

Table 5.7 Threshold Improvement Characteristics

CH	24		60			96	132			192	252	
deviation (rms) f_r (kHz/CH)	250	164	410	270	136	360	630	430	223	297	577	358
C/T (dBW/^{o}K) in S/N = 50 dB	-154.8	-153.0	-151.3	-149.9	-144.0	-148.2	-148.5	-147.1	-141.4	-140.6	-144.1	-139.9
C/T (dBW/^{o}K) in S/N = 43 dB	-158.8	-157.0	-155.3	-153.9	-151.0	-153.2	-152.5	-151.1	-148.4	-147.6	-149.1	-146.9

(7) Baseband Distribution Unit (BDU)

(a) The baseband distribution unit (BDU) is an equipment which shall situate between the baseband equipment and the modulator and demodulator, and have the functions such as pre-emphasis, de-emphasis, insertion and removal of the energy dispersal signal.

(b) BDU shall consist of the four types, telephony transmitting BDU (TP T BDU), television transmitting BDU (TV T BDU), telephony receiving BDU (TP R BDU) and television receiving BDU (TV R BDU).

(c) The exchange of panels, adjustment and operation necessary for the change of the channel size is desirable to be easily carried out at this equipment.

(d) TP T BDU shall have the following functions.

(i) Pre-Emphasis Network

This network shall be easily replaceable and its characteristics shall conform to C.C.I.R. Recommendation 275-1 for telephony.

(ii) Out-of-band Noise Elimination Filter

This shall give the attenuation of more than 50 dB within the range of center frequency f, + (0.005f, + 2) kHz.

Number of channels	Center frequency f_o (kHz)
24	116
60	277
96	448
132	607
192	884
252	1157
432	1976
612	2794
792	3612
972	4430
1872	8932

(iii) Frequency deviation adjusting circuit

This circuit shall be continuously adjustable ± 3 dB or more from the nominal value.

(iv) Energy dispersal signal adding circuit

Energy dispersal signal shall be a synmetrical triangular waveform with an amplitude so calculated that at all times the maximum e.i.r.p. per 4 kHz of their transmitted carriers does not exceed the maximum e.i.r.p. per 4 kHz of the fully loaded carrier by more than 2 dB.

The frequency will be in the band 20 Hz to 150 Hz. The frequency tolerance of this waveform shall be ± 1.0 Hz.

To prevent frequency components above 4 kHz of the wave form from interfering with the baseband signals, the combining arrangement may include a low-pass filter which attenuates such components above 4 kHz below -60 dBm0.

The amplitude of the dispersal wave form shall be adjustable.

(v) 60 kHz pilot oscillator

The frequency shall be 60 kHz and the tolerance shall be ± 1.0 Hz. The level of this pilot shall be -20dBm0 and the tolerance shall be ± 0.25 dB.

(vi) Pre-emphasis network shall have a through switch.

(vii) 60 kHz pilot signal and energy dispersal signal shall be off by a manual switch.

(e) Television Transmitting BDU (TV T BDU) shall have the following functions.

(i) Pre-emphasis network

This network shall be easily replaceable and its characteristics shall conform to C.C.I.R. Recommendation 405-1.

(ii) Frequency deviation adjusting circuit

This circuit shall be continuously adjustable ± 3 dB or more from the nominal value.

(iii) Energy dispersal signal adding circuit

Energy dispersal signal shall be a fixed-amplitude symmetrical triangular waveform capable of producing up to 2 MHz peak-to-peak deviation. The frequency and phase of this waveform should be in accordance with the standard of TV i.e. frequency of 25 or 30 Hz and phase so chosen as to have the points of inflection occurring during the filter and cable equalizer shall be provided if necessary.

(iv) Low-pass filter and cable equalizer shall be provided if necessary.

(v) Pre-emphasis network and energy dispersal circuit shall have a through switch individually.

(vi) This unit shall be so designed as to be easily replaciable or switch-over between 525/60 and 625/50 TV system alternatively.

(f) Telephone Receiving BDU (TP R BDU) shall have the following functions

(i) De-emphasis network

This network shall be easily replaceable and its characteristics shall conform to C.C.I.R. Recommendation 275-1 for telephony.

(ii) Baseband noise detector and squelch circuit

Out-of-band noise level shall be detected in the band specified in (7) (d) (ii). Noise level of -43 dBm0p shall be used for squelching purpose of alarm detection and noise level of -35 dBm Op shall be used for squelching purpose.

(iii) 60 kHz pilot detector

(iv) Level adjusting circuit

This circuit shall be continuously adjustable for ± 3 dB or more from the nominal value.

(v) High-pass filter shall provide for removing energy dispersal signal and low-pass for reducing high frequency noise.

(vi) 60 kHz pilot and/or baseband noise signal may be used for the purpose of switching over from the normal to the emergency of this subsystem if necessary and shall also be provided to recorders.

(vii) De-emphasis network shall have a through switch.

(g) Television Receiving BDU (TV R BDU) shall have the following functions

(i) De-emphasis network

This network shall be easily replaceable and its characteristics shall conform to C.C.I.R. Recommendation 405.

(ii) Baseband noise detector, synchronizing signal detector and squelch circuit.

The Tenderer shall state the details of these circuits.

(iii) Level adjusting circuit

This circuit shall be continuously adjustable for ± 3 dB or more from the nominal value.

(iv) Low-pass filter

This filter shall provide for reducing high frequency noise.

(v) Energy dispersal signal removing circuit

This circuit shall be the feedback clamper compression of energy dispersal signal shall be 44 dB or more.

(vi) De-emphasis network, energy dispersal signal removing circuit shall have a through switch.

(vii) This unit shall be as designed as to be easily replaceable or switch-over between 525/60, 625/50 TV system alternatively.

(h) Input and output impedance of each BDU shall be 75 ohm unbalanced and the return loss shall be 26 dB or better.

(i) Cable equalizer shall be provided in each BDU if necessary.

(j) The Tenderer shall state the following items.

(i) Input and output level of each BDU

(ii) Video amplitude frequency characteristics of each BDU

(iii) Group delay response of TV BDU.

(iv) Alarms and monitors term of each BDU.

(8) Other Items

(a) It is desirable that this subsystem is assembled into one bay per each carrier.

(b) This subsystem shall be provided with the test terminals for the IF loop test and RF loop test.

(c) The alarms of this subsystem shall be sent to the control and monitor system. The switching between the duplicated systems, operation and standby, shall be possible automatically and/or with remote control from the control and monitor system.

(d) The Tenderer shall state the following items:

(i) The connection method of the transmitter and the receiver subsystem (IF cable link or waveguide link)

(ii) The changing method of frequency and channel size

(iii) The manner in which the standby system of this subsystem is installed.

(iv) The Tenderer shall offer a spare units list.

(9) Expected Baseband Performance Characteristics

This article stipulates main performances for the modulator loop measured with the test equipment.

(a) Telephone circuit

(i)	Gain/frequency Response	
	4 kHz to 12 kHz	Within +0.5 dB to -1.5 dB referred to 0.608 f_{top}
	12 kHz to f_{top}	Within $\pm$0.5 dB referred to 0.608 f_{top}
(ii)	Signal to noise Radio	Not less than 62 dB psophometrically weighted
(iii)	Level Stability	Within $\pm$ 0.1 dB/day $\pm$ 0.25 dB/month

(b) Television Video Circuit

(i)	Gain/frequency response	
	50 Hz to f_c	Within $\pm$0.6 dB referred to 15 kHz
(ii)	Group delay response	
	100 kHz to 0.75 f_c	Within $\pm$ 25 ns
	0.75 f_c to f_c	Within $\pm$ 50 ns referred to 100 kHz
(iii)	Signal to noise ratio	
	continuous random noise	Not less than 68 dB (psophometrically weighted)
	periodic noise	
	below 1 kHz	Not less than 50 dB (pp/pp)
	1 kHz to f_c	Not less than 55 dB (pp/pp)
(iv)	Level stability	Within $\pm$ 0.1 dB/day $\pm$ 0.25 dB/month

(v) Linear waveform distortion

Field time waveform distortion

With C.C.I.R. test signal No. 1, the variation of the test signal bar top about its midpoint does not exceeded ± 1%.

Line time and short time waveform distortion

With C.C.I.R. test signal No. 2, the performance objectives shall be satisfied by the following values or better.

Line bar	± 1.0%
2T pulse/bar ratio	0.94 to 1.06
1T pulse/bar ratio	0.75 to 0.95
1T pulse leading or lagging	
Lobe/1T pulse ratio:	
1st negative lobe	0.14
1st positive lobe	0.09

5.3.6 Test Equipment Subsystem

This subsystem shall be capable of conducting the instation, tests, which are necessary for maintenance work and fault locating, and the line-up test specified in S.S.O.G. Volume II.

This subsystem shall be composed of a 6 GHz-4 GHz translator, a test up-converter, a test down-converter, a test modulator, a test demodulator, a test baseband distribution unit (TST BDU), a telephony test bay, measuring sets, associated units and components.

For the in-station tests, RF - RF, IF - IF, BB - BB, IF - RF, RF - IF, BB - IF or RF, IF or RF - BB tests shall be possible by using this subsystem.

(1) 6 GHz - 4 GHz Translator

(a) This translator shall work for the transmitter and receiver system loop tests.

(b) A portion of the power amplifier output power shall be converted into 4 GHz signal, then sent to the low noise pre-amplifier input using directional couplers.

(c) This translator output signal frequency shall be within 3700 to 4200 MHz and the input frequency shall be within 5925 to 6425 MHz.

(d) SHF signal generator shall easily be connected to the translator as a local oscillator.

(e) It is desirable to design this translator so that it can be jointly used with the portable boresight equipment stated in 5.2.9. (1).

The Tenderer shall state the outline of the translator.

(2) Test Up-Converter

(a) The test up-converter shall be capable of converting IF signal into any RF signal within 3700 to 4200 MHz, and shall be provided for receiving chain test.

(b) The local oscillator of test up-converter shall be of all wave type, the method shall be explained.

(c) The output frequencies of the test translator shall be selectable by switching the outputs of the local oscillators.

(d) No less than three oscillators shall be provided at least and the output of these shall be easily selected by the push button operation.

(e) The output power level of the test up-converter shall be easily selected by the push button operation.

(f) The Contractor shall state the followings.

(i) Input and output impedance and VSWR

(ii) Input and output level

(iii) IF signal center frequency

(iv) IF to RF amplitude response

(v) IF to RF group delay response

(vi) Local oscillator frequency stability

(vii) Spurious output level

(3) Test Down-Converter

(a) The test down-converter shall be capable of converting any 6 GHz RF signal (5925 to 6425 MHz) into IF signal, and shall be pro-

vided for transmitting chain tests.

(b) The local oscillator of test down-converter shall be of allwave type, the method shall be explained by the Tenderer.

(c) The input frequencies of the test down-converter shall be selectable by switching the outputs of the local oscillators.

(d) No less than two oscillators shall be provided at least and the output of these shall be easily selected by the push button operation.

(e) The output power level of the test down-converter shall be adjustable by more than 20 dB.

(f) The Contractor shall state the following

(i) Input and output impedance and VSWR

(ii) Input and output level

(iii) IF signal center frequency

(iv) RF to IF amplitude response

(v) RF to IF group delay response

(vi) Local oscillator frequency stability

(vii) Spurious outputs level

(4) Test Modulator

(a) The test modulator shall be capable of converting baseband signal sent from TP or TV test BDU into IF FM signal and of sending the IF signals to TP or TV FM demodulator or test up-converter.

(b) This shall be capable of conducting tests of receiving chain tests.

(c) This shall be capable of conducting tests of both telephony and television video channels.

(d) The other performances shall satisfy the requirements stipulated in Paragraph 5.3.5 (5).

(5) Test Demodulator

(a) The test demodulator shall be capable of converting IF FM signal sent from telephony or television video FM modulator or test down-converter into baseband signal and of sending the signal to telephony or television test BDU.

(b) This shall be capable of conducting for transmitting chain test.

(c) This shall be a conventional demodulator and be capable of conducting test of both telephony and television video channels.

(d) The other performances shall satisfy the requirements stipulated in Paragraph 5.3.5 (6).

(6) Test Baseband Distribution Unit (TST BDU)

(a) The test BDU is situated between the telephony test bay or television test bay and the test modulator or test demodulator and performs necessary processings such as pre-emphasis, de-emphasis, energy dispersal signal addition or removal, etc. for the baseband singal.

(b) The test BDU consists of 4 units, the telephony transmitting test BDU (TP T TST BDU), the television transmitting test BDU (TV T TST BDU), the telephony receiving test BDU (TP R TST BDU) and the television receiving test BDU (TV R TST BDU).

(c) The functions and characteristics of the test BDU are the same as those of the BDU stated in 5.3.5 (7), but the following functions may be omitted.

(i) Baseband noise detector and squelch circuit

(d) The Contractor shall provide with at least 10 kinds of channel size units for the telephony transmitting test BDU and 4 for the telephony receiving test BDU.

The kinds of channel size will be noted later to the Contractor.

(7) Telephony Test Bay

(a) The telephony test bay shall be capable of conducting routine test and measurement of the baseband performance characteristics.

(b) The remote control panels for IF and RF loop tests shall be mounted on the bay, and shall be capable of the following controls and displays at least.

(i) Selection for tests and relating displays of the power amplifier and up-converter outputs.

(ii) Selection for tests and relating displays of the low noise preamplifier (include wideband RF amplifier) and down-converter outputs.

(iii) IF loop test set up and displays

(c) This bay shall have at least the following devices and panels. The Contractor shall state the details of these device.

(i) Video band signal generator

(ii) Video band level meter

(iii) Wave analyzer and tracking oscillator

(iv) Switcher panel

(v) Variable attenuator

(vi) ESC telephone set

(vii) Remote control and display panel

(viii) Drawers

(8) Accessary Measuring Set

The Contractor shall furnish the measuring sets and components specified in the following paragraphs.

In addition, those that the Contractor recognizes and be assembled into one dolly. Those shall be easy to transport.

Manufacturers and parts name of the following list are recommendable ones but not limited to those.

The Contractor shall offer the more detailed list of the sets and components which he will furnish, including their main performances and

manufacturers name.

Proposed sets should include all accessaries, such as patch cords, transitions test terminals, connectors, adaptor and tools.

Specified Measuring Sets

Function	Manufacturer	Frequency	Part Name	Quant
1. Signal Generator	Hewlett-Packard	10Hz - 10MHz	651B OP 01/02	(1)
2. Signal Generator	Hewlett-Packard	10MHz - 480MHz	608E	(1)
3. Signal Generator (Sweep)	Hewlett-Packard	3.7 - 8.3GHz	8690B/8693B OP 100	(1)
4. Synthesizer	Anritsu	100Hz - 100MHz	MG514A	(1)
5. Frequency Counter	Hewlett-Packard	1Hz - 1.8GHz	5340A	(1)
6. Power Meter	Hewlett-Packard	DC - 18GHz	432B/478A	(1)
7. R.M.S. Voltmeter	Hewlett-Packard	10Hz - 10MHz	3400A OP 01	(1)
8. R.M.S. Voltmeter	Anritsu	10kHz - 1000MHz	M-316A/Z-145A - 147C	
9. Selective Voltmeter	Hewlett-Packard	20Hz - 50kHz	302A	(1)
10. Selective Voltmeter	Hewlett-Packard	1kHz - 18MHz	312A/313A	(1)
11. Selective Voltmeter	Anritsu	1MHz - 150MHz	ML55A	(1)
12. Spectrum Analyzer	Hewlett-Packard	1kHz - 40GHz	141T/8552B/8555A	(1)
13. Wideband Microwave Measuring Set	Hewlett-Packard	3.7GHz - 6.25GHz	8605A OP 004 8755M/537A/788C/423A/432B/478A/493A etc.	(1)

Function	Manufacturer	Frequency	Part Name	Quant
14. VSWR Measuring Set	————	3.7GHz - 6.25GHz	————	(1)
15. Threshold Measuring Set	————	IF Band	————	(1)
16. Psophometer	Hewlett-Packard	20Hz - 20kHz	3556A	(1)
17. IF and BB Transmission Measuring Instrument	Anritsu	BB and IF Band	MG - 41A	(1)
18. White Noise Test Instrument	Marconi	Baseband	OA-2090B TK-series	(1)
19. Telephone Transmission Test Set	Anritsu	10Hz - 110MHz	MG-43A/MN-41B	(1)
20. Impulse Noise Counter	Ando	————	ASA - 23	(1)
21. Telegraph Distortion Measuring Set	Ando	————	TGD - 1	(1)
22. Oscilloscope and Camera	Hewlett-Packard	DC - 100MHz	180A/1802A/1821A/197A	(1)
23. Oscilloscope	Hewlett-Packard	DC - 35MHz	1701A	(1)
24. X-Y Recorder	Hewlett-Packard	————	7035B	(1)
25. 2-Channel Portable Recorder	Hewlett-Packard	————	322A	(1)
26. Multi-Channel Pen Recorder	————	————	————	(1)
27. Multi-Range Volt-Ammeter	————	————	————	(2)

Function	Manufacturer	Frequency	Part Name	Quant
28. Electronic Volt-Meter	Yokogawa-Hewlett-Packard	DC - 700MHz	410C	(1)
29. Volt Meter Calibrator (600 ohms and 75 ohms)	———	———	———	(1)
30. Circuit Tester	———	———	———	(3)
31. Insulator Tester	Yokogawa-Hewlett-Packard	———	2852	(1)
32. Crystal Detector	Hewlett-Packard	0.01 - 12.4 GHz	423A	(2)
33. Microwave Variable Attenuator	Hewlett-Packard	3.7 - 6.25GHz	11582A	(1)
34. Coaxial Fixed Attenuator	Heqlett-Packard	DC - 18GHz	11582A	(1)
35. Variable Attenuator	Ando	DC - 400MHz	AL - 511SP	(1)
36. Waveguide-Coaxial Transducer	———	———	———	(2)
37. Waveguide Dummy Load (4GHz, 6GHz)	———	———	———	(2)
38. Coaxial Dummy Load	———	———	———	(2)
39. Waveguide Directional Coupler (4GHz, 6GHz)	———	———	———	(2)
40. Coaxial Directional Coupler	———	———	———	(1)
41. Tunable Bandpass Filter	———	———	———	(1)

(9) Other Items

(a) Each equipment described in the subsystem shall provide the necessary switches, trunk cables, test terminals, patching boards or panels, patching cables, dummy loads, adapters etc. to carry out the tests stipulated in this section.

(b) All the tests above mentioned may be carried out in the vicinity of the telephony test bay.

(c) To avoid the mis-operation in testing, mimic displays and fool-proof system shall be introduced in the subsystem.

(d) Television video tests are described in paragraph 5.4.3.

(e) Measuring sets power source shall be AC 220V. If another source is needed, the Contractor shall furnish the voltage translators.

5.4 Control and Monitor System

5.4.1 General

This system shall be composed of such systems as equipment control/monitor, television control/monitor and data and fault recorder.

This system shall be capable of controlling, monitoring of the main communications equipment and displaying circuit and equipment status, in addition of recording the various kinds of data concerning transmit and receive carriers, pilots, noise level, circuit and equipment fault etc.

A typical configuration of the system is shown in Table 5.8.

Each equipment included in the system shall be installed in the control room.

For the design of the system, much consideration shall be given to the future expansion, protection from misoperation and provision for easy accesibility and visibility.

Table 5.8 Control and Monitor System

No.	Subsystem	Items	Remarks
1	Equipment Control/ Monitor	Antenna control/monitor bay Transmitter control/monitor bay Receiver control/monitor bay Modulator and demodulator control/monitor bay Miscellaneous control/monitor bay	for power supply facilities, wire-wave connecting link, multiplexing equipment and SP SPADE terminal etc.
2	Television Control/Monitor	Television control/monitor console Television test bay	
		Level recorder Circuit and system fault recorder	
3	Data and Fault Recorder	Miscellaneous recorder	for meteorological data, power source data etc.

5.4.2 Equipment Control/Monitor Subsystem

This subsystem shall be composed of antenna control/monitor bay, transmitter control/monitor bay, receiver control/monitor bay modulator and demodulator control/monitor bay and miscellaneous control/monitor bay.

This subsystem shall be capable of remote controlling and working condition displaying for the antenna, transmitter, receiver, modulator and demodulator installed in the antenna pedestal, as well as of those facilities installed in the communications equipment room.

Ordinarily, switch-over between normal and emergency equipment included in the antenna system, the transmitter and receiver system, the baseband equipment system and the power supply system etc. installed in the Earth Station, shall be carried out automatically. Normal/emergency selection shall be possible both remotely from this subsystem and locally at each equipment. Priority of selection shall be on local selection and the status of being locally selected shall be indicated in this subsystem.

Status indication shall also display the selected side.

Fault alarms from each equipment shall be displayed on this subsystem. Visible and audible alarms shall be provided.

Some alarms may commonly be displayed. A minor alarm shall be activiated in case either one of normal and emergency equipment fails. A major alarm shall be activiated when both equipment fail or in the failure of equipment without any emergency one.

A major alarm shall be displayed in this subsystem or television control/monitor console as a circuit or system failure.

These fault alarms information shall be sent to the data and fault recorder subsystem and recorded.

(1) Antenna Control/Monitor Bay

The antenna control/monitor bay shall be, at least, capable of the following control, monitors and displays for the antenna system.

(a) Control

(i)	Operation mode selection	Auto/manual (/program)
(ii)	Antenna drive	on/off
(iii)	Manual positioning control	Az CCW/CW El up/down

(iv) Drive velocity selection low/high

(v) Override switch operation/standby

(vi) Antenna fixing and locking on/off

(b) Monitor

(i) Beacon level

(ii) Angle error

(iii) Beacon frequency

(c) Display

(i) Az and El antenna angle

(ii) Standard time (GMT and PST)

(iii) Antenna overall operation mimic display

(d) Alarm

(i) Each antenna equipment fault

(ii) Wind velocity

(iii) Az and El limit warning

(iv) Standard time oscillator fault

(v) Fuse alarm

(2) Transmitter Control/Monitor Bay

(a) The transmitter control/monitor bay shall be capable of remote control and display for the transmitter subsystem in the antenna pedestal.

(b) The following controls and displays shall be provided at least in this bay.

(i) Main power on/off and display

(ii) High tension voltage on/off and display

(iii) Frequency band select and display

(iv) Wave guide switch-over and display

(v) Television transmitter modes select and display (television, telephony, SPADE)

(vi) Output power meter and output power control
(This may be provided in the modulator and demodulator control/monitor bay)

(vii) Status of each equipment (operation, stand by, maintenance)

(viii) Main alarms display and alarms reset.

(ix) Emergency off

(3) Receiver Control/Monitor Bay

(a) The receiver control/monitor bay shall be capable of remote control and display for the receiver subsystem in the antenna pedestal.

(b) The following controls and displays shall be provided at least in this bay.

(i) Normal/emergency switch-over and display

(ii) Receive carriers display (3700 to 4200MHz band spectrum analyzer)

(iii) Status of each equipment (Operation, stand by, maintenance)

(iv) Main alarms display including RF pilots, cryogenic system etc.

(4) Modulator and Demodulator Control/Monitor Bay

(a) The modulator and demodulator control/monitor bay shall be capable of remote control and display for the modulator and demodulator subsystem in the antenna building and/or communications room.

(b) For the up-converter, the following controls and displays shall be provided at least.

(i) Normal/emergency switch-over and display

(ii) Transmitting power control per carrier (This may be provided in the transmitter control/monitor bay.)

(iii) Output power meter for each carrier

(iv) Switch-over and display of the local oscillators of television associated audio up-converter

(v) Status of each equipment (operation, stand by, maintenance and fault)

(c) For the down-converter, the following controls and displays shall be provided at least.

(i) Normal/emergency switch-over and display

(ii) Switch-over and display of the local oscillators of television down-converter

(iii) Status of each equipment (operation, stand by, maintenance and fault)

(d) For the modulator including telephony and television transmitting BDU, the following controls and displays shall be provided at least.

(i) Normal/emergency switch-over and display

(ii) Status of each equipment (operation, stand by, maintenance and fault)

(iii) Out-of-service control and display

(e) For the demodulator including telephony and television receiving BDU, the following controls and displays shall be provided at least.

(i) Normal/emergency switch-over and display

(ii) Receive carriers level, pilot level and out-of-band noise level meters.

(iii) Status of each equipment (operation, stand by, maintenance and fault)

(iv) Out-of-service control and display

(f) The circuit failure displays and audible alarms for each carrier shall be provided in this bay. (This may be provided in television control/monitor console.)

(5) Miscellaneous Control and Monitor Bay

(a) The miscellaneous control and monitor bay shall be capable of necessary remote controls, status displays and visible and audible alarms for the power supply facilities system, the microwave connecting link system, the multiplexing equipment system and the SPADE terminal system etc.

(b) The Tenderer shall offer the terms of remote controls, displays and alarms to be included in this bay.

5.4.3 Television Control/Minitor Subsystem

The television control/monitor shall be composed of television control/monitor console and television test bay. This shall be capable of controlling, monitoring and testing television transmission circuit.

This shall be installed in the control room and be well arranged for convenient operation and maintenance. This shall initially be equipped with 625/50 monochrome television equipment. Besides, this shall have vacant spaces in the console and the test bay necessary for housing the color monitor, a color bar generator, a vector scope etc., which may be installed in future.

(1) Television Control/Monitor Console

(a) The console shall relay a video and sound signals from the microwave connecting link to the television receiving BDU and carrier frequency broadcasting equipment and from the television transmitting BDU and carrier frequency broadcasting equipment to the microwave connecting link.

(b) The console shall be capable of monitoring the signal itself and qualities, adjusting the level of the television video and sound signal (including Cue signal), switching or selecting the video, sound and test signals and servicing through engineering service circuits (ESC).

(c) The console shall provide with the following devices or panels at least.

(i) Picture monitor 2 sets
(available both for 525/60 and 625/50)

(ii) Waveform monitor 2 sets
(available both for 525/60 and 625/50)

(iii) Telephone set for engineering service circuit 1 set

(iv) Monitor speaker 2 sets

(v) VU meter 2 sets

(vi) Test tone oscillator 1 set
(generating 3 frequencies specified in S.S.O.G.)

(vii) Equalizer offer

(viii) Voice detection amplifier offer

(ix) Swicther panel offer

(x) Circuit and system fault display panel with visible and audible alarms offer
(This may be included in the equipment control/monitor bay)

(xi) Attenuator offer
(no short term outage type, 0.1 step $\pm$ 5 dB maximum)

(xii) Associated units or components offer

(2) Television Test Bay

(a) The test bay shall be capable of testing the television transmission circuit specified in S.S.O.G.

(b) The test bay shall provide the following devices or units at least.

(i) Television test signal generator 1 set

This shall be capable of generating No. 1, 2 and 3, 625/50 test signals specified in C.C.I.R. Recommendation 421-2. The output level shall be 1 Volt (p-p) or more.

(ii) Monoscope pattern generator 1 set

This shall be available for 625/50 and 525/60 by switch-over. The pattern shall be offered by the Contractor.

(iii) Synchronizing signal generator and distributors both for 525/60 and 625/50 system 1 set

(iv) RMS noise meter 1 set

This shall be available for both video (625/50) and sound circuits.

This shall include the weighting network and both low pass filter and high pass filters in comformity with the C.C.I.R. and C.C.I.T.T. Recommendation.

(v) Test jack panel 1 set

Test input and output shall be extended to this panels with the aid of switchers.

(vi) Television engineering service circuit telephone set 1 set

(vii) Associated u. its and components offer

(c) These devices and units shall be plug-in type considering future modifications.

(3) Expected Performance Characteristics

Those performances specified below should be measured after setting the characteristics of cable equalizer flat.

(a) Video route

(i) Input and output level

Nominal	1 Volt p-p
Allowable input level	0.3 to 2.0 Volts p-p

(ii) Input and output impedance

Nominal	75 ohms unbalanced
Return loss	26 dB or better

(iii) Amplitude/Frequency characteristics

25 Hz to 6 MHz within $\pm$0.25 dB (refer to 15 KHz) the outband of the above is descending slope characteristics.

(iv) Waveform distortion (C.C.I.R. Recommendation 421-2)

Field time distortion	less than $\pm$1% using test signal No. 1
Line time distortion	less than $\pm$ 1% using test signal with rise time of T

Short time waveform distortion

Rise-time distortion	less than 0.16 μs
Over shoot	less than 3% using test signal No.2 with a rise-time of T

(v) Differential gain — less than $\pm$ 0.5%

(vi) Differential phase — within $\pm$ 0.5°

(vii) Test signal leakage — less than -50 dB

(viii) Thermal and hum noise — less than -60 dB

(b) Sound route

(i) Input and output levels

Nominal — the Tenderer shall offer.

(ii) Input and output impedance

Nominal — 600 ohms balanced

(iii) Gain/Frequency characteristics

50 Hz to 10 kHz within $\pm$0.5 dB (reference to 800 Hz)

(iv) Test signal crosstalk — less than -70 dB

(v) Distortion — less than -40 dB

(vi) Noise — less than -70 dB

5.4.4 Data and Fault Recorder Subsystem

The recorder subsystem shall be composed of level recorder circuit and equipment fault recorder and miscellaneous recorder.

This shall be capable of recording transmit and receive carriers level, 60 kHz pilots or out-of-band noise level, circuit and system faults, meteorological data etc.

This shall be equipped in the control room and be mounted in bays or on appropriate shelves. Recording paper, pens and ink for these recorders shall be supplied in sufficient quantities (for two years)

(1) Level Recorder

(a) The recorder shall be multi channel continuous or plotted type pen recorder suitable for long term level recording.

(b) The following recording terms shall be included at least.

(i)	Transmit carrier level	3 carriers
(ii)	Receive carrier or pilot or out-of-band Noise level	12 carriers
(iii)	SG or G pilot level	offer

(2) Circuit and System Fault Recorder

(a) This shall be capable of recording transmit and receive circuit fault and system major fault.

(b) Recording terms shall be circuit name, system name, fault occuring and restoring data and time.

(c) The circuit name shall be as follows.

(i) 3 circuits (telephone, television and SPADE) for transmit

(ii) 12 circuits (telephone 9, television 2, SPADE 1) for receive

(d) The system or subsystem name shall be as follows.

(i) Antenna

(ii) Transmitter

(iii) Receiver

(iv) Modulator

(v) Demodulator

(vi) Baseband equipment

(vii) Power supply

(viii) SPADE terminal

(ix) Miscellaneous

(3) Miscellaneous recorder

(a) The recorder shall be capable of recording the following items at least.

(i) Meteorological data (wind direction, wind velocity amount of rainfall)

(ii) Receiving power voltage and amperes.

(4) Other items

(a) The Tenderer may offer another data acquisition system having the same performances described in this subsystem.

(b) The Contractor shall state the details of the offered data acquisition system.

5.5 Multiplexing Equipment System

5.5.1 General

This system shall consist of such subsystems as multiplexing terminal equipment for satellite link, multiplexing terminal equipment for terrestrial link and order wire equipment to be located in the communication equipment room.

For details, each subsystem shall contain the equipment shown in Table 5.9.

This system is such that it converts the signals coming from the microwave terrestrial link into the baseband signals and also conducts such functions inversely, for the purpose of connecting the transmitter and receiver system.

In addition, the system also provides the engineering service circuits to exchange the technical informations between the earth station and the opposite earth stations.

The signals will be normally transfered with voice-grade channels between the satellite link and the terrestrial link.

Table 5.9 Multiplexing Equipment System

No.	Subsystem	Equipment	Remarks
1	Multiplexing Terminal Equipment for Satellite Link	Group and supergroup translating equipment	SEND (1), REC (9)
		Group regulating equipment	(9) Groups
		Channel translating equipment	SEND (5Gs), REC (9Gs)
		Carrier broadcasting equipment	
		Voice frequency distribution frame	
		Voice frequency patching bay	
2	Multiplexing Terminal Equipment for Microwave Connecting Link	Group and supergroup translating equipment	5G (final 10G)
		Group regulating equipment	5G (final 10G)
		Channel translating equipment	
		Carrier supply equipment	
		Intermediate battery supply frame	
		Group and supergroup pilot recording equipment	
		Misc frame	R/G VFT, DC-DC HYB etc.
3	Order Wire Equipment	Telephone order wire translating equipment	SEND (1), REC (9)
		Voice frequency telegraph translation equipment	SEND (1), REC (9)
		Telephone order wire exchange equipment	
		Telegraph order wire exchange equipment	

5.5.2 Overall Performance Characteristics

This article stipulates the main performances for the baseband distribution unit (refers to 5.3.5 (7)) loop.

(1) Supergroup Section

Level setting	less than ± 0.1 dB
Loss frequency characteristics	within ± 1 dB (frequency range 312.3 to 551.4 kHz)
Interference	less than -65 dBm0 (frequency range 312 to 552 kHz)
Near end cross talk	not more than -80 dBm0

(2) Group section

Level setting	less than ± 0.1 dB
Loss frequency chracteristics	within ± 1 dB (frequency range 60.6 to 107.7 kHz)
Interference	less than -65 dBm0 (frequency range 60 to 108 kHz)
Near end cross talk	not more than -80 dBm0

(3) Voice frequency section

Level setting	less than ± 0.1 dB
Loss frequency characteristics	-0.5 to + 1dB (300 to 3000 Hz) -0.5 to + 1.5 dB (3000 to 3400 Hz)
Total noise	not more than -64 dBm0
Cross talk	not more than -70 dBm0
Interference	not more than -60 dBm0
Frequency error	less than ± 0.5 Hz
Phase jitter	less than 15 degrees

(4) Program transmission line characteristics

Level setting	less than -0.1 dB
Loss frequency characteristics	-0.6 to + 1.4 dB (50 to 10000 Hz) -0.6 to + 0.9dB (100 to 8500 Hz) within ± 0.6 dB (200 to 6000 Hz)
Total noise (C.C.I.T.T. weighting)	less than -48 dBm0p
Crosstalk	not to exceed -74 dBm0

5.5.3 Multiplexing Terminal Equipment for Satellite Link

This subsystem shall be composed of group, super group translating, channel translating, group regulator, carrier broadcasting equipment, carrier supply, intermediate battery supply, group and supergroup pilot recording, orderwire equipment, etc.

This subsystem shall receive 60 channels from the carrier terminal of the microwave connecting link and then convert them into a transmitting multi-destination baseband for the satellite link. It shall receive 9 carriers from opposite earth stations and pick up desired channels from each baseband. The number of obtained channels for the terrestrial link is about 30 channels in total. Connection shall be established at voice frequency band to the terrestrial link carrier terminal.

(1) Group and Supergroup Translating Equipment

(a) This equipment shall be capable of translating basic group to baseband of satellite link, and vice versa.

(b) The sending and receiving equipment shall be capable of combining and dividing output and input from/to the engineering service circuits and group A (12 to 60 kHz), respectively.

(c) The sending and receiving equipment shall be capable of inserting or extracting group reference pilot (104.08 kHz) or supergroup reference pilot (547.92 kHz), respectively.

The sending equipment shall also be capable of inserting or extracting line pilot frequency of 60 kHz.

(d) Input impedance

The input impedance of the basic group side of group stage shall be 75 ohms, balanced, and the input impedance of the baseband side of supergroup stage shall be 75 ohms, unbalanced. The return loss of each side shall not be less than 15 dB in the each transmission bandwidth.

(e) Output Impedance

The output impedance of the basic group side of group stage shall be 75 ohms, balanced, and the output impedance of the baseband side of supergroup stage shall be 75 ohms, unbalanced. The return loss of each side shall not be less than 15 dB in the each transmission bandwidth.

The output impedance of engineering service circuits shall, however, be 600 ohms balanced and the return loss shall be more than 20 dB.

(f) Frequency/Attenuation Distortion

The deviation of the frequency/attenuation distortion measured on a combination of sending and receiving group stage shall not be more than 0.5 dB within a basic group frequency band (48 kHz), and 0.25 dB within a channel frequency band (4 kHz).

For the supergroup stage, measured on a combination of sending and receiving, it shall not be more than 1.0 dB within a basic supergroup frequency band (240 kHz) and deviation within a basic group and a channel frequency bands shall be same as above.

(g) Total Noise

The total weighted noise shall not exceed 200 pw measured on a combination of sending and receiving equipment.

(h) Carrier Leak

The leak of any carrier frequency shall be better than -30 dBm0 measured at the sending output terminal each stage of the equipment, and -20 dBm0 measured at the receiving output terminal each stage.

(i) Linear Crosstalk

The effective far-end crosstalk of the equipment shall not be less than 70 dB measured on a combination of sending and receiving equipment. The effective near-end crosstalk shall not be less than 70 dB measured at a basic group.

(j) The Tenderer shall state the level diagram of the equipment in the offer.

(k) This equipment shall be capable of translating the following channel numbers.

Items	Channel Capacity	Number of Baseband	Frequency Arrangement	Pannel Mounting Number
Send	132 chs	1	GA, SG 1~2	GA, SG 2*
Receive	1092 chs	1	GA, SG 1~16	GA, SG 1*
	252 chs	8	GA, SG 1~4	GA, SG 1*

(l) In order to realize the matter symbol * in the table of the item (k), take such a structure as carrying all of the carrier wiring of SG-MOD and SG-DEMO on the terminals on the frame and modifying the connection with the carrier supply to enable the reception of any one SG (60 channels) in the baseband.

(m) Insert the power limiter into the sending side of the basic group of this equipment. With the characteristics of this power limiter, it shall be provided for the automatic gain control which controls the average value of the transmission load to less than $4\log_{10} 2 \times 12 = 4.3$ dB based on the relative level and the limiter which can optionally set the level to more than AGC setting point, in the range of 10 to 20 dB.

(2) *Group Regulating Equipment*

(a) This equipment shall automatically regulate basic group level by group reference pilot.

(b) The characteristics of this equipment shall be as follows.

(i) Impedance
- input: 75 ohms balanced
- output: 75 ohms balanced
- return loss: not less than 20 dB

(ii) Loss-frequency characteristics
within $\pm$ 0.25 dB (60-108 kHz)

(iii) Noise less than -80 dBm0

(iv) Regulating speed
less than 5 sec at 1/e e:2.718

(v) Compression ratio
less than 0.1

(vi) Over load margin
2nd not less 60 dB
3rd not less than 73 dB

(vii) Crosstalk not less than 80 dB

(viii) Level stability
within $\pm$ 0.5 dB (power voltage $\pm$4%,temperature 25° $\pm$15°C)

(c) Alarm circuit

The alarm shall be the minor alarm, when the pilot level at the input of this equipment is changed from the normal value to more than $\pm$ 3 dB, and shall generate the major alarm for the change of more than $\pm$ 6 dB.

(d) Pilot interruption

Regulator shall not produce the output level variation, if pilot interruption occurs.

(e) The Tenderer shall state the level diagram of the equipment in the offer.

(f) The unit mounting numbers are prepared for 10 groups.

(3) Channel Translating Equipment

(a) The equipment shall be capable of translating 12 channels in the voice frequency band into a basic group frequency band occupying 60 kHz to 108 kHz, and vice versa.

(b) Transmission frequency band and frequency/attenuation distortion. (loop back at group band)

0.3 to 3.0 kHz	-0.5 to +1.0 dB
3.0 to 3.4 kHz	-0.5 to +1.5 dB

(reference frequency 1000Hz)

(c) Input and output impedance

at the voice band circuit	600 ohms balanced
at the basic group side	75 ohms balanced
Return loss	not less than 20 dB

(d) Total noise

The total weighted noise of the equipment shall not exceed 330 pwp measured on a combination of sending and receiving equipment.

(e) Carrier leak

Sending output	better than -30 dBm0
Receiving output	better than -20 dBm0

(f) Linearity

The deviation of the receiving output level shall not exceed 0.3 dB measured on a combination of sending and receiving equipment when the level at the sending input is increased from zero relative level to +3.5 dB.

(g) Linear crosstalk

The effective liner crosstalk of the equipment shall be 70 dB or more, measured on combination of sending and receiving equipment.

(h) Voice frequency harmonic distortion

When the test tone is standard level of 1000 Hz, the 2nd harmonic distortion attenuation shall not be less than 30 dB and the 3rd harmonic shall not be less than 40 dB.

(i) Unintelligible crosstalk

The unintelligible crosstalk attenuation shall be better than -60 dBm0 weighted.

(j) The characteristics of the out band signaling (3825Hz) circuit shall be as follows.

(i) Impulse distortion

± 5%	input signal level ± 3.5 dB signal frequency ± 10 Hz impulse speed 10 pps, make ratio 33%

(ii) Erroneous operation

When a signal of 100, 150 and 200 Hz at a level higher than 5 dB at test tone level, send to any channel, adjacent signaling receiver shall not operate.

(k) The power limiter shall insert into the sending side in the voice frequency band of this equipment. With the characteristics of the power limiter, the peak component 10 to 20 dB higher than the level diagram shall be limited and the setting point for the working level of this limiter shall be variable.

(4) Carrier Broadcasting Equipment

(a) The equipment shall translate television sound signal and telephone voice signal (Cue circuits) connecting to satellite link.

(b) The main characteristics of the equipment shall comform to the C.C.I.T.T. Recommendation, J-21, Type-A.

(c) This equipment shall translate television sound signal 2 channels and telephone voice signal 24 channels.

(d) The characteristics of this equipment shall be as follows.

(i) Television sound signal

1. Input impedance 600 ohms balanced

Return loss: not less than 20 dB

2. loss frequency characteristics

50 to 10000 Hz	-0.6 to + 1.4 dB
100 to 8500 Hz	-0.6 to + 0.9 dB
200 to 6000 Hz	$\pm$ 0.6 dB

(reference frequency 800 Hz)

3. distortion

	2nd	3rd
50 Hz	not less than 40 dB	not less than 43 dB
800 Hz	not less than 45 dB	not less than 48 dB
3000 Hz	not less than 45 dB	not less than 48 dB

4. total noise

less than -65 dBm0p (C.C.I.T.T. weighting)
less than -60 dBm0p (flat level meter)

30 Hz to 20 kHz

5. carrier leak — less than -30 dBm0
6. cross talk — more than 80 dB
7. level variation — within $\pm$ 0.3 dB
8. emphasis — refer C.C.I.T.T. Rec. J-21
9. delay distortion

50 Hz	less than 40 ms
100 Hz	less than 10 ms
1000 Hz	less than 4 ms

(ii) Telephone voice signal

The characteristics of this signal are specified in 5.5.3 (3) (a) to (i) and (k).

(e) The group regulator shall be inserted at the basic group band, while in this equipment the telephone signal and TV sound signal are converted into group A (12 to 60 kHz) and group B (60 to 108 kHz) respectively.

(f) The Tenderer shall state the level diagram of this equipment.

(5) Voice Frequency Distribution Frame

(a) This equipment shall be mounted with the terminals which connect the wirings between each of the equipment in the voice

frequency band and change thereof, if necessary.

(b) The crosstalk in the terminal shall be capable of ensuring the attenuation amount to more than 90 dB.

(c) It shall take such a structure that the wiring is easily connected.

(d) It shall take the structure which is provided with the doors at the front and back and does not permit the dust to invade.

(e) The earth bar soluderable shall be provided.

(f) The necessary capacity for this equipment shall be proposed.

(6) Voice Frequency Patching Bay

(a) This equipment shall be used for inserting the connection plug into 4 wire sections of the voice frequency band, and used to be the connecting point of the satellite link and the terrestrial link in the earth station.

(b) It shall be capable of exchanging various circuits by means of cord connection.

(c) The capacity of this equipment shall be prepared for 60 channels.

5.5.4 Mulitplexing Terminal Equipment for Microwave Connecting Link Subsystem

This subsystem shall translate signal in the voice frequency band to the baseband of the microwave connecting link by means of FDM. This subsystem involves the common equipment relative to the terminal of satellite link in the earth station (carrier supply, intermediate battery supply, group and supergroup pilot recording equipment, etc.)

(1) Group and Supergroup Translating Equipment

(a) This equipment shall be capable of translating basic group to base band of microwave connecting link and vice versa.

(b) This equipment shall be for translating 5 basic groups to one basic supergroup and then translating this basic supergroup to the band of SG 1, SG 2 (60 kHz to 552 kHz).

(c) This equipment shall be for performing the insertion, branching and rejection of SG Pilot (547.92 kHz) and the insertion, branching and rejection of line pilot (60 kHz, 4029 kHz).

(d) The main characteristics of this equipment are the same as those stated in 5.5.3 (1) (d) to (j).

(e) The mounting numbers of this equipment shall be prepared corresponding to 5 groups, one supergroup. The final number of this equipment is ten groups (two supergroups).

(2) Group Regulating Equipment

(a) This equipment shall be inserted into the basic group in the earth station receiving line of the microwave-connecting link.

(b) The functions and characteristics are specified in 5.5.3 (2) (a) to (e).

(c) The unit numbers shall be fit for 5 groups (final 10 groups)

(3) Channel Translating Equipment

(a) This equipment shall be for connecting to the microwave connecting link and translating the basic group to the voice frequency band.

(b) The characteristics are specified in 5.5.3 (3) (a) to (j).

(c) The capacity of this equipment shall be fit for 60 channels (final 120 channels).

(4) Carrier Supply Equipment

(a) The equipment shall be capable of supplying carrier and pilot frequencies to each equipment.

Moreover, the equipment shall supply the required carrier and pilot frequencies of the carrier equipment for the microwave connecting link.

(b) The equipment shall furnish both normal and emergency capability. The changeover from normal to emergency shall be automatic. Restoring may be manual.

(c) The equipment shall provide the following carrier, pilot and test frequencies.

Classifications	Frequencies	Remarks
Channel Carriers	Specified in Translating Device of the channel translating equipment	
Group Carriers	420, 468, 516, 564, 612 kHz	
Supergroup Carriers	612, 1116, 1364, 1612, 1860, 2108, 2356, 2604, 2852, 3100, 3348, 3596, 3844, 4092, 4340 kHz	
Pilots	60, 104.08, 547.92, 4092 kHz	with stabilizer
Test tone	1.0, 0.8 kHz	with stabilizer
Carrier broadcasting carrier	95.5 kHz	
Group A carrier	120 kHz	
Order wire carrier	16, 20, 28 kHz	
Order wire signal	2280 Hz	
4 MHz Translation carrier	8432 kHz	

(d) The equipment shall have a crystal type master oscillator enclosed in an oven. The required frequency shall generated by means of multiplying and demultiplying the frequency of the master oscillator.

However, the master oscillator for pilots, except 60 kHz shall be provided separately for carriers.

(e) The Tenderer shall state the master oscillator frequency and each carrier frequencies generating procedure.

(f) Frequency Stability

The frequency stability of the equipment shall be $\pm$ 1 X 10^{-7} for carrier frequencies and $\pm$ 1 X 10^{6} for pilot frequencies.

(g) Frequency Purity

The frequency purity of the equipment shall be more than 50 dB for channel carriers, 80 dB for group supergroup carriers, and 30 dB for pilot frequencies. Moreover, it shall be more than 20 dB for these harmonics.

(h) Level Stability

The level stability of the equipment shall not exceed $\pm$ 1 dB for each carrier, $\pm$ 0.2 dB for group and supergroup pilots, and $\pm$ 0.2 dB for pilot at 60 kHz.

(i) Changeover Normal and Emergency

The changeover from normal to emergency operation shall be made when signal is 1.0 dB to 3.5 dB lower than standard level of carriers and 3.5 dB or more lower than standard level of pilots.

The changeover time shall be within 5 ms.

(j) Alarm Circuit

It shall generate the visible and audible minor alarm, on exchanging from the actually used circuit to spare, and send the earth magnetism for the terminal on the frame.

On disconnecting fuse, major alarm shall be generated and its functions are as above.

(k) The Tenderer shall describe the level of generating frequency, number of branch and output impedance.

(5) Intermediate Battery Supply Frame

(a) This equipment shall be for distributing DC power supply for communication to each terminal satellite and it shall be mounted with no fuse breaker and fuse.

(b) This equipment shall be inserted with the main no fuse breaker and, after branched therefrom, it shall be inserted with no fuse breaker on the load being more than 5 amperes, and with fuse on the load being less than 5 amperes.

(c) Alarm

On disconnecting no fuse breaker or fuse, major alarm shall be generated and the terminal for sending the earth magnetism to the external shall be provided.

(d) The Tenderer shall state the number of no fuse breaker and fuse.

(6) Group and Supergroup Pilot Recording Equipment

(a) This equipment shall be for monitoring for transmission line of the satellite link and the microwave connecting link by means of line, supergroup and group pilot.

(b) This equipment shall amplify and rectify the line, supergroup and group pilot, and there after record continuously the pilot level by pen-type recorder.

(c) The alarm shall generate when the pilot level exceeds the predetermined level range ($\pm$ 3 to $\pm$ 6 dB).

(d) Together with the alarm generation, the lamp indication is performed that enable to judge directly which SG or G in which circuit is failed.

(e) The main characteristics of this equipment shall be as follows:

(i) Input terminal numbers

linepilot	60 kHz 10 terminals
supergroup pilot	547.92 kHz 12 terminals
group pilot	104.08 kHz 20 terminals

(ii) Input signal change switch

Change those of the input numbers in the item (1) by the switch and swing one of the level meters.

(iii) Level Meter 1 set:

It shall be able to measure at an accuracy of $\pm$ 0.2 dB.

(iv) Amplifier and Rectifier numbers (including BPF)

	Satellite link	Terrestrial link
line pilot	7 (9)	1
supergroup pilot	7 (9)	1 (2)
group pilot	9 (12)	5 (10)

( ) indicate final numbers

(v) Recorder

It shall swing to full scale at $\pm$ 6 dB by continuous recorder with more than 2 pens and has the read accuracy of $\pm$ 0.2 dB. Paper feed rate shall be 25 mm/hour and constructed as a recorder easily maintained. It shall be provided for 15 inputs, providing wiring terminals between the output of the amplifier-detector and the input of the recorder and each pilot shall be connectable to the recorder.

(7) Miscellaneous Frame

(a) This equipment shall accommodate the equipment for processing the alarm generated from each of the frames of the equipments in the terminal stations of the earth station, relay group necessary for the communicating circuit between earth station and central station, voice frequency translating equipment for use with telegraph order wire connected to the terrestrial link, DC-DC converter necessary for driving the printer etc. together that are not mounted in other equipments.

(b) Relay group of alarm circuit

It shall process the alarm information from each equipment into intensive alarm or flame row alarm.

(c) Relay group of order wire circuits.

It shall be mounted 4W R/D relay for the order wire circuits, and convert from 2W to 4W.

(d) VFT

It shall carry out frequency division of voice band in the terrestrial link to use for telegraphy and its basic construction and characteristics are the same as VFT in the central station. Prepare for 1 ch of voice frequency band.

(e) DC-DC converter

It shall obtain DC $\pm$ 50 V (or $\pm$ 60 V) necessary for the printer from DC-24V.

5.5.5 Order Wire Equipment Subsystem Subsystem

This equipment shall establish direct telephone, telegraph and international telex order wires necessary for operation and maintenance work between the Paraguay Earth Station and other foreign earth stations, through the satellite communication links.

The equipment shall consist of telephone order wire equipment and telegraph order wire equipment.

(1) Telephone Order Wire Translating Equipment

(a) The equipment, working with group and supergroup translating equipment, shall establish two (2) coordination voice and telegraph channels situated within 4 to 12 kHz in the lower band of the satellite baseband.

These two (2) channels shall be established by means of single side band, suppressed carrier and frequency division multiplex techniques.

(b) Impedance

The input and output impedance of the equipment shall be 600 ohms, balanced, at the voice side and the carrier side respectively.

The return loss shall not be less than 15 dB.

(c) Frequency/Attenuation Distortion

300 Hz – 2400 Hz	+ 2.5 dB – -0.5 dB
400 Hz – 2200 Hz	+ 1.25 dB – -0.5 dB
600 Hz – 2000 Hz	less than $\pm$0.5 dB

(Reference frequency : 1000 Hz, sending and receiving side respectively)

(d) Total Noise

The total weighted noise, measured on a combination of sending and receiving equipment, shall not be less than 500 pw.

(e) Lenearity

The linearity of the equipment is specified in 5.5.3 (3) (f)

(f) Voice Frequency Harmonics

The voice frequency harmonics are specified in 5.5.3 (3), (h).

(g) Carrier Leak

The carrier leak is specified in 5.5.3 (3), (e).

(h) Linear Crosstalk

The linear crosstalk is specified in 5.5.3 (3) (g).

(i) Power limitter

The power limitter circuits shall be provided which limit the signals more than + 10 dBm0 against the sending line.

(j) Signaling system (I.C.S.C. -30 -33E)

(i) Sending unit

sending frequency	2280 Hz $\pm$ 6 Hz
sending level	-6 $\pm$ 1 dBm0
sending dial speed	10 $\pm$ 2 impulse per second
sending dial pulse ratio	33/66 $\pm$ 10% make-break ratio

(ii) Receiving unit

The signalling receiver shall operate within 10 mS on received signals that meet the following conditions: 2280 $\pm$ 15 Hz at a level of -6 $\pm$ 7 dBm0.

The receiver shall not operate on received signals that meet the following conditions:

2280 $\pm$ 15 Hz at level loss than - 28 dBm0 signals outside the frequency range 2280 $\pm$ 150 Hz at level of -6 $\pm$ 7 dBm0

The receiver shall operate satisfactorily in the presence of steady noise at a level not exceeding -40 dBm0p.

(k) Standard level diagram

The Tenderer shall describe the level diagram of voice and signalling.

(2) Voice Frequency Telegraph Translating Equipment

(a) The equipment, combining with telephone order wire equipment described in 5.5.5 (1) (a) above, shall establish five (5) each telegraph channels in the upper band of each coordination channel by means of frequency division.

The lower band of the coordination channel shall be used for a telephone channel.

(b) The equipment shall be furnished with dividing and combining circuits for the telephone and telegraph channels mentioned above.

(c) The electrical characteristics specified in (f) below, shall not be adopted for characteristics including dividing and combining circuits mentioned above.

The Tenderer shall state overall characteristics, including dividing and combining circuits, in his offer.

(d) The telegraph channel shall be frequency-shift modulated voice frequency telegraphy, the modulation rate of which shall be 50 and 75 bauds.

(e) The equipment, in case of transmitting, shall modulate carrier frequency by receiving a ground from the external circuit and in case of receiving, it shall send a ground to the external circuit by receiving a modulated signal.

(f) Telegraph Circuit Characteristics

(i) The number of channels and line frequency band shall covers maximum of five (5) channels. The nominal mean frequency shall be 2,700 Hz, 2,820 Hz, 2,940 Hz, 3,060 Hz and 3,180 Hz.

(ii) The shift frequency shall be as follows at the sending line side:

Nominal mean frequency + 30 Hz relative A polarity;
Nominal mean frequency - 30 Hz relative Z polarity.

The deviation of the each frequency, including initial variation, shall be within $\pm$ 3 Hz.

(iii) The shift bandwidth shall be within 60 Hz $\pm$ 3 Hz.

(iv) Total Distortion

The total distortion, looping the sending line side to the receiving side at a nominal level diagram, shall not exceed 8 % at 50 bauds and 10 % at 75 bauds.

(v) Frequency Shift Modulator

The oscillation frequency of this modulator shall conform to paragraph a. above. "A" polarity frequency shall be sent in case of no DC telegraph signal.

(vi) Relay Circuit

DC telegraph current shall be sent by the relay circuit signal received from the former stage.

(vii) Other characteristics

The characteristics shall conform to a standard of 120 Hz spacing 50 bauds FMVFT of C.C.I.T.T. Recommendation R. 35.

(g) Alarm Circuits

Terminal shall be provided which indicates alarm for the level down by 7 to 10 dB in the telegraph receiving carrier as well as for

sending earth potencial to the out side of this equipment. For the fuse disconnection, only the earth potencial is sent outwardly.

(h) The Tenderer shall furnish the level diagram of the equipment.

(3) Telephone order wire exchange equipment

(a) This equipment shall connect the engineering service circuits with other earth stations and the order wire circuits with central circuit to the telephone set at the intraterminal in the earth station. It shall also include the orderwire equipment for the maintenance and operation in the earth station.

(b) Construction

(i) Inter earth station engineering service circuits:

Sending side	4 channels
Receiving side	20 channels

(all of 4W R/D, dial omnibus, speaker calling are possible).

(ii) To central station:

Send and receive	3 channels

(iii) Telephone set 2 sets (final 3 sets)

(v) In station telephone set (4W R/D) 6 set (final 10 sets)

(c) Selective call signal system to earth stations (4W dial omnibus system)

(i)	Seizing signal	150 to 200 ms
(ii)	Cut down signal	more than 700 ms
(iii)	Dial impulse	speed 10 $\pm$ 1 pps make ratio 33 $\pm$ 5% pause time more than 250 ms.

(d) Telephone set

(i) This equipment shall be accommodated in the television control and monitor console and connect to other earth stations (to 10 stations) in-station 4W/R/D circuit of 10 channels and communication circuits of 3 channels to the central station.

(ii) Push button switch to select station for the item (i) shall be provided. The lamp shall light up on circuit busy, flash on receiving and put out on completion.

(iii) Monitoring speaker, dial shall also be mounted and transmitter and receiver attached.

(iv) The switching equipment shall be driven by the selection switch of this equipment and all of the operation shall be performed automatically.

(v) The transfer of the circuit against earth station to instation telephone board or to the central station shall be possible.

(e) Instation telephone set

(i) This set shall be mainly used for in station orderwire and consisted of 4W/R/D.

(ii) This set shall be able to incorporate into other communication equipments (refer to the drawings)

Antenna pedestal	1
Television Test Bay	1
Power supply room	1
Multiplexing terminal equipment room	1
Telephone test bay	1
Control and monitor bay	1

(iii) This set is provided with switches and pilot lamps that can select 10 stations and lamps and buzzers shall be used together as calling information.

(iv) It shall be capable of monitoring and, at the same time connectable to speaker.

(f) Telehpne order wire switching equipment

(i) This equipment shall have the functions of automatically selecting the opposing earth station and central station and the telephone sets and in-station telephone sets and connect them as stated before.

(ii) Since the transmission path to the earth station is the multidistonation, the correspondence between the sending and receiving shall also be performed by this exchange device.

(iii) It shall generate the ring back tone and the busy tone etc.

(4) Telegraph Orderwire Exchange Equipment

(a) The equipment shall consist of telegraph operator position and telegraph switching equipment.

The telegraph operator position shall be composed of teleprinter, control unit and teleprinter's desk.

The quantity shall be two sets of each.

(b) Teleprinter

(i) Type and quantity

The type and quantity of teleprinters shall be as follows.

Besides, accessories including tape wind reels shall be provided.

Page printer with keyboard, tape punching function and auto tape transmitting attachment.

(ii) Signaling Conditions

The code, transmitting letter, figure and mark used with the teleprinter above, shall conform to the international Alphabet No, 2. It shall use a start-stop of 5 units (7.5 units for transmitting).

(iii) The signaling voltage and current used shall be both double current type and single current type with a voltage of 60 volts and current of 20 mA.

(iv) The communication system shall be simplex system.

(v) The modulation speed shall be a nominal 50 bauds. It shall also be capable of using 75 bauds.

(vi) Other functions

The teleprinter shall be capable of keyboard operation and using answer-back function.

Moreover, the teleprinter shall be capable of play-back and unattended service.

(vii) The control unit shall be capable of controlling the following.

(viii) The control unit shall furnish the telegraph order wire circuit selection keys. The unit shall be capable of selecting the required destination telegraph order wire circuit via telegraph exchange equipment by the key.

(ix) The unit shall provide an incoming call indication lamp for each circuit. However, this indications shall be switched off after traffic clears.

(x) Teleprinter's Desk

The teleprinter's desk shall be fixed type and the teleprinter and the control unit shall be arranged on/in the desk.

(xi) The unit shall be capable of send monitoring and local testing easily.

(xii) The unit shall be installed in the teleprinter's desk for easy control.

(c) Telegraph Switching Equipment

(i) The equipment shall connect with a destination circuit and an operator position by operating the circuit selection key of the control unit.

(ii) The equipment shall automatically select and connect from a destination circuit to a free operator position.

(iii) However, before connection with a destination circuit and an operator position, the equipment shall test whether the circuit is free.

(iv) When incoming call from a destination circuit an audible indication shall be provided. These indications shall be switched off after traffic clears. However, the audible indication shall freely be switched off by manual.

(v) The exchange equipment shall connect initially two operator positions to 7 destination telegraph order wire circuits, and 2 circuits for central station.

(vi) The final capacity of the exchange equipment shall be capable of accommodating 3 operator positions and 10 destination circuits.

(vii) The number of telegraph order wire circuits for exchange.

For other earth station	
sending side	8 channels (final 10)
receiving side	28 channels (final 40)
For central office	
send and receive	2 channels (final 3)
operator position	2 sets (final 3 sets)

(d) International Telex Equipment

(i) The telex circuit shall be connected with the destination circuit via order wire circuit between the central station and the earth station, and the telex exchange equipment at the center station.

(ii) A telex operator position for the earth station will be provided by the ANTELCO.

(iii) As the transmitting and receiving units for the telex circuit to be installed at the central station and the earth station, one set of each unit shall be provided. The set-up positions of each unit at the earth station and the central station will be designated by the ANTELCO.

(iv) The units shall be capable of sending a telegraph signal to the order wire circuit mentioned in 1. above by means of modulating a carrier frequency with a DC signal from the teleprinter, and shall be capable of demodulating a telegraph signal to a DC signal able to operate a teleprinter.

(v) The units shall have hybrid circuits.

5.6 SPADE Terminal System

5.6.1 General

SPADE (Single Channel per Carrier PCM Multiple Access Demand Assignment Equipment) is a kind of the Demand Assignment Multiple Access (DAMA) satellite network.

In SPADE system, a chosen satellite RF frequency band (36 MHz) is divided on the basis of assigning a single voice channel per RF carrier. The RF band, thus divided, forms a "pool" of frequencies. The SPADE system is fully variable, allowing all circuits to be selected by any station on demand. The modulation is PCM/PSK/FDMA. The system does not require a central station for system control, but instead uses a Demand Assignment Signaling and Switching Unit (DASS) for self-assignment of channels based on continually updated channel allocation status data provided via a Common Signalling Channel (CSC). The CSC is PDM/PSK/TDMA circuit. The CSC is used to transmit the assigned burst at assigned time for one station and to continuously apprise each earth station DASS of the availability of pool channels and to establish links directly with other stations. A maximum of 49 DASS units (i.e. 49 signalling bursts on the CSC) may be operated in each demand assigned pool. Up to a maximum of 60 terrestrial circuits may be terminated at each DASS unit.

Table 5.10 shows the SPADE Terminal System Configuration.

A SPADE terminal consists of the Common Equipment, Full Duplex Channel Unit, Terrestrial Interface Unit, Maintenance Center and Teletypewriter.

The Common Equipment is a key equipment of the SPADE terminal and it controls all other equipments.

Table 5.10 SPADE Terminal System

No.	Subsystem	Remarks
1	Terrestrial Interface Unit (TIU)	C.C.I.T.T. No. 5 Signalling
2	Demand Assignment Signalling and Switching Unit (DASS)	
3	Channel Unit (CHU)	3 channels (12 channels final)
4	IF Subsystem (IFSS)	
5	Time and Frequency Unit (TFU)	
6	Maintenance Center (MC)	

The Full Duplex Channel Unit converts the voice signal into PCM and then PSK-modulated signal for its transmitting circuit. The receiving circuit of the Channel Units functions in the reverse way.

The Terrestrial Interface Unit is interfaced with the terrestrial circuit which works with C.C.I.T.T. Singalling No. 5.

The maintenance center is used to control, monitor and maintain the SPADE terminal. More over the status of each equipment is displayed on the display panel of the Maintenance Center.

Fig. 5.11 shows the configuration diagram of the SPADE terminal system and Table 5.11 shows the SPADE characteristics and transmission parameters.

5.6.2 Interface Condition

The SPADE terminal has two main interface points, IF subsystem interface and TIU interface. The former interface with the up-converters of the earth station and the latter with the terrestrial link. The conditions of transmit and receive interfaces with the IF subsystem are the following.

Frequency	70 MHz ± 18 MHz
Impedance	75 ohms unbalanced
return loss	not less than 26 dB

As those of TIU are the following:

4 wire VF interface	
Impedance	600 ohms balanced
return loss	not less than 26 dB
frequency	0.3 to 3.4 kHz

The Tenderer shall state the level of both interfaces.

Fig. 5.12 shows the interface between earth station and SPADE terminal equipment.

5.6.3 Requirements

(1) Initially CHU can provide 3 channels and finally can expand up to 12 channels with CHU panels addition.

(2) The specification of this system shall be based upon COMSAT's R.F.P. "Contract CSC-ESOC-200" and related documents.

5.7 Other Items

(1) Intermediate distribution frame (IDF), patching bay and intermediate battery supply bay (IBS) shall be provided that are necessary for the interconnection of the equipments installed in each room.

The Tenderer shall offer the room name and number to be installed.

(2) Major alarm and minor alarm shall be distinguished as follows:

(a) Major alarm is in the event of failure of both normal and emergency.

(b) Minor alarm is followed by change-over from normal to emergency.

(3) Abbreviated symbol for using purpose shall be printed to the indicators, meters, switches, adjusting screws etc. of each equipment.

(4) Control buttons in every control bay and monitor console shall be provided with the lamp embeded type with display functions.

(5) Lift of display lamp shall be at least 2000 hours.

(6) Color codes for the status display lamps with each equipment shall be in compliance with the following standard.

(a)	Operation	Green
(b)	Stand-by	White
(c)	Maintenance	Yellow or amber
(d)	Fault	Red

Table 5.11 SPADE CHARACTERISTICS AND TRANSMISSION PARAMETERS

Parameter	Requirement
Audio Channel Input Bandwidth	300-3400 Hz
Encoding	7 Bit PCM A=87.6 Companding law
Modulation	Four Phase Coherent PSK
Ambiguity Resolution	Unique Words
Carrier Control	Voice Activated for voice channels
Channel Spacing	45 kHz $\pm$ 50 Hz
Bandwidth unit	45 kHz
IF Noise Bandwidth	38 kHz
Required C/T per channel at threshold	-169.8 dBW/^{o}K
C/T per channel at nominal operating point	-167.3 dBW/^{o}K
Threshold C/N in IF Bandwidth	13 dB
Threshold Bit Error Rate	10^{-4}

CHAPTER 6 PERFORMANCE CALCULATION

6.1 General

In order to realize an Earth Station satisfying the transmission performances stipulated in 4.3, the Tenderer shall design system with the following in mind, then present the results.

6.2 Performance Parameter

6.2.1 Allotment of G/T in the Receiving System

G/T of the Earth Station was prescribed in 4.2.1. The Tenderer shall propose the antenna gain, loss of feed system, matching conditions, antenna noise temperature and receiver noise temperature needed for assuring the above. In this case, the stipulations in 4.2.2. and 4.2.5 shall be satisfied, and at the same time, the antenna gain, antenna noise and receiver noise shall be defined.

6.2.2 System Margin

The Tenderer shall calculate the system magin estimation for the satellite loop link according to the transmission parameter appearing later on.

6.2.3 Noise Allotment for Telephone Link

The Tenderer shall clarify distribution of the noise in each subsystem. The Tenderer shall also correspond each allotted figure to the electrical performances of each equipment comprising the subsystem.

6.2.4 Standard Allotment for Television Link

Referring to the television link, a similar standard allotment plan to cope with individual earth station facilities shall also be clarified. The clarification shall indicate how to correspond each allotted figure to the electrical performances of each equipment comprising the subsystem.

CHAPTER 7 POWER SUPPLY SYSTEM

7.1 General

The present incoming facilities receive the commercial power of 3 phase, 22.9 KV, 50 Hz at the power substation via the power pole in the vicinity of the station property line through the aerial line from 22.9 KV distributor used only for earth station at AREGUA substation and breaker at input of Power Substation decide the responsibility limit of the earth station.

The power supply to the station facilities is provided separately to the communication and associated facilities by high voltage step-down transformer after stepping down to 220 V, 50 Hz via the voltage distribution of future enlargement for second antenna.

The Monitor/Control board for remote-controlling the outdoor substation and diezel engine generator, and monitoring all equipments and the Low voltage distribution boards shall be installed in the electric power room.

For the normal power supply, the commercial power will be used. and if the commercial power failure occurs, the power supply shall be switched automatically to the diezel engine generator.

The power supply system shall permit to add the low voltage distribution boards and the diezel engine generator in the future enlargement of installation.

The protection of technical equipments against interruption during the commercial power failure shall be provided.

A system design utilizing a dual rectifier battery set for supplying the main DC 24 Volts power requirements of communication equipments and a dual rectifier battery inverter set for supplying AC power requirements of two of low noise amplifiers, Telephone transmitter, SPADE transmitter, SPADE terminal equipment, TV monitor, TV control, etc. shall be provided.

7.2 Scope

The scope of the work for construction of power supply shall be as follows.

(1) Complete power configuration necessary from substation to low voltage distribution board to deliver adequate power for site with the reliability required for continuous full time commercial operation, full consideration of safety operation and maintenance.

(2) All proposals shall include a complete detailed description of design feature, equipment, ratings, power estimates.

(3) Special attention in accordance with the system design and equipment characteristics to assure that voltage and frequency limits, transient and surge currents remains within the requirements of the technical equipment.

(4) Capability for installing the equipments of the second antenna shall be provided.

(5) The performance tests of all equipments shall be conducted and measurement devices necessary, including dummy load, shall be prepared.

(6) All electrical installation shall be in accordance with local requirements and regulations in PARAGUAY.

(7) Parts employed shall take into consideration local environment (subtropical) of the site and be simplified as far as possible so as to facilitate procurement, maintenance and cost saving.

(8) Accessories and spare parts

The equipments shall be provided with accessories and spare parts required for operation and maintenance for two years and approved with respect to quantities.

The spare parts to be supplied shall be packed tightly so as to withstand long term storage and marked with part name, quantities and notes for storage.

(9) Coating

The equipments shall be coated with dust proof paint so as to withstand the local environmental conditions. As for paint color, the color samples shall be presented for approval.

(10) Documents

The contractor submit documents as following.

(a) Report of completion

(b) Photographs of completed facilities

(c) Instruction manual for equipments (including drawings and part descriptions)

(d) List of spare parts

7.3 Technical Requirements

Fig. 7.1 shows the power system. This power system consists of the substation equipment at the outside of diesel engine generator, non-break DC equipment, non-break AC power equipment, low voltage distribution board and Monitor/Control board in station building described in Table 7.1.

Table 7.1 Power Supply System

No.	Subsystem	Items	Remarks
1	Power Substation	Step down transformer Line voltage Regulator Breaker Others (lighting, control, etc.)	7.3.1
2	Diesel Engine Generator	The thing in itself Control, Fuel tank, Others	7.3.2
3	Non-break DC power Equipment	The thing in itself Control, Battery, Others	7.3.3
4	Non-break AC power Equipment	The thing in itself Control, Battery, Others	7.3.4
5	Low voltage Distribution Board	The thing in itself Control, Others	7.3.5
6	Monitor/Control Board	The thing in itself Control, Others	7.3.6
7	Miscellaneous		

7.3.1 Power Substation

An enclosed power substation including step-down transformer, line voltage regulator, breaker being cubicle type, arrester and lightning protection shall be provided special regard of electric shield and protection of snak's invation etc., referring to Figs. 3.1 and 3.2, and 8.4.4 should be paid to the fact that the receiving power voltage is very high in respect of construction of power substation.

The details including conditions mentioned below at least shall design and submit for review and approval.

(1) Step-down transformer

Items	Standard	Remarks
Quantity		
Type		
Frequency		
Output		
Rating		
Voltage		
Primary		
Secondary		
Tape Voltage		
Connection		
Primary		
Secondary		
Others		

(2) Line Voltage Regulator

Items	Standard	Remarks
Quantity		
Formation		
Operating System		
Rating		
Type		
Capacity		
Line Capacity		
Frequency		
Voltage		
Line Voltage		
Adjust Voltage		
Other		

(3) Breaker

Items	Standard	Remarks
Quantity		
Formation		
Type		
Voltage		
Current		
Interception Capacity		
Other		

(4) Others

(a) Lighting system

(b) Control system

7.3.2 Diesel Engine Generator

Diesel engine generator is capable of carrying the station load. Those controls shall provide for automatic starting and assumption of station load upon failure of commercial power.

The transfer between Diesel engine generator and commercial power shall be provided for the purpose of uninterrupted load transfer in putting units in and out of service and shall be manual operation.

A fuel tank, having capacities of one week shall be provided and will be described in 8.4.8 in Chapter 8.

The details including conditions mentioned below at least shall be designed and submitted for review and approval.

Items	Standard	Remarks
Quantity		
Formation		
System for engine		
Starting system for Engine		
Cooling System for Engine		
Type for Generator		
Output Voltage		
Output Capacity		
Power Factor		
Phase		
Frequency		
Excitation System		
Others		

7.3.3 Non-Break DC Power Equipment

A Complete dual rectifier set shall be provided. The set shall be of redundant module design utilizing static components and a floating battery rated to provide a continuous DC supply during commercial power system transients and interruptions.

If one of 2 modules fails, the failed module is cut off immediately and automatically with an audible alarm from the circuit, and the other module continues to supply power for communication equipments.

The batteries shall be sized for a minimum of 10 minutes operation at the units full load ratings.

The details including conditions mentioned below at least shall be designed and submitted for review and approval.

Items	Standard	Remarks
Type and Formation		
Rectifier System		
Cooling System		
Rating		
AC Input Phase Voltage Voltage Regulation Power Factor		
DC Out-put Florting Charge System Equalizing Charge System Voltage Current		

7.3.4 Non-Break AC Power Equipment

The equipment shall be modular and static in design. The design and rating shall provide for continued and uninterrupted power supply upon failure (or removal for maintenance) of one of the modules.

If one of 2 modules fails, the failed module is cut off immediately and automatically with an audible alarm from the circuit, and the other module continues to supply power for communication equipments.

In case of failure or routine maintenance a manual by-apss circuit is provided separately.

The details including conditions mentioned below at least shall design and submit for review and approval.

The batteries being always kept as floating shall be sized for a minimum of 10 minutes operation at the units full load ratings.

Items	Standard	Remarks
Quantity		
AC Input		
Voltage		
Voltage Regulation		
Capacity		
Phase		
DC Input		
Voltage		
Voltage Regulation		
AC Out-put		
Capacity		
Voltage		
Voltage Precion		
Frequency		
Frequency Precision		
Wave Form Distortion		
Instantaneous Voltage Regulation		
Response Time		
Phase		
Others (Noise etc.)		

7.3.5 Low Voltage Distribution Boards

Low voltage distribution boards which are cubicle type contain main incoming circuit breaker for A.C. Technical, A.C. associated facilities and D.C. Technical power at the top part of the bays. Distribution breakers for each rack, plus spares of 30 %, are located below the main breakers.

The details including conditions mentioned below at least shall design and submit for review and approval.

Items	Standard	Remarks
Quantity Formation Type Voltage Meter Breaker Others		

7.3.6 Monitor/Control Board

The monitor/control board shall design considering following things.

(1) The measuring apparatus are logically arranged to be monitored easily.

(2) The control switches are also logically arranged considering an engineering and personnel safety.

(3) The operating conditions of the power system are indicated by operating indicators.

(4) If the power system should get a trouble, the fault indicator indicated the kind of fault with audible alarm. The fault indicator should be installed also in the communication equipment room. The details including conditions mentioned below at least shall design and submit for review and approval.

Items	Standard	Remarks
Quantity Formation Main Apparatus Others		

CHAPTER 8 EARTH STATION BUILDING AND RELATED FACILITIES

8.1 General

The earth station building and related facilities will be accommodated the entire satellite communications equipment and auxiliary equipment and facilities as well as personnel working in the station so that smooth implementation of the earth station operation shall be ensured.

This specification concerns the outline of construction work for the station building and related facilities which shall be designed with reference to the accompanying drawings of Figs. 8.1 and 8.2, standards and references available as well as the related codes and regulations effective in Paraguay and Japan.

The Tenderer submit not only to items to be executed on the ground of design and construction, but also to the trivial parts and those not described but to be included naturally.

8.2 Scope

Soil investigation prior to the construction of earth station building and related facilities, the installation of building service equipment, and others are all included in this scope.

Table 8.1 shows details of this scope.

Table 8.1 Power supply system

No.	Subsystem	Item	Remarks
1	Soil Investigation	Soil Investigation Landscoping (grading, terracing, planting of gass native shrubs and trees in appropriate spots)	3.3
2	Earth Station Building and Related Facilities	Building included Antenna Pedestal	8.4.1
		Office House of Station Manager	8.4.2
		Guard House	8.4.3
		Power Substation	8.4.4
		Drainage	8.4.5
		Storage for Storing Various Oils	8.4.6
		Garage	8.4.7
		Fuel Tank	8.4.8
		Fence and Guate	8.4.9
		Hoisting Towers	8.4.10
		Lighting	8.4.11
		Water Supply and Distribution	8.4.12
		Grounding	8.4.13
		Others (Board for Information, Fireplace for burning up. Weather Instrument Shelter, Tower for measuring Wind Direction and Velocity, Micro Tower)	8.4.14
3	Building Service Equipment	Clocks	8.5.1
		Fire Protection	8.5.2
		Airconditioning	8.5.3
		Forced Ventilation	8.5.4
		Forced Exhaust	8.5.5
		Sanitary and Sewing	8.5.6
		Provision for Light Refrechment	8.5.7
		Telephone Plant	8.5.8
		Locking	8.5.9
		Safety	8.5.10
		Hoists	8.5.11
		Miscellanenous (1) Projection (1)-1 35 mm Slide Projector x 1 (1)-2 16 mm Film Projector x 1 (1)-3 8 mm Film Projector x 1 (1)-4 Screen Projection Set x 1 (2) VHF Radio Equipment for Countermeasure against Calamities x 2 (3) Fournitures (3)-1 Workbenchs (3)-2 Machanics Tool Set (3)-3 Cart Maintenance of Equipment (4) Chairs (5) Office Desk (6) Lockers	8.5.12
4	Others	Parking Place	8.6.1
		Sidewalks	8.6.2
		Roads	8.6.3

8.3 General requirements

8.3.1 Buileint Orientation

The typical layout of station building and related facilities are shown in Figs. 8.1 and 8.2.

The building orientation shall be considered direction of preventing winds, natural light, site layout in connection with location of equipment, and intake and exhaust duct, window, and etc.

8.3.2 Design

The design and construction of all foundations and structures shall be in accordance with the environmental conditions shown in Figs. 3.1 and 3.2 in CHAPTER 3.

The design of structures should be especially modern, functional, suitable for use in the area.

8.3.3 Construction for Fire Resistant

The constructions shall be fire resistant with minimum of one hour rating.

8.3.4 Building Floor

The building floor shall be designed for maximum efficiency of operation function so as to preclude interference between the various work functions. The floor covering shall be suitable for the function of the area where installed.

The room with electrical equipment shall be provided with vynilas-bestes floors tile or alternately asphalt tile.

At those rooms, the concrete floors are deemed adequate, concrete floors shall be surfaced, hardened and painted with epoxy.

8.3.5 Painting

The painting shall be of the type used in modern industrial plants and shall be subject to approval.

The building interiors and exteriors shall be painted throughout the facilities. The color samples shall be provided for final approval.

8.3.6 Air Intake and Exhaust Openings

Air intake and exhaust openings shall be protected with hoods against wind, driving rain. The bird and insect screen shall be corrosion resistant that will not require frequenct refinishing.

8.3.8 Exterior Window

Exterior window shall be provided wherever practical to permit natural ventilation during the period of good weather. Non-metallic insect screen shall be provided for all such window.

8.3.9 Materials Employd

Materials employed, taking into account of local environment (sub-tropical) of site, shall be simplified as far as possible so as to facilitate procurement, maintenance and cost saving.

8.4 Requirements

8.4.1 Building Included Antenna Pedestal

Fig. 8.2 is typical layout of facilities arrangement and building. The building shall be of one-story reinforced concrete, the tenderer considering the capability for installing the equipments of the second antenna in the future, and building and antenna pedestal shall be constructed in a united whole, with both structures linked together. The antenna pedestal shall be constructed on the foundation which is built strong enough to support the antenna structure.

The earth station building shall accommodate the communication equipment room, control room, engineering office, administration office, manager office, guest room, sleeping room, meeting room, dinning room, toilet room included shower room, electric power room, diesel engine room, and antenna pedestal included storage room. Floor load, ceiling height, floor wiring channel and insert shall be designed in consideration of equipments and other facilities to be installed in each room and described in the Tender.

8.4.2 Official House of Station Manager

Official house of station manager shall be the house of one-story and be made of brick and be provided for the area of floor of $100m^2$, kitchenware, and necessary furnitures.

8.4.3 Guard House

Guard house shall be provided a good view of incoming traffic from both direction and as much of the entire station as practical.

The guard house shall be one-story and be made of brick, and be provided for the floor having 12 m^2 wide and necessary furnitures.

8.4.4 Power Substation

Power substation shall be one-story and be made of brick. Area of floor shall be provided in accordance with the details of transforming substations equipment described in CHAPTER 7, Power supply system.

8.4.5 Drainage

Drainage suitable for the site shall be provided. Consideration shall be given to adequacy of drainage to eliminate standing water. Drainage ditches shall be grubbed and be so constructed that minimum annual maintenance will be necessary.

8.4.6 Storage for-Storing Various Oil

Storage for storing various oils shall be one-story, made of brick and be provided for the floor having 172 m^2 wide.

8.4.7 Garage

Garage shall be one-story, made of brick and be provided for the floor having 72 m^2 wide.

8.4.8 Fuel Tank

Fuel tank having enough capacity to supply fuel of one week for Diesel engine generator shall be provided and installed under the ground.

8.4.9 Fence and Gate

Fence in the boundaries and gate beside the guard house shall be provided.

8.4.10 Hoisting Towers

Three hoisting towers shall be provided.

8.4.11 Lighting

All building area flood lighting shall be controlled on an area common feeder so that lights can be controlled from some control points. Emergency lighting system operated by battery power shall be also provided.

Mercury vapor weatherproof luminaries shall be provided for exterior illumination.

Power receptacle shall be located through out facilities in accessible location in order to provided to portable equipments.

8.4.12 Water Supply and Distribution

A water well, tank, pump and distribution including piping fixtures and valving shall be provided. The water system for fire protection purposes including hydrants and water storing tank shall be also provided.

8.4.13 Grounding

Three grounding systems shall be provided. Their impedances under any soil conditions are as follows,

(1)	Power source system	less than 10 ohms
(2)	Communication system	less than 2 ohms
(3)	Arrester system	less than 10 ohms

8.4.14 Others

Others consist of board for information, fireplace for burning up, weather instrument shelter, tower for measuring wind direction and velocity and micro tower.

8.5 Requirements of Building Service Equipment

8.5.1 Clocks

All clocks having one second hand provided in the communication rooms or thirty second hand provided for the other rooms shall be connected to the standard time equipment and their faces shall be 30 cm in diameter. The exact location shall be subject to approval.

8.5.2 Fire Protection

The fire protection include automatic fire detectors, smoke detectors by which alarm located in the areas are worked, adequate hydrants and water storing tank as described in 8.4.12, and facilities for fire extinction and chemical extinguisher. The exact location and details of fire protection and alarm system shall be subject to approval.

8.5.3 Airconditioning

Airconditioning facility provided in antenna pedestal shall be satisfied following conditions excepting diesel generator room, battery room and toilet room.

(1) to be 24 hours airconditioing system

(2) to be $20 \pm 2^{o}C$ for temperature

(3) to be 40 to 60 % relative humidity

Capacity and other shall be determined in consideration of the consumption of all equipment installed.

8.5.4 Forced Ventilation

Forced bentilation shall be provided in order to keep a rise of indoor temperature of electric power room, battery room and diesel engine generator room within $3^{o}C$ of outdoor temperature.

8.5.5 Forced Exhaust

Forced exhaust shall be provided in storage and toilet room.

8.5.6 Sanitary and Sewage

Sanitary and sewage disposal whose capacity will be for 100 persons on infrequenct basis shall be provided.

8.5.7 Provision for Light Refreshment

The equipment of boiling water for serving light refreshment and preparing coffee and tea, the refrigerator and kitchenware shall be provided. Hot water gotten by the equipment of boiling water shall be provided for shower and taps in the toilet room.

8.5.8 Telephon Plant

Automatic telephone plant being able to interconnect with public telephone network shall be provided. But the interconnection of the telephone plant and public telephone network will be made by ANTELCO.

Automatic telephone plant system shall be developed and submitted for getting approval of ANTELCO.

8.5.9 Locking

Locking including a master lock shall be provided for building and others necessary and developed and submitted for approval of ANTELCO.

8.5.10 Safety

The contractor shall give particular consideration in all phases of design to safety devices and protection for personnel and equipments.

8.5.11 Hoists

Hoists shall be rpovided at the equipment part and the ceiling of the diesel engine generator room and developed and submitted for approval of ANTELCO.

8.6 Other Requirements

8.6.1 Parking Place

Parking place for 30 cars shall be provided.

8.6.2 Sidewalks

Sidewalks shall be placed so as to adequately provide for the expected traffic patterns and provided along the roads.

8.6.3 Roads

Roads shall be paved, retained for heavy truck traffic such as in case of fuel oil deriveries and for right hand traffic.

8.7 Spare Materials

Spare materials for future touch-up and replacement for each type and color from the same lot shall be provided as follows; tile - 5% but not less than one unopened container.

Spare materials to be supplied shall be packed tightly so as to withstand long term storage and marked with material name, quantities and note for storage.

8.8 Documents

The contractor submit related documents as following

(1) Completion drawings and reports

(2) Photograph of completed building and others

(3) Detailed description

(4) List of spare materials

CHAPTER 9 MICROWAVE CONNECTING LINK

9.1 General

This 8 GHz (or 11 GHz) band single-hop microwave connecting link is provided to link the earth station and the central station covering the distance of 25 km.

This microwave connecting link is consist of two systems. One of the systems is used for telephone and telegraph transmission. The other is not only used for television transmission, but also is used for telephone and telegraph transmission by a frequency diversity method of selecting the desirable signal to noise ratio at the receiving terminal.

This microwave connecting link, as shown in the overall block diagram in Figs. 5.10 and 9.1 is installed independently on the earth station and the central station. Mutual transmission is made possible.

This microwave connecting link must be designed for high reliability, security, easy operation and maintenance. The equipment in the earth station and the central station shall be desinged with all-solid-state, and are practicable provided with the function of automatic switching.

When the expansion of system is required in future the microwave connecting link will be available without a particular change in design. It shall meet the recommendations of C.C.I.T.T. and C.C.I.R. in addition to the requirements described in this Chapter.

9.2 Scope

This work covers manufacturing and mounting of equipment, materials and all devices supplied by contractors. That is, the followings shall be carried out in respect of mounting of the microwave connecting link: Site investigation, preparation, design, manufacture, assembly, adjustment and test of the link.

On the Central Station side, the microwave tower will be erected utilizing a 65 m high new tower which will be constructed in the near future. On the earth Station side, the tower shall be erected on the roof of the station building or somewhere nearby.

The Tenderer shall provide a configuration which contains clearly defined interface, in all other respects, consolidation with other equipment systems in the Earth Station and in the Center Station.

This consolidation shall be extend to equipment layout, power supply arrangement, testing, alarm and monitoring arrangement, and test equipment.

(1) Site investigation

In deciding the site and height of antenna tower at the earth station the Contractors shall carry out investigation on the basis of the antenna tower which will be erected at the central station. The final decision shall be approved by ANTELCO.

(2) The Contractors shall state the following items in respect of design, manufacture, assembly and adjustment:

(i) Antenna system

(ii) Tower design

It is necessary to design and estimate the construction lay-out of the tower which shall be erected on the roof of the earth station building and somewhere nearby.

(iii) Block and level diagram of all systems

(iv) Supervisory and design of control system

(v) Measured points for test and interface between the micro-wave connecting link and other devices in the earth station and the central station

(vi) Performance computations of telephone and television

(vii) Power supply

(viii) Measuring instruments for maintenance

9.3 System Capacity

One of the microwave connecting link systems is provided for telephone and telegraph transmission and its capacity is equivalent to 120 channels. However, 60 channels shall be used as an installed capacity in the beginning. The other system, provided for television service, is used in frequency diversisty system parallel with the above system as spare for telephone and telegraph transmission. However, when the said system is used for television transmission, it is free from telephone and telegraph transmission.

The said 60 channels are provided for the following service:

Telephone & telegraph	24 ch
Order wire	12 ch
TV-audio & order wire (spare)	12 ch
SPADE	3 ch
Reserve	9 ch
Total	60 ch

The television transmission shall be designed so that monochrome television 525/60, 625/50 and color television of NTSC, PAL system may be transmitted. The monochrome television system 625/50 shall be installed in the beginning.

The TV-audio shall be designed to be in simultaneous transmission system with video.

The TV-audio and order wire channels which are provided in the telephone transmission channels will be used as spare. They are not mounted on the panel in the beginning but leave space on the panel to meet demand in future.

9.4 Profile

The profile of this link is shown in Fig. 9.2. The Contractors shall form the profile in making a final decision on site and height of the antenna

tower at the earth station. They shall have it approved by ANTELCO before they start work.

9.5 Configuration

The microwave connecting link system is composed of radio subsystem, antenna subsystem, supervisory and control subsystem. Each subsystem includes the equipment shown in Table 9.1.

The typical block diagram of this system shows in which station the following equipments are installed, earth station or central station: Block diagram of terminal equipment including microwave connecting link equipment in Fig. 5.10 and block diagram of Central Station satellite communication equipment in Fig. 9.1.

The basic idea about this system was described in 9.1 General. The system is divided for telephone and telegraph transmission and television transmission. The system provided for television transmission will be available to telephone and telegraph in parallel operation by frequency diversity when it doesn't transmit television. In this case the working system shall be switched to the spare automatically at the output terminal of the receiver. Manual switching also shall be maintained available.

Table 9.1 Microwave Connecting Link System

No.	Subsystem	Items	Remarks
1.	Radio subsystem	Transmitter and Receiver Modulator and Demodulator	Operating frequency Optional proposal
2.	Antenna subsystem	Antenna Feeder	
3.	Supervisory and Control subsystem	Supervisory and Control Switching Alarm Failure display Engineering service circuit	Optional proposal
4.	Power supply subsystem	Distribution board	Necessary power

9.5.1 Radio Subsystem

The radio subsystem is composed of transmitter and receiver, modulator and demodulator.

(1) Operating Frequencies

The operating frequencies are assigned in accordance with the Recommendations of C.C.I.R.. 8 GHz band of C.C.I.R., Rec. 386-1 or 11 GHz band of Rec. 389-1 is used as an assigned frequency band. The Tenderer shall state which frequency band is used. 7 GHz band of Rec. 384-1 that is used by domestic microwave communication link is desirable in the point of compatibility with the said assigned frequency bands. However, it is subject to interference with them. Any countermeasure to avoid this will be welcome.

(2) Protection System

Telephone and telegraph transmission is carried out through the spare channels in frequency diversity system. Parallel feed is carried out for transmission through the both channels in this case at the input of transmitting antenna.

Received signals with less noise will be selected at the receiving terminal of baseband.

Neither telephone nor telegraph is transmitted while television is on.

Automatic switching shall not carried out in this case. Manual switching has priority. The Tenderer may state the system which makes 60 channels of telephone and telegraph available to the simultaneous transmission of television, audio and order wire.

(3) Transmitter and Receiver Equipment

The Tenderer shall submit the configuration of the transmitter and receiver they offer in accordance with these specifications, level diagram, maximum output of the transmitter and noise power of the receiver.

(4) Modulator and Demodulator

The modulator and demodulator for telephone and telegram are provided with spares. They are always operated parallel.

The modulator and demodulator for television are not provided with spares.

The Tenderer shall state them in consideration of the above description.

(5) TV-audio Modulator and Demodulator

Transmitting TV-audio will be sent to the TV modulator at the composed baseband with the aid of a subcarrier frequency of outside the video frequency band. Received TV carrier will be sent for demodulate to the TV-demodulator, since then, demodulated signal will be sent

to the TV audio demodulator after separate audio and video signal.

The Tenderer shall-submit an audio subcarrier frequency to avoid intermodulation product (For example: subcarrier and synchronous signal of video).

9.5.2 Antenna Subsystem

The antenna shall be available to two radio channels of telephone, telegraph or two radio channels of telephone, telegraph and television for simultaneous transmission.

The antenna shall be designed for monopolarization type using an identical polarization in transmitting and receiving. The size of the antenna shall be decided to satisfy system noise performances required for 960-channel transmission to the full.

The Tenderer shall submit the optimum antenna and feed system in consideration of the above description.

9.5.3 Supervisory and Control Subsystem

(1) The supervisory and control subsystem functions to remote control and switching for easy maintenance and operation of the microwave connecting link.

(2) This supervisory and control center is installed in the earth station. However, the tenderer may describe about the central station with supervisory control function. Its characteristics and cost are necessary in this case.

(3) Switching of radio frequency channels is carried out by either earth station or central station. The switching is indicated to both the station.

(4) Alarms and failure display which are necessary to the operation and supervision of the link shall be installed.

(5) Channel for remote supervision and control shall be provided to above or under part of the baseband.

The Tenderer shall state which of two is selected and how to transmit.

9.5.4 Supervisory And Control Subsystem

(1) Power is supplied to the equipment on the earth station side from the earth station power supply system through the distribution board.

(2) Power is supplied to the equipment on the central station side from the central station power supply through the distribution board.

(3) The Tenderer shall submit necessary power energy and distribution board.

(4) The Tenderer shall state the power supply it an air-filling device will be used.

9.6 Performance Characteristics

The performance characteristics must satisfy not only the recommendations of C.C.I.R. and C.C.I.T.T. but also the following standard to the full.

9.6.1 Radio Frequency Stability

The long term frequency stability (1 month) of any frequency within the system shall be better than 1 part in 10^{-5}.

Short term frequency instabilities shall not contribute detectable noise to the system.

9.6.2 Spurious Emissions

The spurious emissions and oscillator output shall not exceed -60 dBm at the input of the antenna system.

9.6.3 Interference Rejection

At least 70 dB rejection shall be provided for all frequencies 40 MHz or more from the receiver center frequencies.

9.6.4 Baseband to Badeband Gain Stability

Gain variation shall not exceed $\pm$ 0.2 dB per 24 hours or $\pm$ 0.5 dB per week.

9.6.5 Failure Detection And Alarm

Failure detection of this system shall be carried out by pilot and noise. Time required for switching of spare channel must not exceed 5 ms. The transfer time of switching element shall not exceed 10μs in case of IF switching and not exceed 1 ms in case of baseband switching.

Monitor and alarm facilities shall be provided in the supervisory center. In case of system failure it is desirable to be indicated both in the earth station and central station. The Tenderer shall submit what method is employed.

9.7 Baseband Message Performance

9.7.1 General

The performance of the baseband message shall be designed in consideration the contribution of the path, RF, IF and baseband characteristics of the microwave link.

References 1 and 5 will be used to calculation of the propagation characteristics.

The system shall be designed with adequate excess of received signal strength such that the mean noise power and the worst case noise power specified in 9.7.2 shall be satisfied.

9.7.2 Thermal and Other Noise

(1) The mean noise power of any 4 kHz telephony channel shall be no greater than (3L +200) PWp in any busy hour. The one minute mean power for more that 20% of any month shall be no greater than (3L+200) PWp. (L is length in Km).

(2) Inpulse noise should not exceed -40 dBm greater than ten counts within half an hour.

9.7.3 Baseband Television Performance

The microwave link shall be capable of transmitting either monocrome or color television in either direction. The monocrom television system shall be 625 lines per fram, 50 fields per second.

(1) Baseband Gain/Frequency Response

Variation in response from norminal value shall not exceed $\pm$ 0.25 dB from 20 Hz to 5 MHz.

(2) Input and Output Levels

The input and output level of video shall be 1 volt peak for both directions of transmission.

(3) Video performance shall be met in conjunction with the Earth Station. The tenderer shall submit the contributions due to the microwave link.

9.7.4 *Engineering Service Circuits Performance*

The systems shall be designed adequate performance to be used in connection to the engineering service circuit of satellite communication circuits. The tenderer shall consider the engineering service circuit necessary to the microwave connecting link.

The Tenderer shall submit as to necessary patching, switching, signalling, speakers and teletype machines.

9.8 Test Equipment

9.8.1 Microwave Test Equipment

The Tenderer shall state with respect to the microwave test equipments which are used in the earth and the central station. Especially the compatibility of test equipments for satellite communication and domestic microwave communication shall be taken into consideration.

The Tenderer shall submit state as to the test equipments for operation, maintenance and detecting of fault.

9.8.2 Video Test Equipment

The Tenderer shall submit with respect to the monochrome and color television equipment, monitor, test signal generator measuring instruments and potable video tape recorder.

CHAPTER 10 CENTRAL STATION EQUIPMENT

10.1 General

This equipment is connected to the microwave connecting link described in Chapter 9, composing the termination of international transmission circuits. It is installed in the central station. This equipment is composed of a multiplexing terminal equipment, a terminal equipment for central station and order circuits for central station. The configuration of this equipment is shown in Table 10.1. Fig. 9.1 shows the block diagram of the equipment.

10.2 Overall Performance Objectives

All the characteristics of this equipment follows the Recommendation M Series of C.C.I.T.T. requirements in respect of CH, G. SG section are specified in 5.5.2 (1)-(3).

10.3 Multiplexing Terminal Equipment Subsystem for Connecting to Microwave Connecing Link

This multiplexing terminal equipment system is connected to the microwave connecting link and used against the multiplexing terminal equipment subsystem of the earth station. What is described in respect of the translating equipment is exactly same as what is specified in 5.5.4.

However, function and capacity are different to some extent in respect of the channel jack frame, carrier supply and G/SG pilot recording equipment.

Table 10.1 Multiplexing Equipment System (Central Station)

No.	Subsystem	Item	Remarks
1	Multiplexing Terminal Equipment (connecting to terrestrial link)	Group and supergroup translating equipment	5G (10G)
		Group regulating equipment	5G (10G)
		Channel translating equipment	60 ch (120 ch)
		Channel jack frame	60 ch
		Carrier supply equipment	1 bay
		Intermediate battery supply frame	1 bay
		Group and supergroup pilot recording equipment	1 bay
		Misc frame P/G, VFT, DC-DC HYB	1 bay
2	Terminal Equipment for Central Station (ITMC)	Level control frame	60 ch
		Echo suppressor equipment	20 ch (24)
		4W test jack frame	60 ch
		Hybrid and ringer equipment	20 ch (24)
		Voice frequency distribution frame	1 frame
		Voice frequency telegraph equipment	6 ch (10)
		Teleprinter	2 sets (3)
		International telex equipment	1 set
3	Order Wire Circuit	Telephone Order Wire	1 set
		Telegraph Order Wire	1 set

10.3.1 Group and Supergroup Translating Equipment

This equipment is specified in 5.5.4, (1), (a)-(e).

10.3.2 Group Regulating Equipment

This equipment is specified in 5.5.4. (2), (a)-(c).

10.3.3 Channel Translating Equipment

This equipment is specified in 5.5.4, (3), (a)-(c).

10.3.4 Channel Jack Frame

This equipment is specified in 10.4.3.

10.3.5 Carrier Supply Equipment

(a) This equipment is specified in 5.5.4, (4), (a)-(k).

(b) In 5.5.4, (4), (c) the following carrier signals will be changed for this equipment:

1	Supergroup carrier	Only 612 kHz is necessary
2	Group A carrier	120 kHz is unnecessary
3	Order wire carrier	16, 20, 28 kHz are unnecessary
4	Order wire signal	2280 kHz is unnecessary

10.3.6 Intermediate Battery Supply Frame

This frame is specified in 5.5.4, (5), (a)-(d).

10.3.7 Group and Super Group Pilot Recording Equipment

This equipment is specified in 5.5.4, (6), (a)-(v).

In respect of 5.5.4, (6), (e) changes will be made as follows for this equipment:

1	Line pilot 60 kHz	1 terminal
2	Super group pilot 547.92 kHz	2 terminals
3	Group pilot 104.08 kHz	10 terminals

10.3.8 Misk Frame

(a) This equipment is specified in 5.5.4, (7), (a)-(e).

(b) Describe what else needs maintenance and level diagram.

10.4 Terminal Equipment Subsystem for Central Station

This subsystem is mounted on the terminal of international transmission line and used to carry out an effective transfer with the international exchange, maintenance and operation of international transmission line.

10.4.1 Level Control Frame

(a) This equipment functions to carry out a final adjustment of the level fluctuation of international transmission line before signals are transfered to the domestic circuits.

(b) This equipment is provided with a variable attenuator and capable of adjusting the range of $\pm$ 5 dB at 0.2 dB step with both the sending and receiving side.

(c) Impedance

Input and output impedance of the variable attenuator shall be 600 ohms, balanced, and the return loss each side shall not be less than 20 dB in the 300 to 3400 Hz frequency band.

(d) This equipment is equivalent to 60 channels in capacity.

(e) The Tenderer shall state the level diagram of the equipment in the offer.

10.4.2 Echo Suppressor Equipment

(a) This equipment shall be attained satisfactory echo suppression as following conditions.

uni-directional conversation

bi-directional conversation

(b) This equipment shall be operated in tandem connection and in conjection with an MF signalling system.

(c) This equipment can be attached disabling function.

(d) The characteristics of the echo suppressor shall be as follows.

(i)	Transmission bandwidth	300-3400 Hz
(ii)	Input and Output impedance	600 ohms
(iii)	Operate time	Less than 5 msec
(iv)	Hangover time Echo control switch 30-70 msec Transmit control switch 100 msec	
(v)	Echo path attenuation uni-directional conversation bi-directional conversation	 50 dB or more 10 dB

(e) Other characteristics of this equipment shall be based on the specification as recommended by C.C.I.T.T., G161.

(f) The number of channels necessary to this equipment is 20 channels (final 24 channels). However, the tone discebler will be designated separately.

10.4.3 4W Test Jack Frame

(a) This equipment is mounted as a central station installation of international transmission line (4 wires) between the international transmission and the international exchange installation. It is used to keep both the said installations separate and to carry out various tests necessary to the establishment and maintenance of international circuits.

(b) This equipment is composed of a voice band jack, various counters, a telephone order wire equipment and an order telephone installation.

(c) The jack must be composed avoiding the disconnection of the circuit which is in operation, making code access available. It is capable of maintaining the input and the output selective and forming termination on the input and the output side respectively.

(d) Measuring Instruments mounted on this equipment

Level meter	1 set	50 Hz to 20 kHz	-80 dBm to +10 dBm
Oscillator	1 set	50 Hz to 20 kHz	
Amplifier + speaker	1 set	Volume control is available	

(e) Order telephone installation

4W R/D 2 circuits

2W R/D 2 circuits

> Telephone set 1 set

10.4.4 Hybrid and Ringer Equipment

(a) This equipment is installed at the terminal of international circuit. It carries out a mutual exchange of a 4W-2W termination, 1000/20 Hz (500/20 Hz) signal or a DC signal from the exchange. It mutually exchanges a DC signal from the exchange for a 16 Hz signal on 2W side and 1000/20 Hz (500/20 Hz) on 4W side at the same time.

(b) The characteristics of this equipment shall be as follows.

(i) Loss-frequency characteristics

within $\pm$ 0.5 dB from 300 Hz to 3400 Hz

reference frequency: 1000 Hz

(ii) Impedance (600 ohms)

2W side not less than 15 dB

4W side not less than 20 dB

(iii) Non liner distortion

more than 45 dB

(iv) Frequency stability

1000 $\pm$ 3 Hz (500 $\pm$ 2 Hz)
20 $\pm$ 1 Hz

(v) Signal output level

-15 dBm0 at 1000 Hz Keying

(vi) Receiving level range

input level + 1 to -25 dB (50% make-brake ratio)

frequency 1000 $\pm$ 10 Hz (500 $\pm$ 10 Hz)

20 $\pm$ 2 Hz

(vii) The receiver shall not operate on received signals that meet the following conditions.

input-level

signal outside the frequency range;

1000 ± 100 Hz (500 ± 100 Hz)

25 ± 5 Hz

(viii) 2W is disconnected within the limit of 15 ms after a 16 Hz signal or earth is received. The hybrid side is terminated with resistance 600 ohms and then a signal 1000/20 Hz (500/20 Hz) is sent to 4W.

(ix) The 16 Hz signal is sent to 2W side or the earth is sent to the exchange withing the limit of 400 ± 100 ms after the 1000/20 Hz (500/20 Hz) signal is received.

(c) The Tenderer shall state the level diagram of the equipment.

(d) The number of channels necessary to this equipment is 20 channels (final 24 channels).

10.4.5 Voice Frequency Distribution Frame

(a) This equipment is specified in 5.5.3, (5), (a)-(f).

(b) The Tenderer shall state the capacity of this frame in the offer.

10.4.6 Voice Frequency Telegraph Equipment

(a) This equipment shall operate on a frequency shift modulated system providing up to 24 telegraph channels at a telegragh speed of 50 bauds to be used for teleprinter and telex circuits.

(b) The characteristics of this equipment shall be as follows.

(i) Transmission line 4-wire, 300 to 3400 Hz

(ii) Line impedance 600 ohms balanced

(iii) Line carrier frequency (mean frequency)

420, 540, 660, 780, 900, 1020, 1140, 1260, 1380, 1500, 1620, 1740, 1860, 1980, 2100, 2220, 2340, 2460, 2580, 2700, 2820, 2940, 3060, 3180 Hz (Frequency shift ± 30 Hz)

(iv) Transmission speed 50 bauds

(v) *Sending and receiving level*

Sending level of signal/channel	-22.5 dBm*
Receiving level of signal/channel	same as sending level

* Adjustable

(vi) Telegraph distortion

The equipment shall provide a telegraph distortion of a maximum 7% for text a telegraph speed of 50 bauds against the variation in level from + 8.7 to -17.4 dB.

(vii) Local telegraph legs

Start polarity	FA
Stop polarity	FZ
Input impedance of the modulator	1 kohms
Output relay internal impedance of the demodulator	1 kohms
Telegraph voltage	± 50 voltages

(viii) Automatic frequency control

Pilot frequency	300 Hz
Control range	± 15 Hz

(c) This equipment must be provided with 6 channels which are equivalent to the voice band capacity. The final capacity is 10 channels.

(d) The tenderer shall state the level diagram of this equipment.

10.5 Order Wire Circuits for Central Office

10.5.1 General

This equipment composes the order wire which carries out the operation and maintenance of international circuits on the basis of the recommendation by C.C.I.T.T. White Book SGIV as to the maintenance and system. This system is installed in the central station.

The configuration of the order wire is shown in Fig. 10.2.

10.5.2 Telephone Order Wire

4W R/D system is used. Each center is connectable.

We suggest one telephone set is enough for each center in the beginning. However, make an arrangement in respect of ITMC, ISCC and ISMC so that three telephone sets may be connected in future.

10.5.3 Telegraph Order Wire

Mount each printer on ITMC and ISCC in the beginning. Maintain the individual printer capable of being extended to the earth station. Make an arrangement in respect of ITMC, ISCC and ISMC so that two printers may be mounted on them respectively at maximum in future.

10.5.4 Lead-in of Public Circuits

ISCC must be provided with a public telephone circuit (1 circuit) and a telex circuit (1 circuit) at least. Install a terminator near the order wire system.

10.5.5 ITC and ISMC

More than 1 circuit of order wire with television broadcasting companies is necessary to ITC and with the national switching system is required by ISMC.

10.5.6 Others

The Tenderer shall state economical installation with easy maintenance in respect of the order wire circuits.

10.6 Power Supply Subsystem

10.6.1 General

This subsystem shall supply the powers of DC-24 Volts, DC-48 Volts and AC-220 Volts, 50 Hz for all central station equipment which are microwave connection link specified in chapter 9, central station equipment specified in chapter 10, and international telephone switching equipment specified in chapter 11.

DC-24 Volts source being non-break DC power and AC 220 Volts source being the commercial power of 3 phase, 50 Hz are equiped by ANTELCO.

The protection of all equipments against interruption during the power failure shall be provided. The tenderer shall consider to install non-break AC power equipment for 220 Volts.

DC-48 Volts shall be supply by Rectifier whose primary source is AC 220 Volts from non-break AC power equipment.'

The subsystem is shown in Fig. 10.1.

10.6.2 Configulation

The subsystem is composed of the equipments shown in Table 10.2.

Table 10.2 Power Supply Subsystem

No.	Equipment	Item	Remarks
1	Non-Break AC Power Equipment	The thing in itself Control, Battery, Others	
2	Low Voltage Distribution Board	The thing in itself Others	
3	Monitor Board	The thing in itself Others	
4	Rectifier	The thing in itself Others	

(1) Non-Break AC Power Equipment

The equipment shall be modular type and static in design. The design and rating shall provide for continued and uninterrupted power as well.

In case of failure the failed module is cut off immediately and automatically change to manual by-pass circuit with an audible alarm.

The batteries shall be always kept as flooting and be sized for minimum 10 minutes operation at the units full load rating.

The system has no redundancy. The details of technical requirements shall be specified in 7.3.4.

(2) Low Voltage Distribution Board

This board is specified in 7.3.5.

(3) Monitor Board

The mohitor board shall design considering following things.

(a) The measuring apparatus are logically arranged to be monitored easily.

(b) The operating conditions of the power system are indicated by operating indicators.

(c) If the power system should get a trouble, the fault indicator indicates the kind of fault with audible alarm. The fault indicator should be installed also in the room of the central station.

The details including conditions mentioned below at least shall design and submit for review and approval.

Item	Standard	Remarks
Quantity		
Formation		
Main Apparatus		
Others (Phase etc.)		

(4) Rectifier

Receiving AC 220 Volts, 50 Hz from Non-Break AC Power Equipment this set shall supply DC-48 Volts to International Telephone Switching Equipments. The details including conditions mentioned below at least shall design and submit for and approval.

Item	Standard	Remarks
Type		
Voltage Input Output		
Capacity		
Others		

10.6.3 Others

The work for construction of the power supply system shall be as follows.

(1) Complete power configuration necessary from input of low voltage distributor to its output to deliver adequate power with the reliability required for continous full time commercial operation considering safety operation and maintenance.

(2) Others specifys in 7.2 (2), (3) and (5) to (10).

CHAPTER 11 INTERNATIONAL TELEPHONE SWITCHING SYSTEM

11.1 General

This System exchanges and connects the satellite linked international telephone circuits with domestic telephone networks in accordance with the C.C.I.T.T. Recommendations by establishing a central station.

Table 11.1 shows the numbers of circuits, signalling systems and grounding stations of the international circuits operated by the System.

Out of the domestic exchange systems which are working at present and will work in future in Paraguay, those which are related to international circuits are shown in Fig. 11.1. These international circuits are connected with the cord switchboard for domestic automatic exchange and trunk circuits.

The telephone switching system adopts manual switching mentioned in Item (a) below, but Tenderers shall also make their proposals regarding the details of the semiautomatic switching system mentioned in Item (b) below. Tenderers also may make their proposals regarding any economical systems other than that which is stiuplated in these specifications. In such case, they shall explain the outline, advantages and the reason of the proposed systems.

(a) Manual Switching System

This telephone switching system employs a cord switch board and manually switches incoming and outgoing calls by way of an operator. Its signalling system shall, in principle, be ring down; and giving and taking of signals according to the C.C.I.T.T. Signalling system shall be made possible.

(b) Semi-automatic Switching System

The System employs crossbar switches and the cordless switchboards, and shall be able to handle signals of not only the ring down system but also the C.C.I.T.T. No. 5 and R-2 signalling systems; and for

the latter system, the incoming-call automatic connection (semi-automatic operation) shall be made possible.

Table 11.1 Signalling Systems by Earth Station and Number of Circuits

Name of earth stations	No. of initial circuits (1975)			No. of final circuits (1980)	
	Signal system	No. of channels		Signal system	No. of channels
Argentina	R/D	2	5	R-2	7
	No. 5	3			
Chile	R/D	2		R-2	3
Peru	R/D	1		No. 5	SPADE
U.S.A.	No. 5	8		No. 5	11
Brajil	R/D	1		R-Z	1
Spain	R/D	1		No. 5	SPADE
Germany	—	—		No. 5	SPADE
Italy	—	—		No. 5	SPADE
Uruguay	—	—		No. 5	SPADE
Total		18			22 SPADE (3)

Note: "SPADE" means that three channels in total are commonly used by various countries.

In case of the manual switching system, all the signal systems except "SPADE No. 5 (three channels)" shall be R/D.

11.2 Transmission Performance Objectives

The exchange system mentioned below shall satisfy the following electrical characteristics in VDF and MDF:

(a)	Switching time:	Less than 600 ms (except for the manual switching system).
(b)	Deviation of standard loss:	Not exceeding 0.2 dB (reference frequency; 800 Hz).
(c)	Return loss:	300 to 600 Hz : not less than 40 dB. 600 to 3,400 Hz : not less than 46 dB.
(d)	Cross talk:	Between circuits : more than 70 dB. Same circuit : more than 60 dB.
(e)	Noise :	Not more than : -70 dBmO (C.C.I.T.T. weighting). Not more than : -40 dBmO (unweighted).
(f)	Loss-frequency distortion:	300 to 400 Hz : -0.2 to +0.5 dB. 400 to 2,400 Hz : -0.2 to +0.3 dB. 2,400 to 3,400 Hz : -0.2 to +0.5 dB.

11.3 Munual Switching System

11.3.1 General

The System connects incoming and outgoing international telephone calls to domestic networks using a 2-wire cord siwtchboard. The initial and final numbers of international circuits are shown in Table 11.1.

An example of the composition of the System is shown in Fig. 11.2.

The outgoing traffic shall be handled by the ring-down system and semi-automatic signalling system (C.C.I.T.T. No. 5 signalling system), and the incoming traffic shall be handled by Codes 11 and 12 out of the ring-down system and C.C.I.T.T. No. 5 signalling system.

11.3.2 Signaling System

The signalling systems which are handled by the system are as follows:

(1) International Circuits

(a) Ring-down C.C.I.T.T. No. 1 signalling system
1,000/20 Hz and 500/20 Hz

(b) C.C.I.T.T. No. 5 signalling system.

(2) National Circuits

(a) 2W Ring-down 25 Hz

(b) 2W dial pulse keying

11.3.3 Traffic Operating Methods

(1) Outgoing Traffic

(a) When a subscriber to the domestic automatic telephone networks dials "00" for an international outgoing call, the call is connected with the international call booking desk.

(b) An international outgoing call from a subscriber to the national trunk networks is connected with the international call booking desk by way of the trunk cord switchboard.

(c) The booking desk prepares a card and transfers it to the international switchboard.

(d) After the international switchboard receives the card, the international switchboard operator calls back the domestic calling party, and then calls the international switchboard operator of the foreign country, and requests for connection with the opposite subscriber (in case of ring-down signalling system).

(e) In case of No. 5 signalling system, after the international switchboard operator calls back the domestic calling party as shown in Item 11.3.3 (d), the operator directly calls the opposite foreign subscriber by dialling from the international cord switchboard.

(f) After confirming the connection between the two subscribers,

the operator starts the timer.

(g) When the call was finished, the clear-out lamp lights and the timer automatically stops. The operator pulls out the cord; when necessary, the operator makes out a charge notice or makes a pre-arrangement with the opposite operator.

(2) Incoming Traffic

All the calls from foreign countries are connected to the international cord switchboard, and the operator prepares a card on the basis of information given by the opposite operator, calls the domestic subscriber and connects the call.

At this time, for the domestic automatic telephone networks, the operator dials to call the subscriber from the international cord switchboard.

For the trunk line networks, the operator calls the domestic subscriber by way of the domestic cord switchboard.

11.3.4 Configuration

The System is composed of the equipment shown in Table 11.2.

The number of international cord switchboards shall be 5 and 6 units at the initial and final circuits respectively.

Table 11.2 Manual Switching System

No.	Equipment	Remarks
1.	Cord switchboard	
2.	Hybrid & ringer equipment	C.C.I.T.T. No. 1
3.	Hybrid & signalling equipment	C.C.I.T.T. No. 5 (including line and MF signals)
4.	Trunk A, B and C	
5.	Relay group	
6.	Misc.	Patching bay MDF IBS

All the units composing the System shall be easy to maintain and operate.

Between the System and the domestic telephone exchange equipment are provided MDF and the patching bay in order to make interconnection, disconnection tests, and patch connection possible. The hybrid and ringer equipment and the hybrid and signalling equipment are connected with the central station equipment of means of VDF.

The Tenderer shall submit proposal regarding the level diagram and detailed designs of the System.

(1) International Cord Switch Board

(a) This cord switchboard takes in all the international and domestic incoming and outgoing circuits and connects manually by means of a cord. The cords switchboard is provided with lamps for indication and with plugs, jacks and keys for operation.

(b) The number of cord circuits housed in a switchboard is maximum six circuits.

(c) Number of Jacks Housed (Minimum Number)

International circuits:		2W R/D	25
		No. 5 (2W)	3
Domestic circuits	:	2W DP	25
		2W R/D	10
		2W DP	10
Transfer	:		3

(d) Circuits Housed

1.	Dial (push-button type)	1
2.	Ring key	1
3.	Split keys	6
4.	Talk and monitor keys	6
5.	Timers	6
6.	Incoming and outgoing pilot lamps	6
7.	Cord circuits	6

8.	Language assistance	1
9.	Key for No. 5	1
10.	Alarm lamp	1
11.	Telephone set	1

(e) The contents of operation (operator requirements) are as follows:

1.	Recording and booking of calls	Outgoing operators
2.	Connection of calls	Incoming operators
3.	Waiting-time and call-back connection	Delay operators
4.	Giving assistance	Assistance operators
5.	Giving information	Information or special service operators

(f) Indicators and keys to be mounted are as follows:

1. Calling indicators and booking lamps.
2. Response, call, split call, monitoring and supervision.
3. Dialling and calling.
4. Timer control, and control of sending and stopping prediction alarm tone.
5. Interrupting call.
6. Intra-switchboard and intra-office prearrangement and order wire.

(g) The transfer of calls between cord switchboards shall be made possible.

(h) The timer shall be started manually and stop automatically at the time of clearing-out. When the duration of time of a call is designated beforehand, the timer shall send a prediction alarm tone immediately prior to the designated time and an alarm tone after the expiry of the designated time.

(i) The switchboard shall also be able to book the international "00," as and when necessary.

(2) Hybrid and Ringer Equipment

For the details of this equipment, refer to 10.4.4 or the specifications of the central office equipment.

(3) Hybrid and Signalling Equipment

(a) This equipment is used for switching and connection of SPADE-linked circuits to domestic networks and for handling the C.C.I.T.T. No. 5 signalling system with the help of the cord switchboard.

(b) The equipment is provided with a hybrid to carry out the 4W-2W conversion and, at the same time, to make adjustment of the level diagram.

(c) For the outgoing calls from the switchboard, the equipment receives dial pulses due to on-off direct current coming from the switchboard and sends out No. 5 signals.

(d) For incoming calls from foreign countries, the equipment identifies Codes 11, 12, 12xx of the PARAGUAY International Switching Station Code (specified separately), and when these codes are selected, the incoming calls are sent by the earth to the cord switchboard, lighting the incoming lamp of the respective jack.

(e) The number of equipment required is for three channels.

(f) For the signalling system, follow C.C.I.T.T. Recommendations.

(4) Trunks A, B, and C

(i) Trunk A

a. This trunk is used at the interface between the cord switchboard and the domestic switching equipment for incoming calls on the international circuits.

b. The number of trunks required is for 25 channels.

c. The switchboard side of the trunk is of the 3-wire type, two wires being used as speech lines and the remaining one wire being used for transmitting dial pulses by the direct current between earth.

d. The domestic switching side of the trunk is used for trans-

mitting information necessary for the domestic switching system, namely 2-wire speech lines and 1-wire line for transmitting dial pulses between earth.

(ii) Trunk B

a. This trunk forms an interface between the international cord switchboard and the domestic cordless switchboard for the outgoing circuits (R/D circuits) to the international circuits.

b. The number of trunks required is for 10 channels.

c. Signals are given and taken by the 2W ring down system.

d. The signal frequency is 25 Hz.

(iii) Trunk C

a. This trunk forms an interface between the international switchboard and domestic switching equipment for the outgoing circuits (International "00") to the international circuits.

b. The number of trunks requires is for 10 channels.

(5) Relay Group

a. The relay group is connected to the cord switchboard and is used for composing circuits of the key, lamp, dial and telephone set, which are necessary for switching and connection.

b. When the hybrid and signalling equipment is used (No. 5 system), the relay group shall send out a grounding pulse to the echo suppressor so that the function of echo suppressor is disabled.

c. The relay group shall have the testing functions of the key circuits and lamps of the cord switch board, all the trunks and the signalling equipment.

d. The relay group shall be mounted with the alarm circuit for the Switching System.

(6) MISC

The patching bay and MDF shall be provided as an interfaces

between the System and other systems, and IBS (intermediate battery supply) shall be provided as a power source.

11.4 Semi-Automatic Switching System

11.4.1 General

This system connects incoming and outgoing traffic of international telephone calls with domestic networks using a 4-wire crossbar type exchange, and a cordless switchboard is used for the System.

An example of the composition of this system is shown in Fig. 11.3.

Outgoing and incoming traffics are operated by the ring-down and semi-automatic signal systems, while the transmit traffic is operated by the manual transmit system.

11.4.2 Signaling System

(1) International Circuits

Ring down C.C.I.T.T. No. 1

C.C.I.T.T. No. 5 signalling system

C.C.I.T.T. R-2 signalling system (Future adoption of this system shall be made possible)

(2) Domestic Circuits

2W ring down 25 Hz

2W dial pulse keying.

For the dial pulse keying system, its future change to C.C.I.T.T. R-2 signalling system shall be taken into consideration. In such case, an out-band signal of 3,825 Hz will be used as a line signal for the R-2 signalling system.

11.4.3 Traffic Operating Method

(1) Outgoing Traffic

This outgoing traffic is the same as that of the manual switching system shown in Item (1) of 11.3.3.

(2) Incoming Traffic

In case of ring-down circuits, this incoming traffic is the same as that of the manual switching system shown in Item (2) of 11.3.3.

In case of incoming calls from the earth of No.5 signalling system, calls to the domestic automatic earth station are directly connected with domestic subscribers without passing through the international cordless switchboard, provided however that in case of performing language assistance, the cordless switchboard is directly connected with the respective circuits. To connect with the trunk ring-down station, the incoming call is taken up by the international cordless switchboard and then connected to the domestic subscriber by way of the trunk cord desk.

11.4.4 Number of Circuits

The number of international circuits is shown in Table 11.1. The number of domestic circuits shall be 2W 25 channels at the time of initial installation, but shall be so arranged that installation of 2W 20 channels and 4W 10 channels at the final stage is made possible.

11.4.5 Functions of This System

(a) This system is a 4W crossbar exchange having the function of handling international incoming and outgoing calls, and its domestic circuits are of the 2W and 4W types.

(b) This system has the sending and receiving functions of the national cord, area code and station number and also have the "enable" and "disable" functions of the language assistance and echo suppressor.

(c) The international switchboard shall be of the cordless type and easy in operation and maintenance.

11.4.6 Design Conditions

(1) Offered Traffic

The offered traffic will be 0.8 Erlang per circuit.

(2) Average Holding Time

The average holding time for a call including an unfulfilled one is 360 seconds.

(3) Grade of Service

The link-block probability shall be 1/1,000 or less, and the loss probability of a circuit group is 1/100.

(4) Average Waiting Time

The average waiting time of a semi-automatic incoming call destined to the manual switchboard shall be 5 seconds.

(5) Incoming lines 30 terminals

Outgoing lines 30 terminals

(6) Numbering Capacity

International, KP signal + national number

+ language number + domestic number

14 digits (final 17 digits)

(7) Maximum Number of Routes

Upto routes

11.4.7 Configuration

This system is composed of the equipment shown in Table 11.3. Those units which compose this system shall be easy in operation and maintenance.

Between this system and the domestic telephone exchange equipment, MDF and the patching bay shall be provided at shown in Fig. 11.3. The connection between the bothway trunk equipment and the central station equipment shall be provided by VDF.

Tenderers shall propose the level diagram, trunking and detailed design of this system.

Table 11.3 Semi-automatic Switching System

No.	Subsystem	Items
1	Main frames	Switch frame Resistor sender link Marker connector Translator connector Trunk block connector Trunk circuits
2	Manual cordless switchboard	Board Position circuit
3	Maintenance equipment	Master test frame Line test frame
4	Misc.	Signal supply Power supply (IBS) Patching bay MDF

(1) Manual Cordless Switchboard

(a) This switchboard shall conform to C.C.I.T.T. Recommendation Q101 (vol. VI) and be given consideration for human engineering so that its operation becomes easy. The switchboard also shall have a construction and circuits to allow easy maintenance.

(b) The switchboard shall be a cordless one and be able to handle the following calls:

CLR call
Delayed call
Code 11 call
Code 12 call
Code 12 xx call
Language assistance call

(c) The number of cord circuits shall be maximum 6 circuits for

booking and 1 channel for language assistance; and the kinds of calls to be handled shall be made selectable with the help of the key.

(d) The switchboard shall be able to handle not only semi-automatic circuits but also ring-down circuits.

(e) The switchboard shall satisfy the following operating conditions:

1. Outgoing operators
2. Incoming operators
3. Delay operators
4. Assistance operators
5. Information and special service operators

(f) This cordless switchboard shall satisfy the following functions:

1. Talking
2. Monitoring calls
3. Splitting speech or offering speech
4. Signal sending
5. Selective signal sending
6. Supervising
7. Counting speech duration time
8. Preventing double connection due to operator's mistakes

(g) Each of the cordless switchboards shall have independent functions; and at the same time, transfer from one switchboard to another shall be possible.

(h) Each switchboard shall be provided with an operator's chair and a head-set.

(i) The number of international cordless switchboards to be installed at the initial stage shall be 3 units.

Position Circuit Composition

1. Front or rear splitting key
2. Front and rear side ringing key
3. MF signal sending button
4. Answer keys and indication lamps

5. Calling keys and indication lamps
6. Ring-down trunk keys with lamps
7. Position clock

(2) Main Frames

(a) These frames compose the international semi-automatic exchange and consists of the switch frame employing the crossbar system, the resistor sender (RS) for sending and receiving C.C.I.T.T. No. 5 and R-2 signals, and the marker which is actuated by the information from RS. These frames also include a translator for translating MF signals and various kinds of trunks.

(b) The bothway trunk (BWT) which is to be used for the C.C.I.T.T. No.5 signalling system shall be mounted with the sender and receiver of the line signal.

(c) The details of the codes for the various trunks are shown below:

Code 100	600Ω termination
Code 101	Order wire
Code 102	1,000 Hz send
Code 103	Signal test
Code 109	For making prearrangement between the satellite and earth stations.

(3) Maintenance Equipment for Switching System

(a) This equipment shall be used for facilitating the maintenance of the international switching system. It shall carry out the supervision of the condition of circuits and the testing and supervision of the switching equipment.

(b) Main Functions

(i) Testing of individual equipment such as the resistor sender, marker, transistor, etc.

(ii) Jumper testing of the translator

(iii) Operating condition and signal level of the signalling

(iv) Condition of the trunk being busy or not

(v) Blocking and switching-over when circuits develop faults

11.5 Power Supply Requirements

The power to be supplied to the international switching system shall be obtained from the power source for the central station. Tenderers shall submit their proposals about their power supply requirements.

The interface between the switching system and the power supply shall be provided with a power distribution bay equipped with a breaker and fuses.

The supply voltages shall be 24 volts DC and 48 volts DC, and tenderers shall submit their proposals about any other necessary power supply and also about the permissible allowance of variation in the power supply.

11.6 Maintenance

To facilitate maintenance, consideration shall be given to making possible the connection of the System to the test trunk and supervision of faults of circuits; and consideration shall also be given to installing an automatic measuring apparatus of traffic.

Tenderers shall submit their proposals regarding the measuring apparatuses, spare parts and tools of the System.

11.7 Layout and Installation

The data material of the layout shall be supplied after selection of the contractor is completed, but tenderers are advised to submit the layout which they consider the most advantageous.

CHAPTER 12 SPARE AND TOOLS

Taken up in this CHAPTER are spares and tools to be supplied for the whole system provided for in this contract. The spares described in other related chapters are also included herein.

12.1 General

(a) All spares and tools necessary for stable and reliable operation of the whole system shall be supplied.

(b) Spares and tools shall be supplied prior to the provisional acceptance of the whole system.

(c) The Tenderer shall quote for a set of spare components, including electron tubes, lamps, fuses, etc., sufficient for two years' operation, and for tools as well.

Some major units which would require a long time to be supplied, because they have been specially manufactured (e.g. the high voltage transformer for the power amplifier might be in this category), and any such item which, by its failure, could cause the station to be inoperative for two days or more will be required on a one-for-the station basis.

The Contractor shall guarantee the supply of spare components and tools for a minimum period of 15 years without unreasonable cost increase.

The Tenderer shall propose recommendable quantities of spares and tools, and shall give full explanations so that the ANTELCO can judge to what degree they are needed.

12.2 Spare Plug-in-cards

Plug-in cards to be used for replacement in the case of equipment failure shall be supplied to allow immediate operation upon replacement of the corresponding plug-in cards.

12.3 Tools

Design of the equipment shall hold to a minimum the need for any special tools for tuning, adjustment, etc.

All special tools of unusual nature, including special calibrating and alignment devices and assembly or disassembly devices shall be furnished with the equipment and they shall be mounted on the equipment in a readily accessible location.

CHAPTER 13 INSTALLATION WORK AND WORKMANSHIP

The installation work and workmanship to be included in this contract shall comply with the descriptions mentioned in this CHAPTER. Some of this work is handled in other related chapters also and the descriptions may be duplicated.

13.1 General

(a) The installation shall cover all necessary work, such as unpacking and handling of materials from storage, custom procedure, transportation, leveling, marking, fixing, mounting, assembling, and full performance tests thereof.

(b) The Contractor shall bear expenses for all necessary materials and tools, as well as for transportation of the equipment, and for living and traveling of this workers.

(c) Throughout the installation period, the Contractor shall assume the responsibilities of keeping the related sites, buildings, access roads, and equipment, as well as parts and materials, in good condition and, at the end of the installation work, to put all such facilities in good order and perfect trim.

(d) The Contractor shall submit to the ANTELCO for approval such drawings that show relations between facilities to be established under this contract and other facilities or buildings.

Furthermore, the Contractor shall take into consideration the correlation between installation work under this contract and other installation work running in parallel therewith or scheduled in future.

(e) The ANTELCO personnel will be allowed to cooperate in the actual installation work for the purpose of receiving training. In this case, the ANTELCO will bear salaries and wages of such personnel.

(f) The Contractor shall exercise safety precautions during the installation period.

13.2 Conditions and Indication

13.2.1 Access Road

Access road(s) will be provided over which 30 tons/m^2 vehicles can travel.

13.2.2 Building

Building of the station is shown in 8.2.

13.2.3 Electricity and Water

The Contractor may procure all electricity and water required for the installation work.

13.2.4 Utilization of Lands and Buildings

The Contractor will be allowed to utilize sites and buildings for the purpose of completing the installation work effectively. However, all temporary structures which the Contractor may build for the purpose mentioned above shall be withdrawn prior to the provisional acceptance of completed work. For the use of lands other than the sites, the Contractor shall assume all responsibilities.

13.3 Workmanship

13.3.1 Approval of Workmanship

The Contractor shall, as soon as possible after the signing of the contract, submit to the ANTELCO for approval a detailed description of workmanship for the whole system.

When necessity to change the contents of such description arises in the course of work, the Contractor shall get in touch with the ANTELCO Engineer to receive his instructions.

13.3.2 Conditions of Workmanship

(1) Basic Conditions

(a) Workmanship shall be such as will provide convenience for maintenance work;

(b) Installation materials of optimum quality shall be selected and used;

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

(d) Work shall be finished presentably;

(e) When working additionally on station buildings, the Contractor shall get in touch with the ANTELCO Engineer to obtain his approval. The workmanship shall be such as will not impair waterproofing, shielding effect and other functions of station buildings;

(f) Flashing and finishing of feeder and power cable outlet holes shall be provided according to the ANTELCO's instructions.

(2) Wiring and cabling

(a) Utmost care shall be exercised for cable and wire termination in order that the fixed terminals can be used for a long period;

(b) Care shall be exercised for cabling in order that no undesirable stress will be exerted or no damage inflicted on the cable;

(c) Each equipment shall be effectively connected to earth potential. Troubles due to imperfect earthing shall be prevented;

(d) Power lines and signal lines shall be laid in separate groups;

(e) Wiring, piping and termination shall be performed carefully so as to eliminate harmful induction trouble.

(3) Steel Work

(a) Material to be used for steel work shall be high in quality and anti-corrosive;

(b) It shall be permissible to attach fixing rails on beams of the

building for mounting of structures, etc.

13.4 Installation Control

13.4.1 Installation Report

The Tenderer shall submit as part of his offer, schedules for the provision of the Earth Station from the date of the signing of a contract to the date of the provisional acceptance of the Earth Station as a working system in accordance with the provisions of Articles 10, 11 and 12, the General Conditions of Tender.

The schedules shall include the dates of preliminary design reviews, procurement, design and drafting, fabrication, assembly, factory testing, delivery, installation and field testing.

Among the methods to control progress of installation work which the Contractor is bound to propose shall be included the periodical submission of reports.

In such reports shall be stated not only the progress of installation work but the instructions received from the supervisor and the measures taken to fulfil such instructions.

13.4.2 Attendance of Supervisor

The Contractor, when executing such part of work as cannot be inspected after the completion or when so instructed previously by the ANTELCO, shall be in touch with the ANTELCO Supervisor. The ANTELCO, when it deems such action necessary, will dispatch the Supervisor in order to have such work as mentioned above executed in his presence.

CHAPTER 14 TEST AND GUARANTEE

14.1 General

This CHAPTER provides for factory tests, installation period tests and handing-over tests, as well as guarantee to be extended thereafter. However, some items in other related chapters are also included herein.

Factory tests and acceptance tests are, in principle, to be conducted inclusive of inspections by the ANTELCO. The Contractor, however, shall not fail to take necessary action for smooth proceeding of tests, such as preparing the personnel and methods of tests, and shall prepare to carry out such tests on behalf of the ANTELCO when so instructed. Installation period tests fall within the Contractor's responsibilities.

All tests, including overall tests of the communication facilities of the Earth Station, shall be conducted, in accordance with the performances stipulated in CHAPTER 4, on the basis of comparing with the specifications hereby presented, the latest pertinent C.C.I.T.T., C.C.I.R. and I.C.S.C. Recommendations and data submitted by the Contractor. To pass the tests, work shall satisfy all such standards completely.

The Contractor shall propose the methods of tests, including procedural details, and, after approval by the ANTELCO, shall prepare them in time for each test.

The ANTELCO will bear expenses for living and traveling of his Inspectors.

14.2 Factory Tests

14.2.1 Data to be Submitted at Time of ANTELCO Inspection

The Contractor shall, prior to the ANTELCO inspection, submit manufacturer test data, including the method of testing, on goods to be delivered. In such prior inspections, the Contractor can use, if necessary, the sampling test method approved by the Inspectors.

14.2.2 Start and Period of Inspection

When units have been made ready for inspection in considerable quantities, the Contractor shall inform the Inspector without delay of the time the inspection can be started.

14.2.3 Measuring Facilities

The Contractor shall prepare, free of charge, all necessary facilities for inspection, including measuring instruments.

The Contractor shall reserve sufficient time for each inspection.

14.2.4 Factory Inspection

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

14.2.5 Test Certificates

Goods to be delivered shall undergo inspections by the ANTELCO before shipping, and the test certificate signed by the Inspector shall be attached to each packing.

The Contractor shall prepare suitable sheets for inspection in sufficient quantities. Manufacturer test data, as specified in 12.2.1 above, shall be attached to the test certificates. These, certificates shall not be considered definitive.

14.3 Installation Period Tests

14.3.1 General

The Contractor shall conduct all necessary tests for turn-key basis operations during the installation period, and submit data obtained to the ANTELCO. Such tests shall be based on the specifications hereby presented and pertinent C.C.I.T.T., C.C.I.R. and I.C.S.C. Recommendations.

14.3.2 Measuring Equipment

The Contractor may use for the tests specified above the measuring equipment scheduled to be supplied. Such equipment, however, shall, by the time of the provisional acceptance, be restored so as to furnish normal functions that can be expected from brand-new equipment.

14.3.3 Items not Available for Effective Inspections

For items for which effective inspections are difficult to carry out at the time of the acceptance tests, the pertinent data and records (including photographs) shall be submitted as evidence.

14.3.4 Participation of Trainees

The Contractor shall accept the ANTELCO personnel for the purpose of giving them on-the-job training, instructing them accordingly with regard to tests, as well as repair and adjustment work. In this case, the Contractor can have part of the tests conducted by such personnel, but shall assume final responsibilities for test results.

14.3.5 Measuring Methods

Measuring method shall be based on the C.C.I.T.T., C.C.I.R. and I.C.S.C. Recommendations. In case of items for which official governing regulations are not available, measuring methods shall be proposed by the Contractor and approved by the ANTELCO.

14.4 Handing-over Tests

14.4.1 Preparation for Acceptance Tests

Acceptance tests shall be started according to procedures shown in Article 10, 11 and 12 of the General Conditions of Tender.

The Contractor shall, by the time the acceptance tests are started, submit the following papers prepared for the plant:

(a) Plant records (including completion drawings);

(b) Records of materials used;

(c) Installation period test data;

(d) Other reference papers.

The Contractor shall also prepare a complete inventory of provided and installed facilities in order that he can make clearout explanations therewith at the time of inspections.

14.4.2 Examination of Paters

The ANTELCO Engineer or the Supervisors under his supervision will examine submitted papers and, by comparing them with installed facilities, check whether or not the supplied equipment and materials are used properly.

14.4.3 Checks of Workmanship

The ANTELCO Engineer or Supervisor will check whether or not all facilities have been finished according to the workmanship proposed by the Contractor and approved by the ANTELCO.

When instructed by the ANTELCO Engineer or Supervisor to amend the finish, the Contractor shall fulfil such instructions without delay.

14.4.4 Performance Tests

The ANTELCO Engineer or Supervisor will examine whether or not the installed facilities operate as they ought in accordance with the specifications hereby presented and other governing standards.

The examinations will be carried out in the form of comparison between the data submitted in accordance with provisions of 14.4.1 above and the performance of installed facilities. For sampling inspections, the separately prepared standards shall be applied.

14.4.5 Provisional Acceptance

Reference shall be made to Articles 10, 11 and 12 of the General Instructions for Tender.

14.5 Guarantee

14.5.1 Scope of Guarantee

By "guarantee period" is meant the period between the provisional acceptance and the final acceptance.

Expenses incurred by normal operation and maintenance of facilities during such period will be borne by the ANTELCO.

In case, however, defects are discovered in the course of normal operation during the period mentioned above, although natural wear and tear are expected, the Contractor shall, on his own responsibility, have the operation restored to normally as quickly as possible.

All facilities shall satisfy the standards given in the specifications hereby presented and in the relevant C.C.I.T.T., C.C.I.R. and I.C.S.C. Recommendations throughout guarantee period. In this connection the ANTELCO reserves the right to enforce necessary tests whenever he chooses to do so.

14.5.2 Replacement of Consumed Materials

Replacement and stock piling of consumable materials necessitated during guarantee period are to be undertaken at the ANTELCO's cost. However, when such consumed materials that are used under normal conditions will have to be replaced before their commonly accepted life terminates, the Contractor shall bear the cost of replacement.

14.5.3 Maintenance Supervision

In order to fulfil the undermentioned, the Contractor shall have richly experienced maintenance supervisor(s) stay at the station for six months after the provisional acceptance.

The Tenderer shall offer the number of the supervisor(s).

The Contractor shall bear all expenses incurred by the stationing of such maintenance supervisor(s).

(a) Technical instruction for operation and maintenance of circuits and facilities;

(b) Technical instruction in trouble shooting and repairing work;

(c) Supervision of routine checking;

(d) Analysis of collected data;

(e) Technical instruction in material control.

14.6 Test for Each System

Tests for each system shall be performed under the conditions stipulated in CHAPTER 2 and herein and at least on the items described herein.

The inspection schedule and cost submitted by the Tenderer shall be taken into account the test items described herein and the principal performances stipulated in each CHAPTER.

14.6.1 Antenna System

(1) Test Conditions

(a) Antenna noise, gain, boresight error, etc. shall be measured with the radio stars, boresight equipment and if possible a communications satellite.

For test results, priority shall be given to the radio stars.

The Tenderer shall offer the name of radio stars and their constants (flux density, correction for angular extension, etc.).

(b) System G/T and noise temperature measurement combined with the receiver and down-converter shall be included in this system.

(c) Some test items will not always be possible to realize, for example, wind velocity condition; tests on such matters shall be substituted by test data presentation with the ANTELCO's approval.

(2) Test Items

(a) Transmit and receive gain (include feed subsystem).

(b) System G/T and noise temperature measured at 5^{o} increments of elevation angle from 5^{o} to 90^{o}.

(c) Polarization characteristics

(i) Polarization sensitivity.

(ii) Cross polarization characteristics.

(iii) Axial ratio.

(d) Antenna pattern

(e) VSWR and loss

The overall feed subsystem and each component of the feed subsystem shall be tested.

(f) Isolation between transmitting and receiving feed.

(g) Main and subreflector surface accuracy.

(h) Tracking performance

Tracking error and drive velocity to all the operation modes shall be tested.

(i) Locked-rotor mechanical resonance frequency.

(j) Other performances stipulated in each subsystem.

14.6.2 Transmitter and Receiver System

(1) Test Conditions

(a) Factory tests shall be executed under the environmental conditions mentioned in CHAPTER 2 using test equipment.

(b) In-station facilities endurance tests shall be executed on site inspections realizing the worst conditions with aircondition equipment malfunction in so far as possible.

(2) Test Items

(a) Both telephone and television circuits

(i) Signal-to-noise ratio

(ii) Gain/Frequency response (RF and IF loop)

(iii) Non-linearity response (BB-RF-BB)

(iv) Baseband noise spectrum (BB-RF-BB)

(v) Amplitude and group delay response (BB-RF, RF-BB)

(vi) Output power level, control range and stability

(vii) Spurious outputs

(viii) Residual amplitude modulation

(ix) Carrier frequency tolerance

(x) Noise temperature

(xi) Noise loading test

(xii) Threshold characteristics

(xiii) Main performances of each equipment

(xiv) Check of alarms and switch-over functions

(xv) Other items recognized by the ANTELCO as necessary

(b) Telephone circuit

(i) Impulse noise

(c) Television circuit

(i) Linear waveform distortion

(ii) Differential gain

(iii) Defferential phase

(d) Test equipment

Each measuring equipment shall be independently tested.

14.6.3 Control and Monitor System

(1) Test Conditions

(a) Inspections for this system shall be carried out as both individual inspection and combined inspection with other systems.

(b) Each control bay, television control/monitor console and data and recorder shall have the certification that they satisfy the minimum requirements stipulated in 5.4.1 to 5.4.4.

(c) Television test bay shall be independently tested.

(2) Test Items

(a) Check of switch-over functions by remote control

(b) Check of displays, alarms and recordings

(c) Performances of television circuit stipulated in 5.4.3 (3)

14.6.4 Multiplexing Equipment System

(1) Test Conditions

(a) Tests of this system shall be executed under the condition with the baseband distribution unit loop.

(b) Other conditions are the same as the transmitter and receiver system test.

(2) Test Items

(a) Loss/Frequency characteristics

(b) Interference

(c) Near end cross talk

(d) Noise

(e) Frequency stability

(f) Level stability

(g) Main performances of each equipment stipulated in 5.5.1 to 5.5.5

(h) Check of alarms

(i) Other items recognized by the ANTELCO as necessary

14.6.5 SPADE Terminal System

The Tenderer shall offer and supply the programs of factory and in-station inspections.

14.6.6 Power Supply System

(1) Test Conditions

Inspections for this Items described in Chapter 7 and 10.6 shall be carried out as both individual inspection and combined inspection with other systems, and shall satisfy not only requirements offered by Tenderer, but also minimum requirements at atmospheric temperature.

(2) Test Items

(a) Voltageproof Test

(b) Insulation Test

(c) Confirmation of Action

(d) Lords Test

(e) Others

14.6.7 Connecting Microwave Link

(1) Test Conditions

Inspections for this system shall be carried out as both individual inspection and combined inspection with other systems.

Each subsystem shall be carried out the individual inspection that they satisfy the minimum requirements stipulated in sections 9.6 Performance characteristics and 9.7 Baseband message performance in Chapter 9.

(2) Test Items

(a) Transmitter and receiver gain

(b) Antenna gain

(c) Signal-to-noise ratio

(d) Baseband noise spectrum

(e) Amplitude and groupdelay response

(f) Output power level, control range and stability

(g) Spurious outputs

(h) Carrier frequency tolerance

(i) Receiver noise figure

(j) Noise loading test

(k) Threshold characteristics

(l) Main performance of each equipment

(m) Check of alarms and switch-over functions by remote control

(n) Performance of television circuit stipulated in sections 9.5.1 and 9.7.3

(o) Performance of engineering service circuits stipulated in section 9.7.4

14.6.8 Central Station Equipment

(1) Test Condition

(a) Inspections for this system shall be carried out as individual inspections and combined inspection with other systems.

(2) Test Items

(a) Test items are the same as the multiplexing equipment system stipulated in 14.6.4.

(b) Main performances of the each equipment stipulated in sections 10.4.1 to 10.4.5 and 10.5.

14.6.9 International Telephone Switching System

(1) Test Condition

(a) Inspections for this system shall be carried out as individual inspections and combined inspection with other systems.

(b) Each subsystem shall have the certification that they satisfy the minimum requirements stipulated in section 11.2.

(2) Test Items

(a) The Tenderer shall offer the test program of factory and in-station inspections.

(b) Main performance of the each subsystem stipulated in sections 11.3.4 or 11.4.7

(c) Check of switch-over functions

(d) Check of displays and alarms

(e) Check of connection between international circuit and domestic circuit

CHAPTER 15 TRAINING

15.1 General

This CHAPTER deals with the training, however, some items in other related chapters are also included herein.

In accordance with provisions of Articles 10, 11 and 12 of the General Instructions for Tender, the Contractor shall, on his responsibility, administer in PARAGUAY and at the manufacturer's factory necessary training for benefit of the ANTELCO's personnel.

The training program shall be proposed by the Contractor, and final decision shall be based on agreement with the ANTELCO.

15.2 Category of Training

15.2.1 Theoretical Training

Training on the following subjects shall be administered in ASUNCION;

(a) Outline of satellite and satellite communications;
(b) Satellite communications circuit design;
(c) Construction of earth station facility;
(d) Antenna control system and the construction thereof;
(e) Transmitter and receiver facilities;
(f) Measuring methods at the earth station;
(g) TV engineering and measurements;
(h) Microwave engineering;
(i) Other associated accessories, including the power facilities.

15.2.2 Training at Factory

Personnel selected by the ANTELCO from among trainees names as per 15.2.1 above shall be accepted by the Contractor, and training shall be administered for them at the manufacturer's factory.

15.2.3 On-the-Job Training

During the installation period, the Contractor shall accept trainees and give them on-the-job training at the sites where construction work is in progress.

15.3 Languages

For training to be administered in PARAGUAY, the Spanish or English language shall be used, whereas for training to be given in the manufacturer's factory, English shall be used.

15.4 Text-books

The Contractor shall prepare all necessary text-books for all trainees, and shall supply an additional 30% as spare text-books.

15.5 Expenses

Salaries and wages of trainees, as well as expenses to be entailed for travel to and from ANTELCO and their living expenses in the manufacturer's country, will be borne by the ANTELCO. Damages caused by trainees will also be indemnified by the ANTELCO.

All other expenses shall be borne by the Contractor.

15.6 Quotation

The Tenderer shall quote training expenses specified in the foregoing.

CHAPTER 16 PUBLICATION AND DRAWINGS

This CHAPTER provides for all technical information and manuals, to include drawings, circuit diagrams, operating instructions, testing procedures and maintenance methods, to be submitted by the Tenderer and the Contractor. Some items in other related chapters are also included herein.

16.1 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 6 copies, in accordance with provisions of Item 8.6 of the General Instruction for Tender. Such items shall include:

(1) System Design

Technical information concerning system design and 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) Equipment layout of the communication facility.

(2) Equipment and Material Data

Technical information pertaining to equipment and materials shall be presented. Equipment specifications shall be prepared in the formula appearing in 1.7. Drawings shall also be prepared if necessary.

(3) Installation

Information concerning installation shall be presented. Especially, clear descriptions with drawings shall be presented for equipment lay-outs.

(4) Price Quotations

Statement shall be made in the formula appearing in 1.7.

16.2 Documents to be Approved

The Contractor shall, within two months after the signing of the contract, submit information in full detail pertaining to designs, installation including workmanship, methods of tests and training to be administered, and shall have such information approved.

Each document shall be submitted in four copies.

16.3 Instruction Manuals

The Contractor shall supply the under-mentioned manuals presen ing detailed information required for operation and maintenance of system.

Each manual shall be supplied in ten copies.

(1) Station Operating Manual

The station operating manual shall be prepared to include the following information:

(a) How to operate the station in each of the various and diverse modes and an explanation of the uses and differences of the operating modes.

(b) How to carry out rapid system and equipment fault location.

(c) A master index of all other handbooks, manuals, etc. for equipment supplied as the earth station system.

(2) Handbooks or Manuals

Handbooks or manuals shall be supplied for every item of equipment forming part of the earth station system.

These manuals shall include:-

(a) Description of the equipment.

(b) An explanation of each operating function.

(c) Step by step instructions on how to use the equipment.

(3) Circuit Drawings

Wiring drawings and schematics shall be supplied for every item of equipment and for all interconnections between equipment assemblies and subsystems.

(4) Each manual shall contain a detailed list of typical meter readings together with the limits on such readings for all test points and likely trouble spots in the circuit of the equipment.

Diagrams of oscilloscope waveforms to be expected shall be shown for appropriate points.

(5) Ordering Information

The instruction manuals shall include ordering information on all parts purchased by the Contractor, in detail sufficient to allow procurement directly from the component manufacturer.

(6) The manuals shall be submitted prior to commencement of the provisional handing-over test.

16.4 Text-books

Text-books for the training mentioned in 15.4 shall be provided prior to commencement of training.

16.5 Data

(1) Manufacturer's test data

Test data described in 14.2.1 shall be presented.

Three copies of such data for each equipment shall be submitted.

(2) Installation period test data

Test data prepared by the Contractor at the sites for each equipment and for each system shall be submitted. Such data shall be submitted prior to the provisional acceptance tests and in four copies each.

(3) Acceptance test data

The Contractor shall put in order data of the acceptance tests conducted by the ANTELCO personnel. Four copies of compiled data shall be prepared.

16.6 Plant Records

(a) Detailed plant records covering all executed work shall be

submitted prior to the provisional acceptance tests.

(b) In such plant records the following items shall be taken up:

(i) Channel arrangement;

(ii) Level diagrams;

(iii) Communications system wiring block diagram;'

(iv) Power system wiring block diagram;

(v) Site plan;

(vi) Equipment layouts;

(vii) Intra-office cable laying, wiring list and lengths;

(viii) Mounting of antenna system, schematic of feeder arrangement and feeder lengths;

(ix) Details of steel work (structures, cable racks, etc.)

(x) Jumpering details;

(xi) Outdoor cable laying splicing list and lengths.

(c) Four copies of plant records shall be submitted for each item appearing above.