## 4-5 Digital Microwave Transmission Equipment

### 4-5-1 Basic Conditions

Equipment shall be designed on the basis of basic design policy so as not to introduce any radio interference with existing terrestrial microwave system, the INTERSPUTNIK system, and the INTELSAT system.

### 4-5-2 Configuration and Function

The configuration and function are as follows, and the system configuration is illustrated in Figure 4-5-1.

(1) Antenna system

A 2.4 m class parabola antenna is to be used for both transmission and reception between the earth station and the TV center tower (about 10 km), and a 1.8 m class parabola antenna for both transmission and reception between the TV center and the central office (about 3 km).

The height of antenna from the ground level will be 22 m for the earth station, 55 m for the TV center, and 26 m for the central office.

An upper part of 6 GHz band shall be used for both transmission and reception (To avoid using the same frequencies which are currently used for the INTERSPUTNIK system, the INTELSAT system, and existing terrestrial microwave system). Considering future expansion, the antenna shall be able to transmit and receive both vertically and horizontally polarized microwaves.

The waveguide between the radio equipment and the antenna will be about 45 m for the earth station side, about 90 m for the TV center side and about 20 m for the central office side.

(2) Radio equipment (terminal type equipment for the earth station and central office)

Install 6 GHz band 34 Mbit/s digital microwave radio equipment with redundancy configuration of operation (1) + stand by (1). The main unit shall be composed of transmitter/receiver, modulator/demodulator, operation/stand by change-over device, and a branch circuit.

(3) Radio equipment (repeater type equipment for the TV center)

6 GHz band 34 Mbit/s digital microwave radio equipment shall be used. Redundancy configuration shall be of operation (1)+stand by (1), respectively toward the earth station and the central office.

The equipment is composed of transmitter/receiver, modulator/demodulator, operation/stand-by change-over device, and a branch circuit.

(4) Digital multiplexed terminal equipment (for the earth station, the central office)

This equipment shall be placed between the Ground Communication Equipment and the microwave radio equipment in the earth station, and between the microwave radio equipment and the digital switching equipment in the central office.

1) 2M/34M digital multiplexed terminal equipment

This converts 2 Mbit/s digital signals to a 34 Mbit/s digital signal, and vice versa. 34 Mbit/s signal consists of 16 sets of 2 Mbit/s digital signals. The 34 Mbit/s digital signal is equivalent to 480 channels of analog telephone signal.

2) 2 M PCM digital multiplexed terminal equipment

This converts analog telephone signals to a 2 Mbit/s digital signal, and vice versa. A 2 Mbit/s digital signal has a capacity equivalent to 30 channels of analog telephone signal.

3) Digital distributing frame

This equipment serves for connecting and distributing 2 Mbit/s digital signals and analog telephone signals.

4) 2 Mbit/s digital interface equipment

This branches data that are mixed in a 2 Mbit/s digital signal into two digital signals, or reversely mixes data in two 2 Mbit/s digital signals into one digital signal. This equipment shall be placed in the central office to insert and branch telex signals.

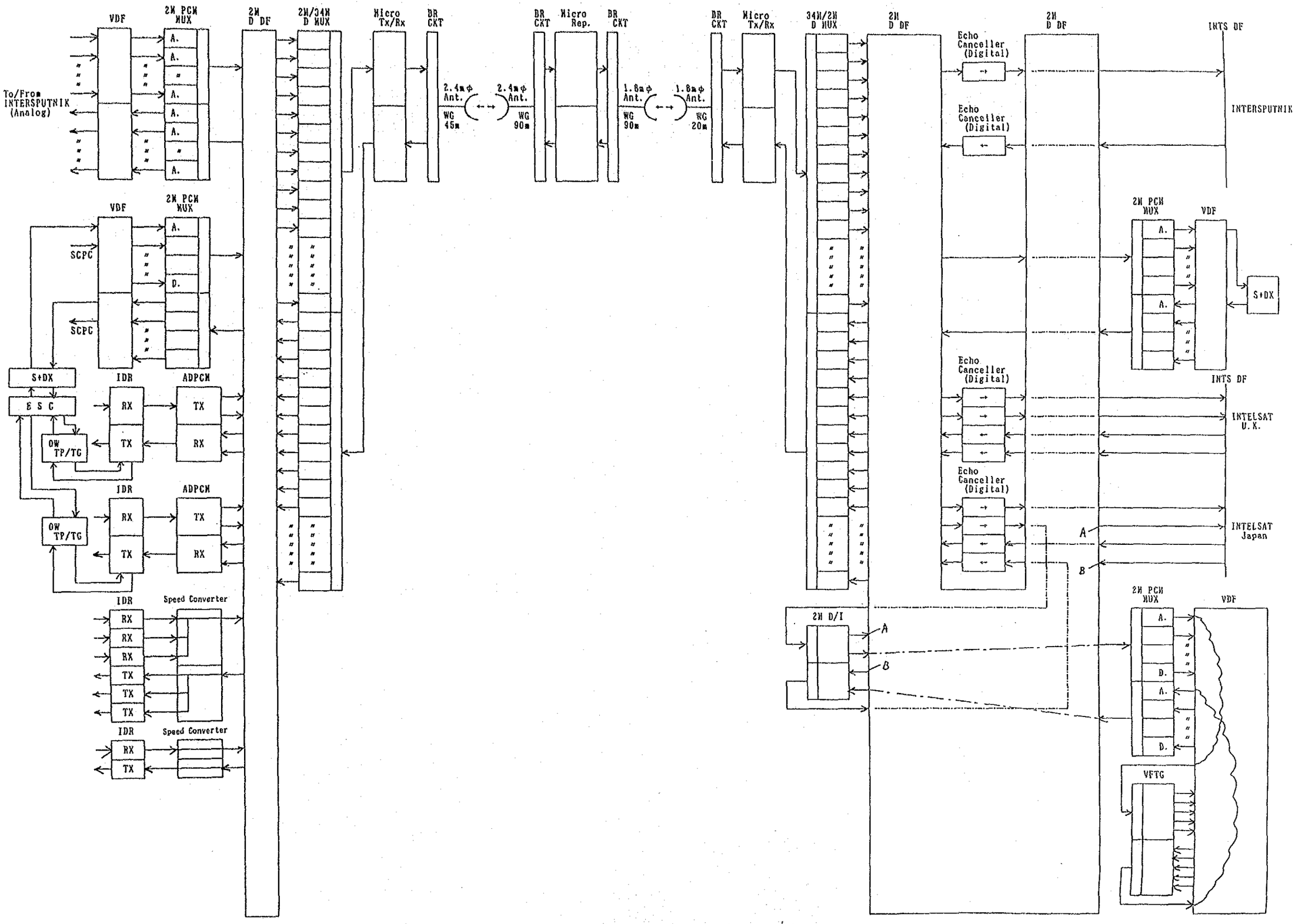



Fig. 4-5-1 Blockdiagram of Terrestrial Equipments between Earth Station and MTA Central Office

(5) Voice frequency telegraph equipment (VFT)

This multiplexes up to 24 circuits of 50 baud telegraph signal into one analog telephone signal. The equipment shall be installed in the central office and provides telex and telegraph circuits.

(6) Equipment for Engineering Service Circuit

This employs one analog circuit and serves telephone and telex Engineering Service Circuits.

(7) Power supply

1) Power supply in the earth station

Direct Current of −24 V from the existing uninterruptible power supply system is used. Required capacity is 10 A. However, if the batteries in the existing equipment are found to have deteriorated in discharging characteristics, they shall be replaced with new −24 VDC 200 AH batteries.

2) TV center

In the TV enter, −24 VDC shall be supplied from the existing DC distributing board. The required capacity is 10 A.

3) Central office

In the central office, −48 VDC generated by the power system in the new digital switching system is also applied to digital microwave transmitting equipment.

### 4-5-3 Equipment Layout

Equipment layout is shown in Figure 4-5-2 "Floor layout for the 6th floor in the central office tower", Figure 4-5-3 "Floor layout for the rooftop of the central office tower", and Figure 4-5-4 "Floor layout for the 3rd floor of the TV center", and Figure 4-5-5 "Floor layout for multiplexed equipment room of the earth station".

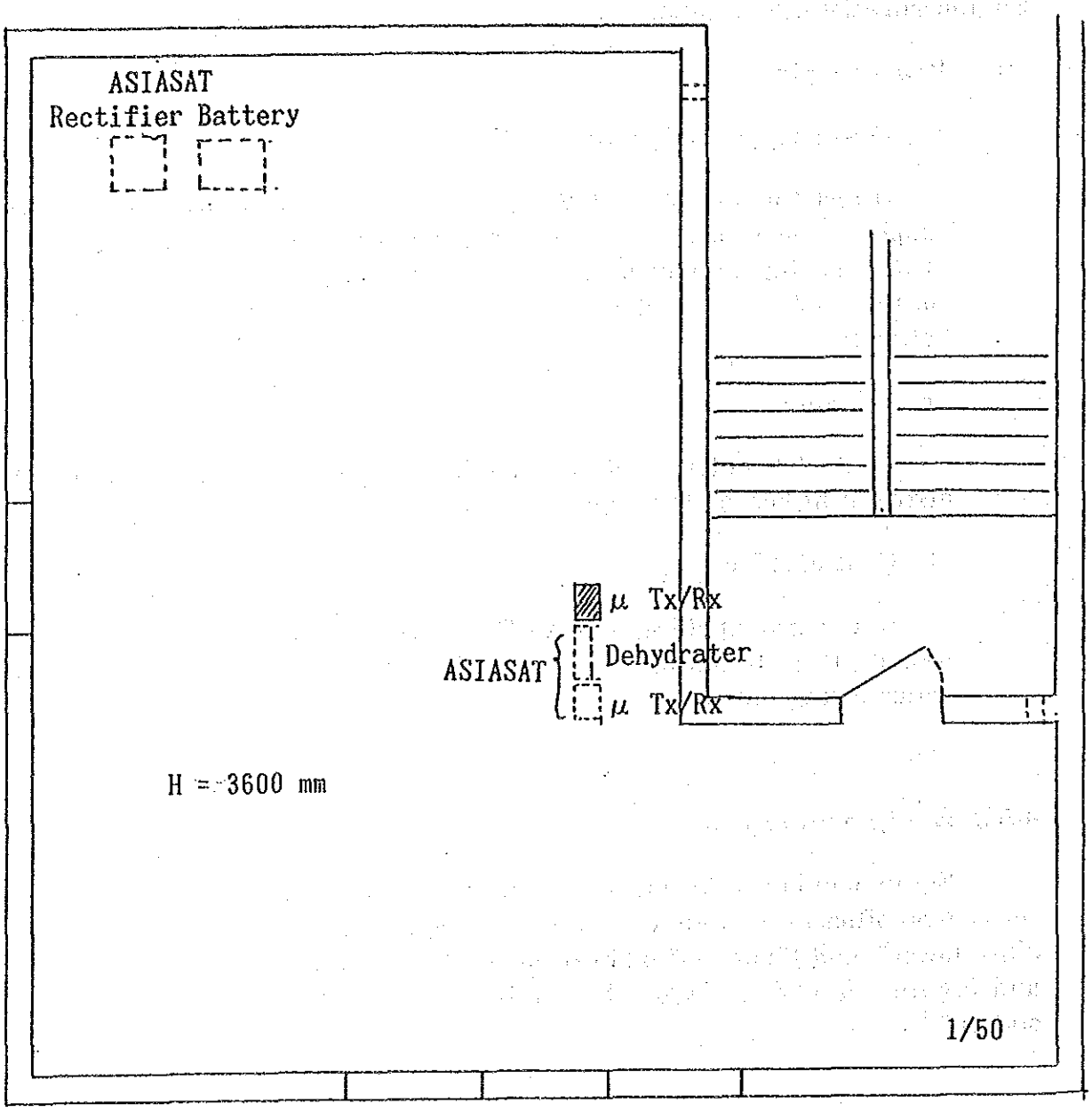



**Fig. 4-5-2 Floor Layout of Central Office Building (6F)**

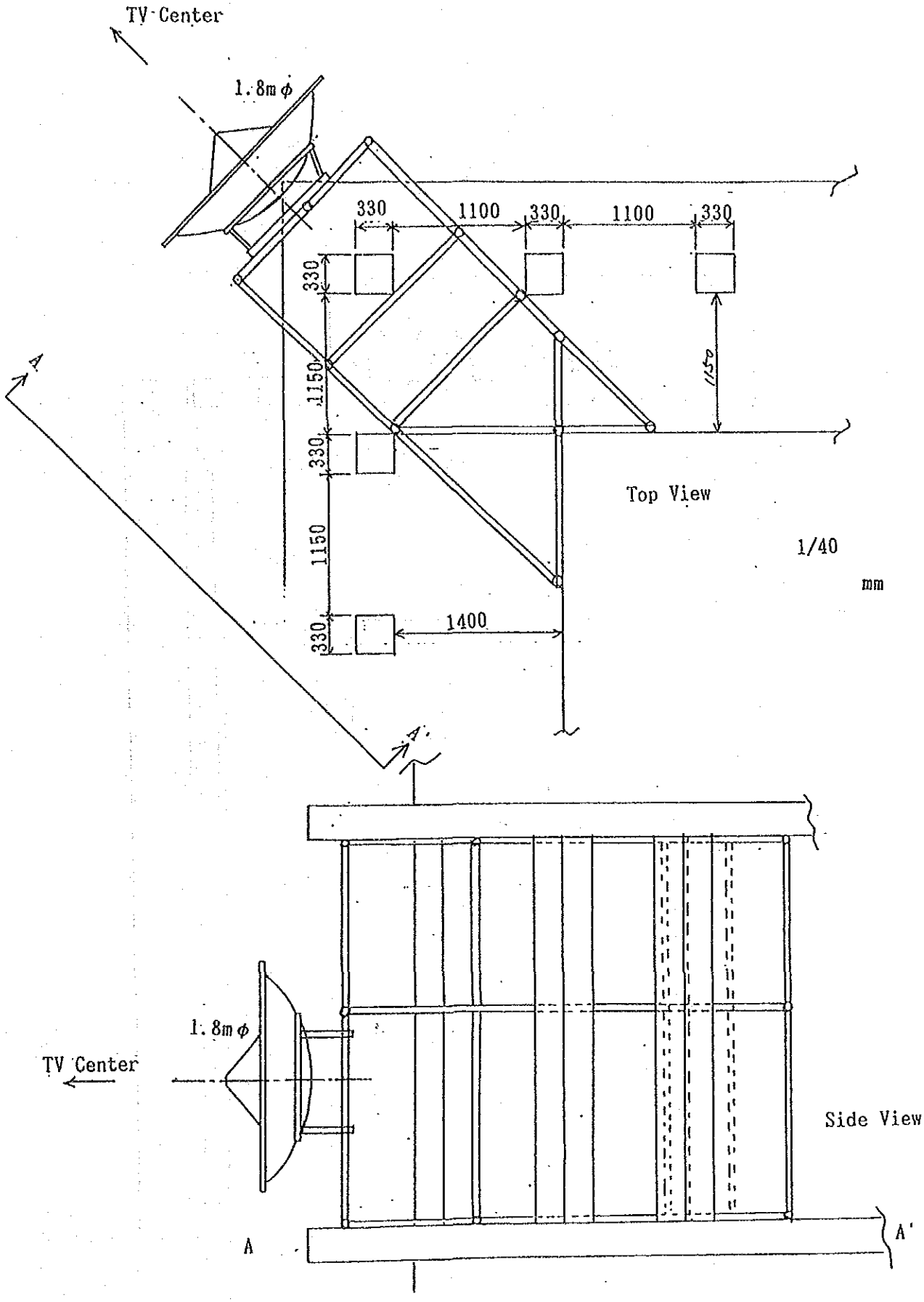



**Fig. 4-5-3 Floor Layout of Central Office Building (Tower)**

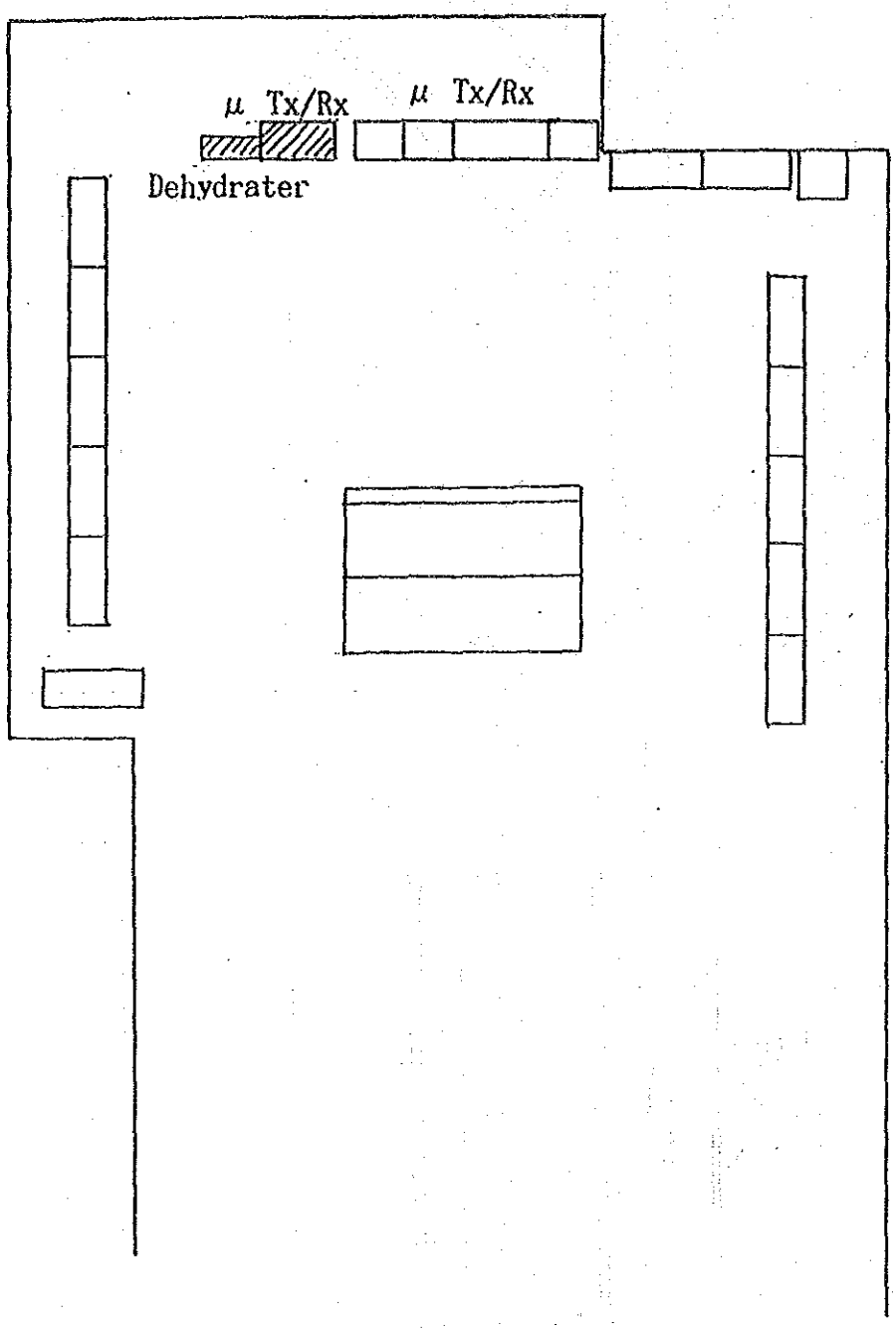



**Fig. 4-5-4 Floor Layout of TV Center (3F)**

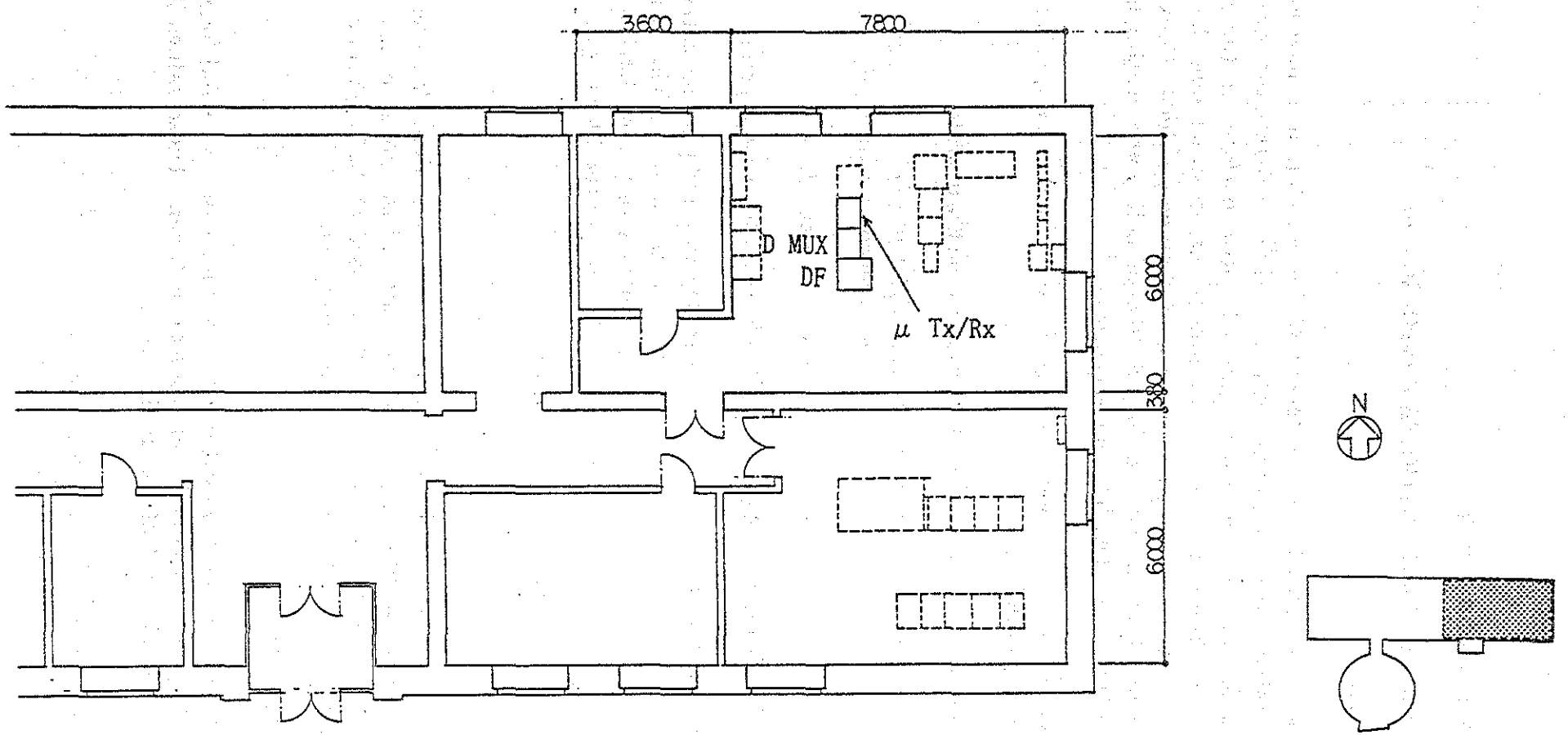



Fig. 4-5-5 Floor Layout of Earth Station
(Multiplexed Equipment Room)

## 4-6 Construction Work

### 4-6-1 New Building for the INTELSAT Earth Station

(1) Floor plan

In order to construct the new INTELSAT earth station, a new building shall be constructed to accommodate the radio equipment and UPS (uninterruptible power system) which cannot be accommodated in the existing building. Besides the above mentioned machine rooms, an air chamber for taking in the air to cool telecommunications equipment shall be provided. Considering Mongolian's climatic conditions and the reduction of cooling and heating load, an anteroom shall be provided with the main doorway.

As a module for a span between posts is 60 cm in Mongolia, this shall be applied to the new building.

The required spaces are calculated as follows on the module.

- Telecommunications equipment room (about 76 $m^2$) ..... To accommodate radio equipment.
- UPS room (about 24 $m^2$) ..... to accommodate UPS.
- Air chamber (about 16 $m^2$) .... to take in air to cool equipment.
- Anteroom (about 12 $m^2$) ..... main doorway and path for carrying in instruments and tools. This room also is provided with power distributors for lighting and air conditioning.

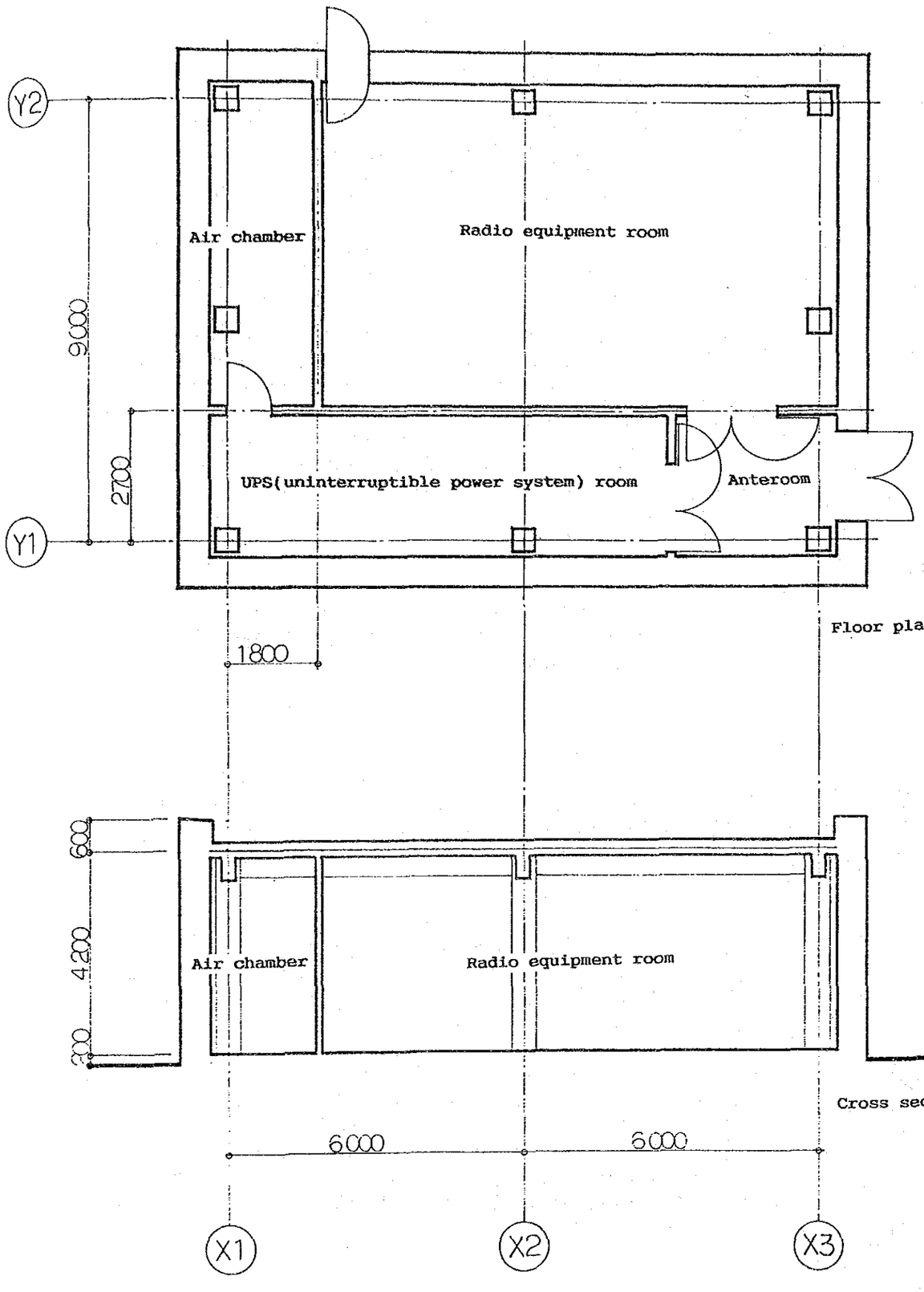
The floor plan is shown in Figure 4-6-1.

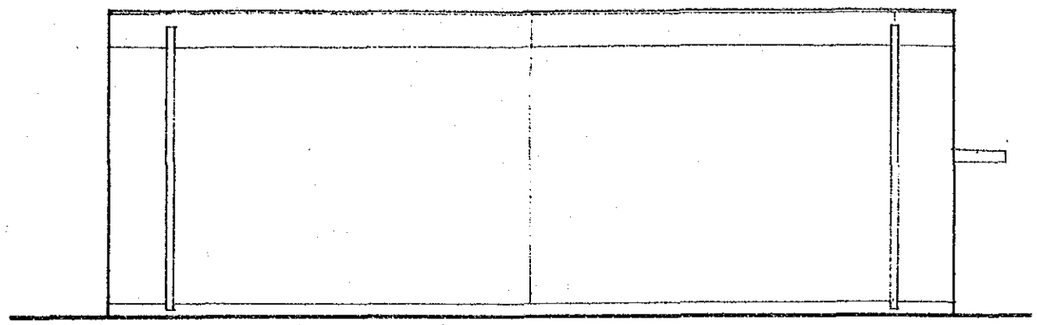
(2) Cross section plan

From its scale, the building should be a one-story building. Considering the height of telecommunications equipment (2.1 m) and the space necessary for wiring, the height under the beam shall be 3.5 m, as a result, height of a story of the building should be 4.2 m including the depth of beam.

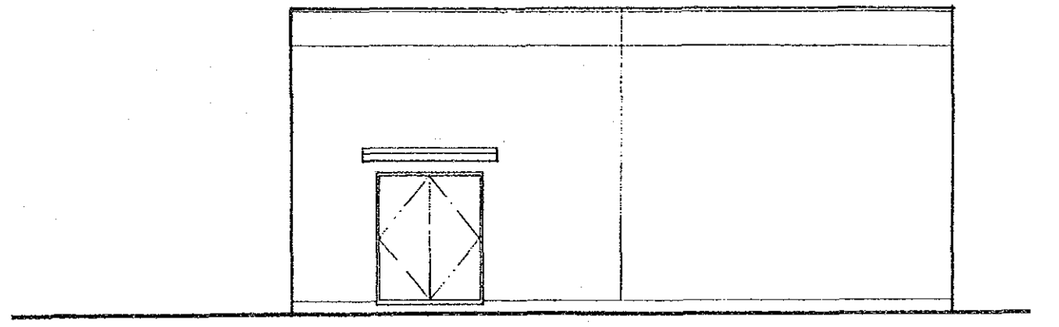
(3) Structural plan

In Mongolia, standard values of external forces such as wind load, snow load, and seismic force are provided for structural design. These values shall be used as the basic data for calculation in the Project.



South elevation



East elevation

**Fig. 4-6-1 New Building for INTELSAT Earth Station, Floor Plan, Cross Section, Elevation Scale 1/100**

1) Dead load

All weights such as those of structural materials and finishing materials shall be put into calculation as dead load.

2) Live load

Live load on the floor shall be 500 kg/m$^2$.

3) Wind load

In Mongolia standard values of wind velocity pressure are provided in five area in this country 27, 35, 45, 55, and 70 kg/m$^2$ respectively, which are used in combination with factors relative to height. The projected site falls under the 35 kg/m$^2$ area, and from this value the wind velocity is estimated to be about 24 m/s. The maximum instantaneous wind velocity at the Boyantohar weather station is 30 m/s, which is anticipated to occur once in 20 years. For a safe design, a wind velocity of 30 m/s shall be taken as the basic design data.

4) Snow load

50 kg/m$^2$ and 70 kg/m$^2$ are used as standard values for two areas in Mongolia as snow load. The projected site falls under the 50 kg/m$^2$ area. This value shall be used as basic data for the structural design.

5) Seismic force

For seismic force, the USSR's seismic intensity grade (unit: ball) is adopted. Anticipated maximum intensity is 10 ball in Mongolia. Ulan Bator has the 6 to 8 ball area, and the projected site falls under the 7 ball area. (7 ball is equivalent to the Japanese grade IV [strong] to V [very strong].)

6) Bearing capacity of soil

According to the record of the borings which had been conducted for construction of AsiaSat, the soil on the projected site is silt including sands and pebbles. According to the information from parties related to building construction, the ultimate bearing capacity of soil in Ulan Bator is 50 to 60 t/m$^2$ at a depth of 3 m. It is also affirmed that depths of embedment of buildings in Ulan Bator are from 2.5 to 3 m without piling work. For the above reasons, permanent bearing capacity of soil for basic design shall be 16 t/m$^2$, as one third of the ultimate value. Considering precedents of building construction in Ulan Bator and the scale of the projected building, the foundation shall be embedded in a depth of 2.5 m under the ground. This is to be determined finally on the subsoil exploration of the site by

Mongolia, because the location of new building will be about 80 m from the location of above mentioned borings.

(4) Structural and finishing materials

1) Structural materials

In Mongolia main structural parts such as posts, beams, and floors are generally made of cast-in-place concrete or precast concrete, and exterior walls are built of bricks in thicknesses of about 64 cm. For large buildings and high-rise apartment buildings the precast concrete panels are used in most cases.

For the projected facilities, considering the precedents in building construction in Mongolia, the main structural parts such as posts, beams, and floors should be made of cast-in-place concrete or precast concrete, and exterior walls and partition walls should be built of bricks.

2) Finishing materials

Finishing materials shall be determined on the specifications of the existing buildings, the precedents in building construction is this country, and ease of procurement. The table below is a reference of interior/exterior finishing.

| Portion | Finishing |
|---|---|
| Roof | Heat insulating material (coke ash), mortar, bituminous membrance waterproofing |
| Exterior wall | Mortar paint finishing |
| Ceiling, interior wall | Mortar paint finishing |
| Floor | Mortar linoleum carpeting |
| Doors | Wooden flush door |

(5) Electric installation

1) Main line

A distributing board shall be provided for electric outlet, lighting, air conditioning, and ventilation facilities.

Capacity $1\phi$ 220 V: 6 kVA
(for lighting, electric outlets, ventilating fans)

$3\phi$ 380 V: 30 kVA (for air conditioning)

2) Light fixtures

In consideration of reductions in running cost, fluorescent lamps will be used for interior illumination. For lighting for the telecommunications room, power should be supplied through raceways under metal fixtures attached to equipment. Illumination will be as follows:

| | |
|---|---|
| Telecommunications room, UPS room: | 500 lx |
| Other rooms: | 100 lx |

(6) Air conditioning

In Ulan Bator, hot water heating is popular during the winter season by means of a radiator using hot water from a power generating plant. In the summer the temperature rises up to 35°C in the day time, while it falls as low as 0°C at night. So instead of using air conditioners, they usually simply open windows in the day time.

But for the reasons below, rooms shall be equipped with air conditioners.

① Radiating heat is greater with new equipment than with conventional one.

② It is quite important for service and equipment reliability to keep the room environment at a proper level.

③ It is necessary to keep equipment free from dust coming in through opened windows during the summer season.

Based on the Mongolian architectural standard, climatic data available from the Ministry for Nature and Environment Protection and environmental condition previously used for telecommunications equipment, the design data for outdoor temperature and room temperature shall be as follows:

[Outside air temperature condition]

| | | |
|---|---|---|
| For air-conditioning in summer: | Dry-bulb temperature | 35°C |
| | Relative humidity | 65% |
| For heating winter: | Dry-bulb temperature | −39°C |
| | Relative humidity | 65% |

[Inside air temperature condition]

Dry-bulb temperature 20±5°C

1) Air-conditioner

The room that accommodates telecommunications equipment and UPS shall be equipped with air-conditioning. In consideration of maintenance and reliability, room coolers for the telecommunications equipment room should be of packaged air-conditioners composed of 2 packages rated at 50% of maximum cooling load for continuous use plus 1 package rated at 50% of load for a spare. For the UPS room, one packaged air-conditioner unit for continuous use should be accompanied by a 100% load unit as a spare. Change-over between the continuous use unit and the spare unit is to be operated manually. Alarms shall be transferred to and displayed in the control room.

Required cooling capacity is calculated as follows, using the conditions such as outside air temperature data, generation of heat from equipment, and inside air temperature:

Drain from air-conditioner units shall be connected to the existing underground sewer pipe, with an intermediate trap.

[Required cooling capacity]

Telecommunications equipment room: 17,800 kcal/h

UPS room: 12,200 kcal/h

2) Heating

The existing earth station office has a hot-water heating system with radiators. Because it is located far from the metropolitan area of Ulan Bator, they make hot water by burning coal. With the new building, however, electric heating shall be installed because of the necessity to control the room temperature. The heater is to be set in the packaged air-conditioners. The alarm signal is to be transferred and displayed in the existing office, the same as for the air-conditioner.

The rooms to be equipped with heating are the telecommunications equipment room and the UPS room. Since some heat is generated by the equipment, the required heating capacity is calculated as follows, using the design data of outside and inside air temperature as listed above.

[Required heating capability]

Telecommunications equipment room: 9,100 kcal/h

UPS room: 4,400 kcal/h

(7) Ventilating equipment

The UPS is equipment with storage batteries, therefore, it shall be ventilated to prevent possible disaster. The volume of ventilation is calculated at 160 $m^3$/h on the basis of storage battery capacity (240 Ah/cell). Ventilation should be performed by the mechanical ventilation system with an exhaust fan with appropriate dust filter in the louvers.

(8) Plumbing

Rainwater on the roof is to be drained into the ground of the surrounding premises as is done by the existing office buildings.

(9) Fire alarm

Fire alarms shall be provided with the new building. Alarms shall be transferred to and displayed in the control room.

### 4-6-2 Foundation Work for Antenna of the INTELSAT Earth Station

(1) Type of foundation

Because soil of the projected site has satisfactory bearing capacity, a direct foundation shall be adopted. When the wind is strong, considerable moment force is anticipated due to the 16 m diameter of the antenna, therefore, the foundation shall be a mat foundation of ferroconcrete with adequate width and length.

(2) Design conditions

1) Dead load

Total dead load shall include the weight of the antenna, at 80 tons and the dead load of the foundation, at 135 tons.

2) Wind load and seismic force

The above external forces shall be calculated as was done with the antenna of the new earth stations.

3) Bearing capacity of soil

There is no problem because the bearing capacity of soil is estimated to be 16 t/m$^2$ for permanent load.

### 4-6-3 Constructions on the Yard of the INTELSAT Earth Station

(1) Re-constructions of existing fence

To secure the area for construction of antenna and new building, the existing steel fence (height 1.6 m) shall be moved by 15 m westward in the site and re-constructed there.

(2) Pavement yard road

The existing road (with concrete pavement) shall be extended to the east of the new office.

(3) Communication cable ladder between new building and existing building

A horizontal ladder is to be constructed between the new building and the existing building to lay communication cable. The horizontal ladder shall be more than 3.5 m above ground.

### 4-6-4 Renovation Work in Central Office

The existing central office shall be renovated in order to install new equipment on its 3rd story.

(1) Renovation in the exchange room

In order to utilize a portion of the existing telex room as an exchange room, the room shall be renovated as follows:

1) A partition shall be placed between the newroom and the narrowed telex operating room. As a result, a doorway between the telex room and the corridor shall be necessary. Considering possible future extension, the partition should be made of wood material.

2) In order to remodel the existing floor to raised floor the existing parquet flooring shall be removed, and at that time floor dust shall be cleaned thoroughly.

3) The finish of the existing ceiling and wall (perforated plywood) shall be replaced with paint finish.

(2) Repair work in telephone operator room

After removing the existing switchboards, the floor (parguet flooring) shall be repaired.

(3) Installation work of air-conditioner in the new exchange room

The new exchange to be installed in the central office shall be accompanied by an air-conditioner because of heat generation. The required cooling capacity is calculated at 18,000 kcal/h based on the outside air temperature (35°C) in summer and inside air temperature condition (27°C).

## 4-7 Construction Plan

### 4-7-1 Plan of Construction

(1) Necessity of separate construction phases

The construction work shall be divided into two phases. The first phase includes the construction of the INTELSAT earth station, and the second phase includes the installation of international exchange and the installation of digital transmission facilities relaying between the earth station and the central office.

(2) Organization of the MTA, for implementation of the Project

The Mongolian authority to conduct the implementation of the plan is the Mongolian Telecommunications Authority (MTA), which is under direct control of the Mongolian Government. To successfully promote the whole process of installation, test, putting into service, which require professional skill, and long range planning, it is desirable to organize a tentative team as suggested in Figure 4-7-1.

The capability of the project team exerts a serious influence on the results of project implementation.

Therefore, it is desirable that the person posted as project leader be a competent manager or an active engineer with appropriate skills. The know-how obtained through construction of the earth station, transmission and exchange system may be valuable experience never obtainable from reading books or maintenance training. It is also desirable that the chief and section managers for

the system in the operational stage should be selected from among these members.

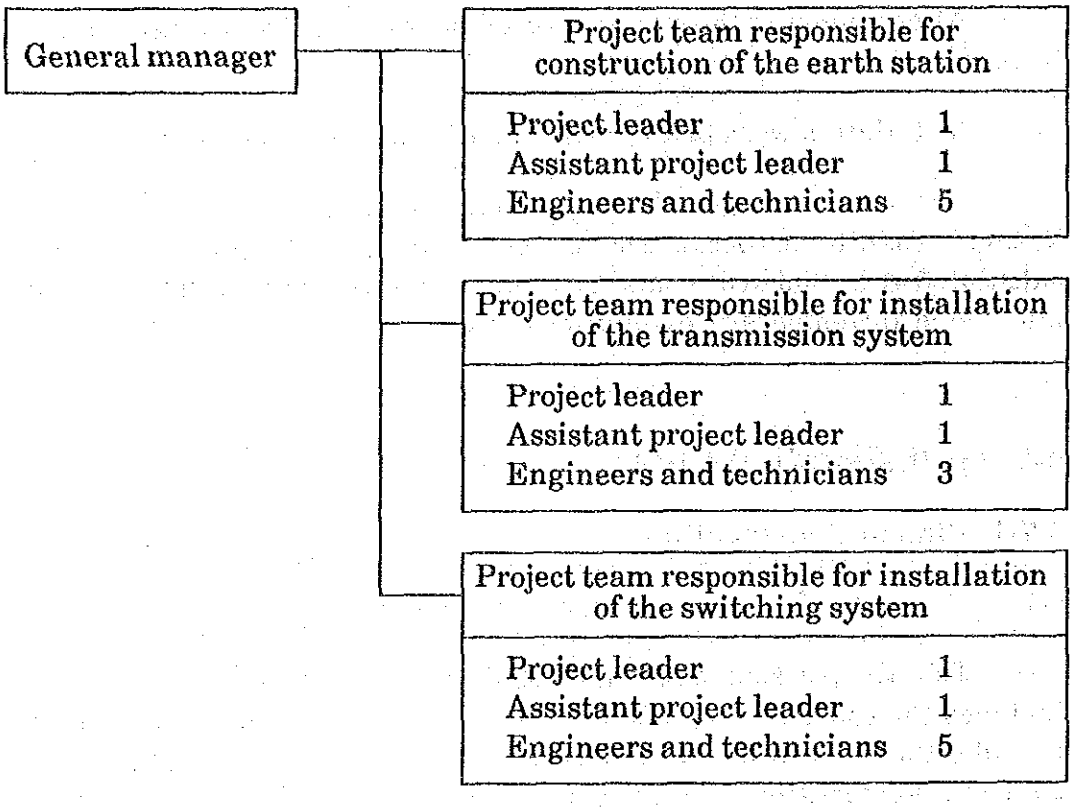



**Fig. 4-7-1 Organization of Tentative Project Team**

(3) Employment of consultant firm

After Exchange of Notes, the MTA should employ Japanese consultant for detailed design, preparation of tender documents and supervision of implementation.

The consultant firm will be responsible for the following tasks:

1) Making technical specifications
2) Evaluating proposals, and assisting negotiations on contract
3) Witnessing the acceptance inspection at the factory
4) Supervising the implementation of construction
5) Performing acceptance tests and INTELSAT verification tests

(4) Architectural work

1) Design

The architectural design room in Mongolia shall be utilized for design of the new building for the INTELSAT earth station, except for electric and air conditioning installation. The basic architectural design and the design requirements of telecommunications facilities shall be arranged in Japan. Detailed design shall be entrusted to the architectural design room in Mongolia. In the practical stage of design, detail design shall be negotiated with contractors and confirmed by the Japanese consultant firm.

2) Architectural contractors

Since Mongolian architectural precedents show no problem, local construction companies will be utilized in the implementation.

### 4-7-2 Allotment of Construction

All the telecommunications equipment and electric installations as well as delegation of supervisors and engineers in connection with the Project shall be borne by Japan, but those works and costs concerned with equipment installation such as fees for crane work, and relevant labor and material costs shall be paid by the Mongolia.

With respect to the above construction, Japan shall furnish all of the cement, reinforcing rods and steel frames, but other materials and works shall be borne by the Mongolia.

In the implementation of the Project, total construction shall be divided into two shares, Mongolian share and Japanese share, as follows:

(1) Japanese share of construction work

1) Construction work I (1st phase)

a) Telecommunications equipment and construction materials in connection with the earth station facility, furnished and constructed

b) Power cable from the existing sub-station to the INTELSAT earth station, furnished

c) Grounding work for the INTELSAT earth station, constructed

d) Electric installations and air-conditioners concerned with the new earth station, furnished and constructed

e) Cement, reinforcing rods and steel frames for the new earth station and foundations of the antenna, furnished

f) Horizontal ladder for laying cable between the new building and the existing office, furnished and constructed

2) Construction work II (2nd phase)

a) Electronic exchange, the telecommunications equipment and construction materials for the exchange and the digital transmitting system, furnished and constructed

b) Air-conditioner unit for the new exchange room on the 3rd floor in the existing central office, furnished and constructed

(2) Mongolian share of construction work

1) Construction work I (1st phase)

a) Detail design and construction of the new building for the INTELSAT earth station, (except electric installations and air conditioners)

b) Construction of foundation of the INTELSAT earth station antenna

c) Relocation of the existing fence and preparation of the office yard relating to construction of the INTELSAT earth station

d) Constructions laying underground cable

e) Extension of access road in the earth station office yard

2) Construction work II (2nd phase)

a) Floor space of 73 $m^2$ shall be prepared in the existing telex operation room (about 125 $m^2$) on the 3rd story in the central office. For this purpose, the MTA shall move the existing telex positions by the end of 1992.

b) The above space shall be prepared for use as an exchange room with partition and remodeling.

c) Floor space of 125 $m^2$ for the switchboards shall be prepared on the 3rd story in the Central office. For this purpose, unused telephone switchboards shall be removed by the end of 1992.

d) Repairing the floor finish upon removal of the telephone switchboards.

e) Fitting up the room with ceiling lights, emergency lights and AC wall outlets.

f) Laying cable and associated wiring:

- Laying the grounding wire (B1-3F), prepared by the contractor.
- Laying 220 VAC power cable (B1-3F), prepared by the contractor.
- Laying 380 VAC power cable (B1-3F), prepared by the contractor.
- Laying cables to the existing distributing frame (MDF) and transmitting facilities

| | |
|---|---|
| International: | USSR (microwave transmitting system) |
| | China (cable transmitting facilities) |
| National: | Local exchange (MDF). |

g) Expansion or modification of the existing domestic exchanges for provision of new circuits with new INTS/TS

### 4-7-3 Implementation Plan

(1) The Project shall be completed by cooperation between two countries, in which the Mongolia and Japan shall each undertake its responsible share, respectively. Because of operational requirements of Japan's Grant Aid, the construction must be completed within the same fiscal year of the E/N, as a general rule. Consequently, to promote the Project smoothly and without delay, it is necessary to make close arrangements on the schedule and process prior to implementation.

After the E/N, both the MTA and the Japanese Consultant Firm shall each make a total implementation plan, arrange its schedule, and implement the Project up to completion, each closely cooperating with the other.

(2) The Consultant Firm shall contract the whole process from blueprint to acceptance, promote the smooth implementation assuring the cooperation of all

parties concerned, and exercise leadership of the MTA in guidance and technical transfer.

Delegation of technical staff at the appropriate time shall be included in its service.

(3) For supervising the construction on site, the local architectural design office may be utilized. In order to promote the architectural construction during the whole schedule without delay, Japanese engineers will be delegated to the site as often as needed.

(4) Spare parts and consumable parts can not be procured in the Mongolian domestic market and must be imported entirely. Parts shall be supplied for five years' operation.

(5) Because installation and testing of the projected equipment requires special high-level skills and experience, the contractors shall delegate special employees skilled in the fields of satellite communication, microwave transmission and telephone switching system as it is deemed necessary.

(6) The MTA shall appoint staff members, to attend the testing on the site for technical training. Also the MTA shall appoint the necessary workers for laying cable and installation.

### 4-7-4 Implementation Schedule

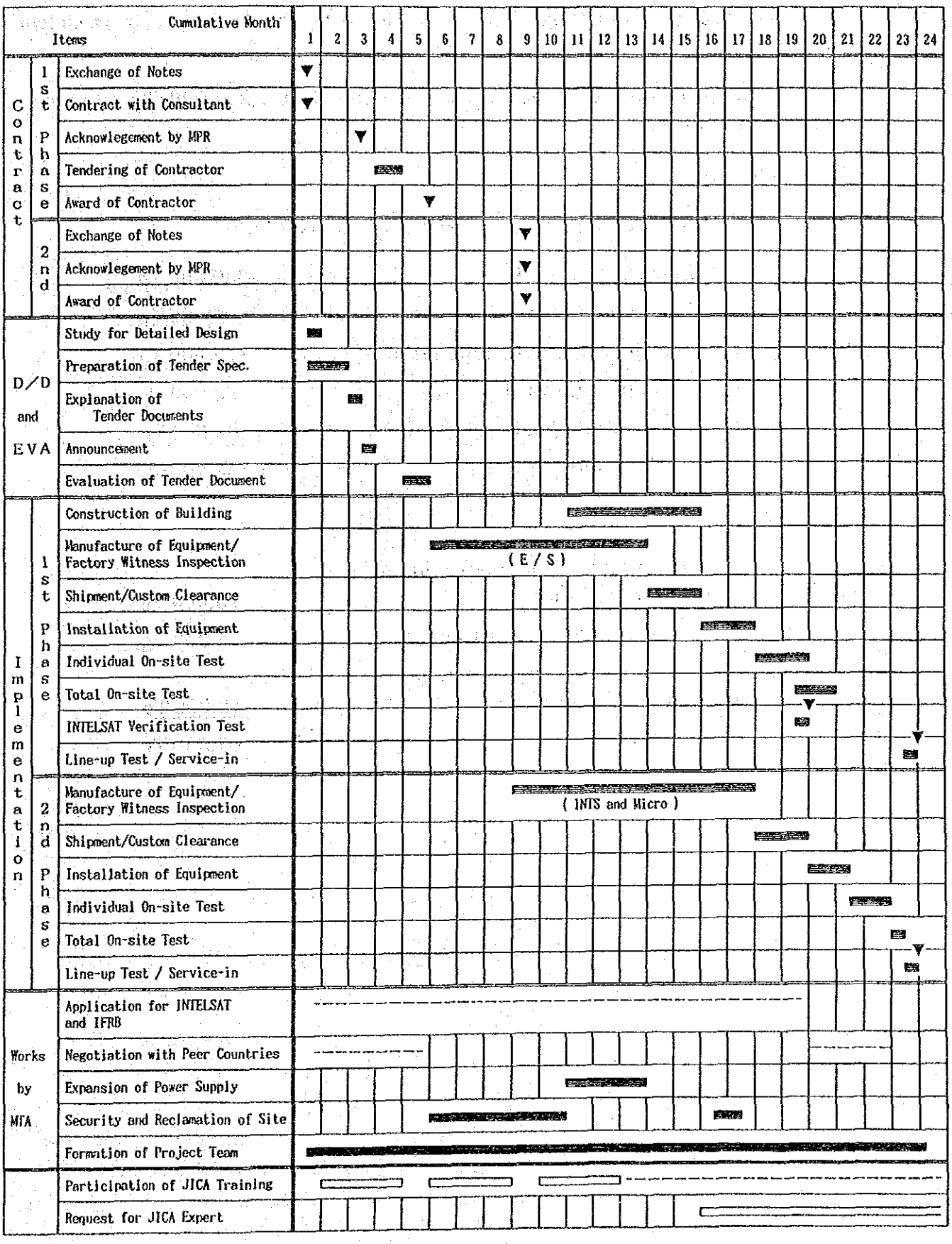
The implementation schedule is shown in Table 4-7-1.

The period necessary for the first phase can be broken down as follows; 3 months for consultation contract and detail design, 2 months for tendering business, 8 months for fabricating equipment, 4 months for transportation and installation, and 3 months for on-site test.

The period necessary for the second phase can be broken down as follows; 9 months for fabricating equipment, 3.5 month for transportation and instalation, and 2.5 month for on-site test.

In Mongolia, the months from May to October are mild and favorable for architectural construction. However, interior work is possible in winter if heating is available after the heating system has been installed in the newly built building. Considering the whole schedule of the Project, the new building for the INTELSAT earth station shall be built during May to October, including the electric facilities and air-conditioners.

# Table 4-7-1 Schedule of the Project



### 4-7-5 Estimation of Project Cost

The estimation of Project cost to be borne by the Mongolia, is as shown below:

Total estimation of Project cost is calculated at 1,216,000 Tg as shown below in breakdown.

(1) 1st phase

| | | |
|---|---|---|
| a) | The new building for the INTELSAT earth station | |
| | i) Construction work | 880,000 Tg |
| | ii) Design, administration | 5,700 Tg |
| b) | Construction of antenna foundation | 173,000 Tg |
| c) | Pavement in office yard | 30,000 Tg |
| d) | Relocation of existing fence | 60,000 Tg |
| | Subtotal | 1,148,700 Tg |

(2) 2nd phase

| | | |
|---|---|---|
| a) | Remodeling interior of new exchange room in central office | 25,000 Tg |
| b) | Repair work of telex operating room | 2,300 Tg |
| c) | Cable laying between new switching system and existing facility | 40,000 Tg |
| | Subtotal | 67,300 Tg |

# CHAPTER 5
# PROJECT EVALUATION AND CONCLUSION

# 5 PROJECT EVALUATION AND CONCLUSION

## 5-1 Effect on the Activities of the Telecommunications Services

The Mongolian People's Republic projected a plan to consolidate and expand their facilities, mainly for constructing an INTELSAT earth station, in order to improve their current situation of degraded international telecommunications. This Project is ranked as a national top priority matter in the improvement of infrastructures which is indispensable for the progress of the national economy being introduced by the market economy.

As a part of the new Five-year Development Plan for the telecommunications including a consolidation plan for international telecommunications, the MTA targeted to proceed with improvement of its telecommunications network based on their long-term vision. In connection with this target, the MTA has been trying its best , for example, to reduce the waiting list of subscribers and to improve service quality by installing new telephone exchange for domestic use at the capital city. The implementation of the Project, both in domestic and international telecommunications network with international subscriber dialing, will provide high quality services of international telecommunications, and the outstanding problem of the country will be solved.

The following are the effects of the Project.

(1) The Project will solve the top priority matter of the nation's policy with regard to telecommunications and will contribute to raise the efficiency in operation of telecommunications.

(2) The Project will furnish the high quality services of international subscriber dialing, particularly at Ulan Batar where such demands are greatly requested.

(3) The profit increase to be obtained from the success of the Project will have a favorable effect upon the establishment of the MTA's financial basis. This will also contribute to the on-going improvements in the telecommunications.

(4) With regard to the technical ability of maintenance and operation for the new earth station and telephone exchange, the MTA does not have any problems as it has the valuable experience of over 20 years with the operation of the INTERSPUTNIK earth station and likewise with the operation of similar telephone exchanges.

(5) Since the new earth station and telephone exchange are planned to be installed at the existing stations, a personnel increase would be minimal for

operation and maintenance, and the MTA should not have any problems with operation by the minimal cost increase.

## 5-2 Effect upon Diplomacy, Foreign Trade, and Economic Activity

### 5-2-1 Diplomacy

At the 19th Congress in 1988, basic policy was decided to swing Mongolia's targeted direction to a new economic policy and freedom of information, taking into consideration of the aggressive political changes being introduced in the Soviet Union.

Since then, Mongolia reviewed their diplomatic policy and changed into an omni-directional diplomacy, equally with all countries by the promotion of "Reform and Renovation", which seems like Mongolian style Perestroika. With the rapid changes in Eastern Europe, Mongolia further accelerated their promotion.

However, the current facilities for international telecommunication are inconvenient in terms of the communication exchange, and the necessary contacts are not fully carried out with foreign countries or international organizations on important diplomatic information. This means that it should be indispensable to improve their diplomatic targets. Therefore, their top priority should be in the construction of international telecommunications' facilities.

### 5-2-2 Foreign Trade and Economy

In addition to the diplomatic function, international telecommunications will be a vital factor in promoting new economic policy, which is quite important for the country.

Foreign trade of the country still relies heavily on the Soviet Union with lesser amounts traded with Western countries. One of the reasons for this would be that international telecommunications does not play its full role. International telecommunication is an indispensable and important factor for expanding foreign trade by obtaining timely information on commodity prices such as the market price and fluctuations of the market, or by exchanging information on foreign trade transactions.

The trade balance of the country has been suffering from a deficit. Therefore, to put the breaks on this deficit, it will be necessary for the country to set up their profitable export activities by their specialty commodities. It is

confirmed that great mining resources, for example, copper ore, molybdenum and cement, are reserved in the country. These items supporting the national economy are the most promising export items, as its rich store of reserves can be supplied for export as well as for domestic demands.

Since agriculture and livestock farming for sheep, cattle, horses, etc., is popular in the country, it is expected that the by-products from these endeavors (cashmere products, furs and leather products, and meats) will also rank as promising export items in addition to the mining minerals.

On the other hand, the country needs to import foodstuffs other than meat, industrial machines, electrical appliances and construction materials. Therefore, expansion in foreign trade is absolutely required.

To summarize this section, the promotion of the Project is an urgent matter for the country in order to proceed with its target of smooth shifting to the market economy. This promotion is considered to have a favorable effect on activities of foreign trade and the overall economy.

## 5-3 Conclusion and Recommendations

### 5-3-1 Conclusion

The purpose of the Project is to improve the current situation of international telecommunications in the Mongolian People's Republic, mainly to construct the INTELSAT New Standard A earth station as well as to install telephone exchange by Japan's Grant Aid.

This movement arose from the present difficult situation of international telecommunications. The country has been facing a lot of problem to be solved in the international telecommunications. And this will not be solved by only improving the existing facilities, because of exceeding obstacles in connectivities and circuit's capacity as well as the quality of the current international circuits via the INTERSPUTNIK Network.

With political reforms, the country decided to introduce the market economy for the promotions of aggressive contacts and economic activities with Western countries. For introducing the market economy, the international telecommunications are absolutely indispensable. This study also proved such cases as that the important communications between countries were sometimes unable to be made, or that the communications are abandoned due to its current situation despite a brisk demand. The Project is indispensable to carry Mongolia's national project into effect, and the Project will contribute to fix the fundamental conditions of their telecommunication policies. And also, there will be every

possibility of operation and maintenance of the facility after its installation, with not only a minimal burden in expenses but a favorable effect on the activities of the MTA.

As stated above, the Project is the most important and the highest priority matter for the country to proceed with its infrastructure reforms. The Project will surely contribute to the smooth operation of the market economy as well as for the national target of constructing a wealthy country.

Table 5-3-1 shows the Project evaluation.

## Table 5-3-1 Project Evaluation

| | Pending matters | Countermeasures in the Project | Effect of the Project |
|---|---|---|---|
| Current situation | 1. Due to manual operation, it takes a long time for connection, and in some cases, connection is not available. Even if connected, it is hard to continue conversation because of poor quality. Furthermore the rates are expensive.<br>2. It is almost impossible to have facsimile service. | 1. To introduce direct circuits with Western countries by the INTELSAT network.<br>2. To improve a network for international telephone calls by installing the international telephone exchange. | 1. Telephone circuits will be increased from the present 20 circuits to 111 circuits which can offer high grade services.<br>2. International Subscriber Dialing will be available for major countries which enable rate reduction. |
| Demand | 1. Upward tendency for further demand in international telecommunications, reflecting political reform and the introduction of the market economy.<br>2. There are many potential demands under the present situation, but there are lots of subscribers who give up telephone call, because of inconvenience. | 1. To rationalize the capacity of the facilities judging from the forecast for telecommunications demand.<br>2. To improve the connectivity. | 1. Economical operation will be available, as the capacity for future demand is already secured to meet the future demand in telecommunications.<br>2. It is possible to meet the demand by solving connection problem. |
| Diplomacy | Difficulties with diplomatic information exchange and telecommunication with other countries. | | |
| Economy and foreign trade | 1. With the progress of the market economy, immediate information gathering on international market prices and foreign trade will be needed to advance trading with Western countries. Providing such information takes a long time or is unavailable under the present circumstances.<br>2. Although the country has rich mining resources, meat, and fur products for export, their insufficient telecommunication system interferes with the trading of these products.<br>3. Difficult to secure high grade telecommunications which is necessary for inviting foreign companies.<br>4. Due to an insufficient telecommunication system, travellers are not increasing as expected, despite the potential. | 1. To construct INTELSAT Satellite Earth Station, International Telephone Exchange and Digital transmission link.<br>2. To match this Project to the Digital Network Plan which is now under planning by MTA. | Possible to establish a direct route with Western countries via INTELSAT satellite. Available to exchange reliable information speedily.<br>This will contribute to the progress of diplomacy, economy and foreign trade. |
| Information disclosure | Very limited provision of information and TV program from Western countries, although information disclosure is on the way. | 1. To establish circuits available to communicate all over the world.<br>2. To establish one TV receiving circuit by utilizing the INTELSAT network. | 1. Available to communicate with all countries which leads to further progress in information gathering from wider sources and further developments in information disclosure movement.<br>2. Enable to receive the TV program from any Western country. |

### 5-3-2 Recommendations

The following are recommended for the execution of the Project in order to promptly proceed with construction work and to smoothly operate the facility.

(1) Negotiations with international organizations

The MTA needs immediate negotiations with international organizations for the following matters to install the new earth station.

1) Registration of the earth station to the ITU Frequency Registration Board.

2) Notice to the INTELSAT the construction of the earth station and application for use of space segment.

(2) Negotiations with correspondents

The MTA also needs immediate negotiations with correspondents for the following matters.

1) Negotiations with telecommunication providers in Japan and the U.K. about the telecommunication system, the number of circuits and the commencement date of service.

2) Negotiations with USSR and China to change the signaling system from R2 to CCITT No.5.

(3) Influence of air routes

The MTA needs to have continuous discussions with the officials concerned with the airport so that any possible expansion of airport facilities and air routes will not influence the operation of the earth station.

(4) Preparation work for the planned site

Prior to start-up the construction, the MTA needs to carry out the following environmental arrangements.

1) Rearrangements of the telex operation room and telephone operators room at the central office.

2) Preparation of electricity, according to the Project at the earth station and the central office.

(5) Employment plan and training plan

The MTA is requested to make an appropriate plan for employment and staff training as well as to secure necessary staff members, and to practice the staff training adequately.

(6) INTELSAT earth station verification test

The MTA needs to secure a telephone line with the INTELSAT Headquarter which will be used during the verification test period for the earth station.

# APPENDIX 1

## 1-1 Staff Lineup of the Study Team

(1) Basic Design Study (from February 10 to March 4, 1991)

| | |
|---|---|
| Team leader | Takuo KIDOKORO<br>Assistant Director, Grant Aid Division,<br>Economic Cooperation Bureau,<br>Ministry of Foreign Affairs |
| Cooperation Planning | Youichi KOBAYASHI<br>Section Chief<br>Space Communications Development Division<br>Communications Policy Bureau<br>Ministry of Posts and Telecommunications |
| Network and switching plan | Takeshi SHIMIZU<br>Project Engineering & Consulting Department<br>KDD Engineering and Consulting ( KEC ) |
| Earth station facilities | Tatsuyoshi NAKAMURA<br>Project Engineering & Consulting Department<br>KEC |
| Demand forecast and switching facilities | Akira NUDESHIMA<br>Project Engineering & Consulting Department<br>KEC |
| Microwave transmission facilities | Tsunemori YAMAGUCHI<br>Training Department<br>KEC |
| Civil and architectual plan | Masaaki RYOHKE<br>Project Engineering & Consulting Department<br>KEC |
| Interpreter | Ryoh OHTSUKA<br>Berlitz Translation Services |

(2) Consultation of Draft Report (from May 20 to May 28, 1991)

| | |
|---|---|
| Team leader | Yutaka YOKOI<br>Deputy Director, Grant Aid Division,<br>Economic Cooperation Bureau,<br>Ministry of Foreign Affairs |
| Cooperation Planning | Masatoshi YANAGIDA<br>Technical Official<br>Space Communications Development Division<br>Communications Policy Bureau<br>Ministry of Posts and Telecommunications |
| Network and switching plan | Takeshi SHIMIZU<br>Project Engineering & Consulting Department<br>KDD Engineering and Consulting ( KEC ) |
| Earth station facilities | Tatsuyoshi NAKAMURA<br>Project Engineering & Consulting Department<br>KEC |
| Civil and architectual plan | Masaaki RYOHKE<br>Project Engineering & Consulting Department<br>KEC |

## 1-2 Schedule for the Study

(1) Basic Design Study

| Date | |
|---|---|
| Feb.10 (Sun) | Lv. Tokyo |
| 11 (Mon) | Ar. Ulaanbaatar,Courtesy call at the Ministry of Trade and Industry(MTI) ,Explanation / Discussion on Inception Report, Courtesy call at the Embasy of Japan |
| 12 (Tue.) | Courtesy call at the MTA |
| 13 (Wed.) | Discussion on the Project with the MTA and the MTI |
| 14 (Thu.) | Discussion on the Project with the MTA and the MTI<br>Courtesy call at the Ministry of Foreign Relations |
| 15 (Fri.) | Discussion on the Project with the MTA and the MTI |
| 16 (Sat.) | Signing of Minutes of Discussions<br>Reporting to the Embasy of Japan |
| 17 (Sun.) | Analysis of collected data and information |
| 18 (Mon.) | Discussion on field survey items and schedule |
| 19 (Tue.) | Field survey |
| 20 (Wed.) | Field survey |
| 21 (Thu.) | Field survey |
| 22 (Fri.) | Field survey |
| 23 (Sat.) | Discussion on Field survey result |
| 24 (Sun.) | Analysis of collected data and information |
| 25 (Mon.) | Field survey |
| 26 (Tue.) | Field survey |
| 27 (Wed.) | Field survey<br>Courtesy call at the Ministry of National Development |
| 28 (Thu.) | Discussion on Field survey result |
| Mar. 1 (Fri.) | Final meeting with the MTA and the MTI |
| | Reporting to the Embasy of Japan |
| 2 (Sat.) | Explanation of Japan's Grant Aid System |
| 3 (Sun.) | Analysis of collected data and information |
| 4 (Mon.) | Lv.Ulaanbaatar<br>Ar.Tokyo |

(2) Consultation of Draft Report

Date

May 20 (Mon) Lv. Tokyo

21 (Tue.) Ar. Ulaanbaatar, Courtesy call at the MTA and the MTI
Courtesy call at the Embasy of Japan

22 (Wed.) Explanation of Draft Final Report

23 (Thu.) Explanation of Draft Final Report

24 (Fri.) Explanation of Draft Final Report

25 (Sat.) Explanation of Draft Final Report
Signing of Minutes of Discussions
Reporting to the Embasy of Japan

26 (Sun) Team meeting

27 (Mon) Lv. Ulaanbaatar

28 (Tue.) Ar. Tokyo

## 1-3 List of the Parties Concerned

(1) Basic Design Study

Ministry of Foreign Relations

| | |
|---|---|
| Mr. B-O Doljintseren | Deputy Foreign Minister |
| Mr. T.Namjim | Ambassador at large |
| Mr. R.Zigjid | Officer of Asia Dept. |

Ministry of Trade and Industry

| | |
|---|---|
| H.E.S.Bayarbaatar | Minister |
| Mr. Doyod | First Deputy Minister |
| Mr. Battsengel | Director |
| Ms. L.Nasanbuyan | Assistant Director |
| Mr. R.Tumurbaatar | Officer of Planning and Finance Dept. |

Ministry of National Development

| | |
|---|---|
| Dr. R.Tsagaanhuu | First Deputy Minister |
| Dr. D.Enkhbat | Deputy Minister |
| Dr. S.Ganbaatar | Chief Expert,Dept.of Informatization and Electronics |

Mongolian Telecommunications Authority

| | |
|---|---|
| H.E. B.Baatar | Director |
| Mr. Zunkhuu | Second Deputy Director |
| Mr. Magvan Onon | Chief of Foreign Relation Dept. |
| Ms. B. Purevsuren | Senior officer of Foreign Relation Dept. |
| Mr. G.Namsrai | Manager,Telecommunication policy group |
| Mr. Erdenejugder | Manager,Telecommunication policy group |
| Ms. Banzragch | Manager,Telecommunication policy group |

| | | |
|---|---|---|
| Mr. | Batmunkh | Manager,Telecommunication policy group |
| Mr. | Batduulga | Telecommunication policy group |
| Mr. | R. Arvintsogt | Project Manager/Radio Communication |
| Mr. | D. Zanaa | Manager of Earth Station |
| Ms. | Uranchimeg | Enginner, Earth Station |
| Mr. | Jamsran | Enginner, Earth Station |
| Mr. | T. Chogjmoo | Head of telephone and radio service office in Ulaanbaatar |
| Mr. | N. Nansaliav | Chief of the board of telecommunication |
| Mr. | Jamsranjav | Telecommunication Service Agency |

Mongolian Air( MIAT )

| | | |
|---|---|---|
| Mr. | Mijiddorj | Manager of airport communication |
| Mr. | Altanctom | Manager of traffic services of airport |
| Mr. | Ganbaatar | Manager of data processing |

Kharsh Ltd.

| | | |
|---|---|---|
| Mr. | Buyanbadrakh | General Architect |

State Bank

| | | |
|---|---|---|
| Mr. | Sukhdorj | Director of EDP Center |

Cable and Wireless plc

| | | |
|---|---|---|
| Mr. | G.L. Viner | Manager Mongolia |

(2) Consultation of Draft Report

Ministry of Trade and Industry

| | |
|---|---|
| Mr. Battsengel | Director |
| Ms. L.Nasanbuyan | Assistant Director |

Mongolian Telecommunications Authority

| | |
|---|---|
| H.E. B.Baatar | Director |
| Mr. S.Boldbaatar | First Deputy Director |
| Mr. Magvan Onon | Chief of Foreign Relation Dept. |
| Mr. G.Namsrai | Manager,Telecommunication policy group |
| Mr. Erdenejugder | Manager,Telecommunication policy group |
| Ms. Banzragch | Manager,Telecommunication policy group |
| Mr. R. Arvintsogt | Project Manager/Radio Communication |

Kharsh Ltd.

| | |
|---|---|
| Mr. Buyanbadrakh | General Architect |

## 1-4 Minutes of Discussions

(1) Basic Design Study

(2) Consultation of Draft Report

MINUTES OF DISCUSSIONS

ON

THE IMPROVEMENT PROJECT OF THE SATELLITE COMMUNICATIONS

IN

THE MONGOLIAN PEOPLE'S REPUBLIC

In response to the request of the Government of the Mongolian People's Republic, the Government of Japan decided to conduct a Basic Design Study on the Improvement Project of the Satellite Communications (hereinafter referred to as "the Project") and entrusted the Study to the Japan International Cooperation Agency (JICA). JICA sent the Study Team headed by Mr. Takuo KIDOKORO, Assistant Director, Grant Aid Division, Economic Cooperation Bureau, Ministry of Foreign Affairs to the Mongolian People's Republic from 10th February to 4th March, 1991.

The Study Team had a series of discussions on the Project with the officials concerned with the Government of the Mongolian People's Republic headed by Mr. L.ZUNKHUU, Deputy Director of the Mongolian Telecommunications Authority.

As a result of the study, both parties agreed to recommend to their respective Governments that the major points of understanding reached between them, attached herewith, should be examined towards the realization of the Project.

Ulaanbaatar February 16 ,1991

Takuo KIDOKORO
Leader,
Basic Design Study Team
JICA

B. BAATAR
Director,
Mongolian telecommunications
Authority

L. NASANBUYAN
Assistant Director,
Ministry of Trade and Industry

- Attachment -

1. The objectives of the Project are to improve the present situation of international telecommunication services of the Mongolian People's Republic (hereinafter referred to as "MPR") and to support consequently the social and economic development in world-wide scale.

2. The Study Team fully understood the requests from the Mongolian Telecommunications Authority (hereinafter referred to as "MTA") of MPR.

3. As a result of discussions between the MTA and the Study Team, the items listed in Annex 1 have been confirmed finally for the Project.

4. The construction of the facilities will be divided into two phases. The implementation priority of the facilities is as follows.

(1) The earth station facilities
(2) The international exchange
(3) The approach microwave link

5. The MTA is responsible for the administration and execution of the Project.

6. The Study Team will convey to the Government of Japan the desire of the Government of MPR that the former takes necessary measures to cooperate by providing the facilities listed in Annex 1 within the scope of the Japan's Grant Aid scheme.

7. The Government of MPR has understood the Japan's Grant Aid System explained by the Study Team which includes a principle of use of a Japanese Consultant Firm and Japanese Contractors for the implementation.

8. The Government of MPR will take necessary measures listed in Annex 2 on condition that the Grant Aid would be extended to the Project.

9. The tentative schedule of the Study is shown in Annex 3.
The final Report in English will be submitted to the MTA.

10. The International Telecommunication Services provided by ASIASAT should be terminated, on condition that the Project would be completed.

- Annex 1 -

Items of the Project confirmed upon the discussion

1. Installation of the facilities to accommodate new international satellite communication circuits in the INTELSAT system composed of:

(1) The earth station facilities
(2) The associated approach microwave link
(3) The international telephone exchange

2. Construction of the antenna foundation and the ground communication equipment building

3. Provision of necessary materials for operation and maintenance:

(1) Spare parts
(2) Measurement equipment
(3) Tools

4. Appropriate on-site training for technology transfer.

Undertaking by the Government of MPR

1. To secure, clear and reclaim the following sites prior to commencement of the construction work as follows:

(1) Ground space for the earth station antenna, the ground communication equipment building and the approach microwave link antenna at the earth station

(2) Floor space for the communication facilities and power suppy facilities at the existing earth station building

(3) Floor space for the approach microwave link facilities and international telephone exchange at the MTA building

(4) Floor space for the approach microwave link facilities and use of iron tower for the antenna at the TV broadcasting station

2. To undertake incidental works such as:

(1) at the earth station

- Cable hole, conduit and/or trench between the newly installed facilities and the existing facilities
- Access road to the new antenna

(2) at the MTA building and the TV broadcasting center

- Cable hole, conduit and grounding

3. To provide the following peripheral facilities:

(1) Primary power supply facilities for the newly installed facilities in the earth station, the MTA building and the TV broadcasting station

(2) National clock for digital communication equipment

4. To provide the following facilities for the construction work:

(1) Electricity, Water, Drainage and Sewage for the construction work

(2) Working and Storage space

(3) Telephone

5. To bear commissions to the Japanese foreign exchange bank for banking services based upon the Banking Arrangement.

T. Ki

6. To exempt customs duties and to take necessary measures for customs clearance of the materials and equipment brought for the Project.

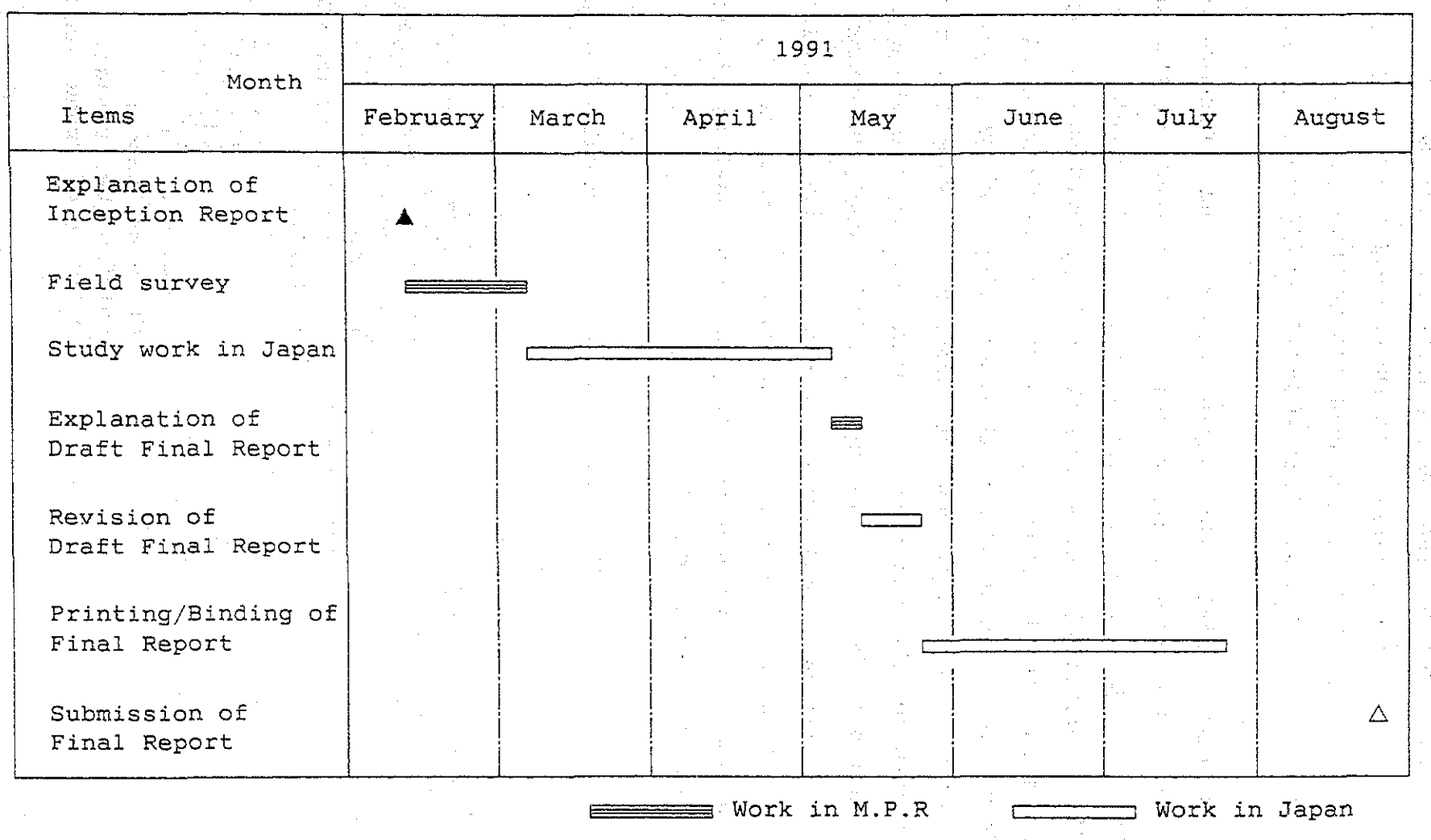
7. To accord Japanese Nationals, whose services may be required in connection with the supply of products and the services under the verified contract, such facilities as may be necessary for their entry into MPR and stay therein for the performance of their work.

8. To maintain and use properly and effectively the facilities constructed and equipment purchased under the Grant.

9. To bear all the expenses other than those to be borne by the Grant.

## Schedule of the Study





MINUTES OF DISCUSSIONS

BASIC DESIGN STUDY ON THE IMPROVEMENT PROJECT OF THE SATELLITE COMMUNICATIONS IN THE MONGOLIAN PEOPLE'S REPUBLIC

( CONSULTATION OF DRAFT REPORT )

In February 1991, the Japan International Cooperation Agency ( JICA ) dispatched a Basic Design Study team on the Improvement Project of the Satellite Communications ( hereinafter referred to as "the Project" ) to the Mongolian People's Republic, and through discussions, field survey, and technical examination of the result in Japan, has prepared the draft report of the study.

In order to explain and to consult the Mongolia side on the components of the draft report, JICA sent to the Mongolia a study team, which is headed by Mr.Yutaka Yokoi, Deputy Director, Grant Aid Division, Economic Cooperation Bureau, Ministry of Foreign Affairs, and is scheduled to stay in the country from May 21 to 27, 1991.

As a result of discussions, both parties confirmed the main items described on the attached sheets.

Ulaanbaatar May 25,1991

Mr. Yutaka Yokoi
Leader
Draft Report Explanation Team
JICA

Mr. B.Baatar
Director,
Mongolian Telecommunications Authority

Mr. G.Battsengel
Chief of Department,
Ministry of Trade and Industry

ATTACHMENT

1. Components of Draft Report

The Government of the Mongolian People's Republic has agreed and accepted in principle the components of the Draft Report proposed by the team.

2. Japan's Grant Aid system

(1) The Government of the Mongolian People's Republic has understood the system of Japanese Grant Aid explained by the team.

(2) The Government of the Mongolian People's Republic will take the necessary measures, described in Annex, for smooth implementation of the Project on condition that the Grant Aid assistance by the Government of Japan is extended to the Project.

3. Further schedule

The team will make the Final Report in accordance with the confirmed items, and send it to the Government of the Mongolian People's Republic by the end of August 1991.

4. Technical cooperation in connection with the Project

The study team explained the Japanese technical cooperation system and pointed out that a new proposal of the Government of the Mongolian People's Republic would be necessary, when such cooperation is needed in connection with the Project.

Annex : Necessary measures to be taken by the Government of the Mongolian People's Republic in case Japan's Grant Aid is executed.

1. To secure the site for the Project.
2. To clear, level and reclaim the site prior to commencement of the construction.
3. To undertake incidental outdoor works such as gardening, fencing, gates and exterior lighting in and around the site.
4. To construct the access road to the site prior to commencement of the construction.
5. To provide facilities for distribution of electricity, telephone, drainage, sewage and other incidental facilities to the Project site.
   (1) Electricity distribution to the site.
   (2) Drainage city main to the site.
   (3) Telephone trunk line to the main distribution panel of building.
   (4) General furniture such as carpets, curtains, tables, chairs and others.
6. To bear comissions to the Japanese foreign exchange bank for the banking services based upon the Banking Arrangement.
7. To exempt taxes and to take necessary measures for customes clearance of the materials and equipment brought for the Project.
8. To accord Japanese Nationals whose services may be required in connection with the supply of products and the services under the verified contract such facilities as may be necessary for their entry into the Mongolian People's Republic and stay therein for the performance of their work.
9. To maintain and use properly and effectively the facilities constructed and equipment purchased under the Grant.
10. To bear all the expenses other than those to be borne by the Grant, necessary for construction of the facilities as well as for the transportation and the installation of the equipment.

## 1-5 List of Collected Documents

1.General situation of M.P.R

(1) The state of Mongolian Economy in 1989

(2) UNDP Report on Living Condition of Mongolia (January 1989)

(3) Meteorological Data (monthly, 1984 - 1988)

:temperature,humidity and precipitation

at Ulaan Bataar and Darkhan

(4) Map : Ulaan Bataar, Project site

2.Situation of MTA

(1) Organization Chart of The Mongolian Telecommunications Authority

(2) Overseas Telephone Charge (1990) : each destination

(3) Incomes in foreign currencies

(4) Financial statements

(5) Personal engaged in telecommunication system

(6) Next 5 years telecommunications development plan

(7) Aid program by international organizations and foreign authority

(8) Situation of international cooperation for the MTA in the telecom. field

(9) Five year plan on telecomminications sector

(10) The present situation of telecommunicaiton services of the MTA

3.Traffic forecast

(1) Telephone Service Paid Minutes ( 1986 - 1988 )

(2) Telex and Telegraph Services Paid Minutes ( 1986 - 1989 )

(3) Number of Telephone Subscribers ( 1984 - 1989 )

Number of Telex Subscribers ( 1984 - 1989 )

(4) Traffic statistics

(5) Statistics of international TV program transmission

(6) Telephone,telex & telegram calls from Mongolia (1988-1990)

(7) Income of international telecom services (1988,1989)

(8) Number of employees each occupation (1986-1989)

(9) Mongolian foreign trade turn over (1988,1989)

(10) Information about the INTERSPUTNIK communication

4.Telecommunication network

(1) Nation-wide Microwave Network (including under planning)

(2) Exchanges of province centers and other cities

(3) Microwave system and Openwire system of Mongolia

5.Earth station facilities

(1) INTERSPUTNIK Earth Station Configuration

(2) INTERSPUTNIK Earth Station Power Supply System Diagram

(3) INTERSPUTNIK Earth Station Site Layout

(4) INTERSPUTNIK Earth Station Floor Layout

(5) Data of Airport

(6) TV equipment for international transmission in the Earth station and TV center

(7) Frequency utilization plan in Mongolia. Existence of radio interference in communication band.

(8) Aircraft routes and route map.

(9) Earth station location map

(10) Floor layout of earth station

(11) Blockdiagram of earth station

(12) Schematic diagram of power suply

(13) Existing terrestrial microwave route

(14) Outline of "Курс-4,-6,-8 microwave system

(15) Record of fault in the INTERSPUTNIK earth station (1986-1990)

6.Terrestrial Transmission Link

(1) Microwave Repeater Station Configuration

(2) Profile between Earth station and TV center

(3) Microwave frequency

(4) Analogue microwave system between Earth station and TV center

(5) Profile between the Earth station and Central office

(6) Profile between the TV center and Central office

(7) Coaxial cable route between the TV center and Central office

7.Exchange

(1) Number of Trunk-lines to Tall Exchange (Trunking diagram)

(2) Telephone Switching System in major cities

(3) Percentage of differnt types of switching system in Mongolian network

(4) Number of waiting subscriber in Province

(5) International gateway exchanges of Telephone and Telex

(6) Number of Trunk lines from E10B to local exchange in Ulaanbaatar

(7) Signalling sequense between E10B and existing toll switch

(8) Signalling system between E10B and existing local switch

8.Civil and architectural plan

(1) Site map of the Earth station

(2) Soil condition survey result of the Earth station

(3) Floor layout of the Central office

(4) Floor layout of the Earth station

(5) Climatic and Seismic condition of Mongolia and design standards

(6) Information on Cost

9.Central office

(1) Floor layout plan

(2) Block diagram of power supply

10.Operation and Maintenance

(1) Organization chart of Central office

(2) Organization chart of Earth station

(3) Organization chart of TV center

(4) Personnel program of the MTA,training plan,employment plan

(5) List of measuring instrument

# APPENDIX 2

## 2-1 Trends of INTERSPUTNIK

Study team analyzed the trends of present and future telecommunication networks via the INTERSPUTNIK satellite, which is the major international telecommunication route in Mongolia. The results of this analysis work showed that the present network has difficulties in expanding its circuit capacity. It was concluded that the network is insufficient for fundamental quality in international telephone calls and lack of reliability and connectivity.

(1) Analysis of the present situation

1) The satellite network provided by the Soviet Union is utilized in a limited area within only 22 socialist countries; therefore, the telephone circuits between these countries are need to pass through the Soviet Union. And, the capacity of the circuits is only about 200 circuits in total with allocation to each country at about 10 circuits except circuit between the Soviet Union and Cuba which has 30 circuits.

This is the reason why terrestrial networks are mostly applied to communications between neighbor countries in Eastern Europe. Furthermore, this satellite network is utilized for much TV relaying, thus it will be mainly utilized as a TV relay taking into consideration further developments of information exchange among these countries.

2) The countries that participated in this satellite system are recently promoting utilization of the INTELSAT satellite networks. It is expected that the few countries not utilizing INTELSAT system may participate in this international satellite organization soon. The present countries not utilizing are as follows: Bulgaria (under planning), Czechoslovakia (under planning), Afghanistan (already participating in the organization), Kampuchea, Laos and Mongolia (under planning).

3) Although Eastern European countries are promoting an active interchange with Western countries, no country has left from INTERSPUTNIK system at this moment. One of the reasons would be that the charges for space segment are set at similar levels as of the INTELSAT, particularly equivalent for TV transmission. However, the situation may change with the progress of combined utilization with INTELSAT system.

4) Table 2-1 shows the countries equipped with the INTERSPUTNIK earth station installed and the utilization of the INTELSAT satellite system:

## Table 2-1 Current Situation of INTERSPUTNIK Earth Station

| Countries | INTERSPUTNIK | INTELSAT |
|---|---|---|
| Democratic and people's Republic of Algeria | Atlantic Ocean | Atlantic & Indian Ocean |
| People's Republic of Bulgaria | 〃 | be planning |
| Czechoslovak Socialist Repubric | Atlantic & Indian Ocean | 〃 |
| Hungarian Pepole's Republic | Atlantic Ocean | 〃 |
| German Democratic Republic | 〃 | Unified with Federal Republic of Germany |
| People's Democratic Republic of Yemen | 〃 | Unified with Yemen Arab Republic |
| Republic of Nicaragua | 〃 | Atlantic Ocean |
| Republic of Cuba | 〃 | 〃 |
| Republic of Iraq | 〃 | Atlantic & Indian Ocean |
| Polish People's Republic | 〃 | Atlantic Ocean |
| Syrian Arab Republic | 〃 | Indian Ocean |
| United states of America | 〃 | Atlantic & Pacific Ocean |
| Union of Soviet Socialist Republic | Atlantic & Indian Ocean | Atlantic & Indian Ocean |
| Republic of Afghanistan | Indian Ocean | Joined member in 1973 |
| Democratic Kampuchea | 〃 | - - - - |
| Peploe's Republic of China | 〃 | Pacific & Indian Ocean |
| Republic of Korea | 〃 | 〃 |
| Lao Peple's Democratic Republic | 〃 | - - - - |
| Mongolian People's Republic | 〃 | be planning |
| Socialist Republic of VietNam | 〃 | Indian Ocean |
| Socialist Republic of Rumania | - - - - - | Atlantic & Indian Ocean |

# APPENDIX 3

# APPENDIX 3

## 3-1 Historical Record of Failure and System Availability of the INTERSPUTNIK Earth Station (1986 - 1990)



| Date | Cause | Duration |
|---|---|---|
| 1986 02 24 | Termination in TV transmitter waveguide of microwave system | 3m 10s |
| 02 25 | --- ditto --- | 33s |
| 04 20 | Failure in telephone channel multiplexer equipment | 1h 00m 00s |
| 07 10 | Failure in sound modulator | 12s |
| 07 24 | Failure in telephone carriers LNA | 2h 30m 00s |
| 09 20 | Failure in TV transmitter power supply | 28s |
| 09 21 | Failure in telephone channel multiplexer equipment | 30m 00s |
| 11 26 | Antenna drive off ( telephony channels ) | 4h 00m 00s |
| | 8 items | 8h 04m 23s |
| | Earth station availability | 99.91% |
| 1987 01 16 | Failure in antenna system for TV transmission | 2h 00m 20s |
| 03 09 | Failure in modulator of TV transmitter of microwave system | 1m 30s |
| 04 16 | Failure in sound of TV transmitter | 1m 30s |
| 06 26 | Failure in telephone channel multiplexer equipment | 8h 00m 00s |
| 07 02 | Failure in telephone carriers LNA | 28h 00m 00s |
| 07 12 | Failure in TV transmitter of microwave system | 1m 30s |
| 09 29 | Failure in waveguide ( telephony channels ) | 17h 00m 00s |
| 10 04 | Failure in telephone channel multiplexer equipment | 4h 30m 00s |
| 10 06 | Failure in power supply | 30s |
| 12 13 | Failure in sound modulator of TV transmitter | 2m 00s |
| | 10 items | 59h 37m 20s |
| | Earth station availability | 99.32% |

| Date | Cause | Duration |
|---|---|---|
| 1988 02 03 | Failure in TV reception | 1m 10s |
| 04 09 | Failure in TV transmitter power supply | 1m 06s |
| 05 19 | Failure in antenna system | 4m 00s |
| 05 19 | --- ditto --- | 1h 45m 00s |
| 10 15 | Failure in telephone channel multiplexer equipment | 2h 00m 00s |
| 12 28 | Failure in telephony transmitter | 2h 00m 00s |
| | 6 items | 5h 51m 16s |
| | Earth station availability | 99.93% |
| 1989 01 12 | Failure in telephone channel multiplexer equipment | 1h 30m 00s |
| 03 24 | Failure in TV transmitter of microwave system | 21m 00s |
| 04 02 | --- ditto --- | 1h 40m 00s |
| 08 09 | Failure in telephone channel multiplexer equipment | 2h 30m 00s |
| 11 10 | Failure in LNA | 1h 30m 00s |
| | 5 items | 7h 31m 00s |
| | Earth station availability | 99.91% |
| 1990 02 04 | Failure in telephone channel multiplexer equipment | 1h 45m 00s |
| 08 14 | Failure in TV transmitter power supply | 5m 00s |
| 08 14 | Failure in power supply | 1h 15m 00s |
| 08 25 | --- ditto --- | 4h 00m 00s |
| | 4 items | 7h 05m 00s |
| | Earth station availability | 99.92% |

## 3-2 Skyline Profile Data of the Earth Station

(1/2)

| Measured Angle | | Calculated Angle | | Measured Angle | | Calculated Angle | |
|---|---|---|---|---|---|---|---|
| Azimuth (D.M.S.) | Elevation (D.M.S.) | Azimuth (Deg.) | Elevation (Deg.) | Azimuth (D.M.S.) | Elevation (D.M.S.) | Azimuth (Deg.) | Elevation (Deg.) |
| 196.16 | 0.38 | 79.5 | 0.6 | 290.51 | 1.30 | 174.1 | 1.5 |
| 196.16 | 1.15 | 79.5 | 1.3 | 299.38 | 0.32 | 182.9 | 0.5 |
| 197.10 | 0.38 | 80.4 | 0.6 | 301.18 | 0.33 | 184.5 | 0.6 |
| 202.30 | 0.33 | 85.7 | 0.6 | 306.37 | 0.17 | 189.9 | 0.3 |
| 210.18 | 0.45 | 93.5 | 0.8 | 311.24 | 0.50 | 194.6 | 0.8 |
| 216.20 | 0.37 | 99.6 | 0.6 | 327.25 | 0.10 | 210.7 | 0.2 |
| 218.10 | 1.05 | 101.4 | 1.1 | 329.06 | 0.34 | 212.3 | 0.6 |
| 219.30 | 0.46 | 102.7 | 0.8 | 330.33 | 0.40 | 213.8 | 0.7 |
| 230.40 | 1.56 | 113.9 | 1.9 | 335.26 | 0.00 | 218.7 | 0.0 |
| 235.15 | 2.15 | 118.5 | 2.3 | 341.10 | -0.10 | 224.4 | -0.2 |
| 236.47 | 2.30 | 120.0 | 2.5 | 343.35 | -0.10 | 226.8 | -0.2 |
| 243.24 | 3.10 | 126.6 | 3.2 | 348.30 | 1.18 | 231.7 | 1.3 |
| 265.36 | 2.12 | 148.8 | 2.2 | 352.40 | 1.19 | 235.9 | 1.3 |
| 269.38 | 1.30 | 152.9 | 1.5 | 0.00 | 1.30 | 243.2 | 1.5 |
| 272.43 | 1.58 | 156.0 | 2.0 | 10.40 | 0.08 | 253.9 | 0.1 |
| 275.37 | 1.24 | 158.9 | 1.4 | 18.30 | 1.00 | 261.7 | 1.0 |
| 277.19 | 1.40 | 160.6 | 1.7 | 29.38 | 1.08 | 272.9 | 1.1 |
| 280.29 | 1.20 | 163.7 | 1.3 | 34.40 | 1.31 | 277.9 | 1.5 |
| 284.20 | 1.31 | 167.6 | 1.5 | 40.00 | 1.59 | 283.2 | 2.0 |
| 288.27 | 1.25 | 171.7 | 1.4 | 42.21 | 2.11 | 285.6 | 2.2 |

Correction formula from Measured Azimuth to Calculated Azimuth :

Calculated Azimuth = Deg. ( Measured Azimuth ) − 116.76 ( Measured Az : 196.16～352.40 )

Calculated Azimuth = Deg. ( Measured Azimuth ) + 243.23 ( Measured Az : 0.00～ 42.21 )

| Measured Angle | | Calculated Angle | | Measured Angle | | Calculated Angle | |
|---|---|---|---|---|---|---|---|
| Azimuth (D.M.S.) | Elevation (D.M.S.) | Azimuth (Deg.) | Elevation (Deg.) | Azimuth (D.M.S.) | Elevation (D.M.S.) | Azimuth (Deg.) | Elevation (Deg.) |
| 45.22 | 2.15 | 288.6 | 2.3 | 69.30 | 3.02 | 358.1 | 3.0 |
| 47.22 | 2.32 | 290.6 | 2.5 | 72.27 | 2.26 | 0.9 | 2.4 |
| 50.10 | 1.47 | 293.4 | 1.8 | 73.47 | 2.56 | 2.4 | 2.9 |
| 51.42 | 2.00 | 294.9 | 2.0 | 75.30 | 3.02 | 4.1 | 3.0 |
| 60.25 | 1.21 | 303.7 | 1.4 | 75.30 | 2.44 | 4.1 | 2.7 |
| 65.22 | 1.42 | 308.6 | 1.7 | 78.14 | 3.16 | 6.8 | 3.3 |
| 23.30 | 1.26 | 312.1 | 1.4 | 79.19 | 3.16 | 7.9 | 3.3 |
| 27.59 | 1.50 | 316.6 | 1.8 | 86.43 | 2.27 | 15.3 | 2.5 |
| 30.40 | 1.25 | 319.3 | 1.4 | 98.58 | 2.11 | 27.6 | 2.2 |
| 32.40 | 1.35 | 321.3 | 1.6 | 102.02 | 2.49 | 30.6 | 2.8 |
| 35.30 | 1.22 | 324.1 | 1.4 | 109.43 | 2.07 | 38.3 | 2.1 |
| 39.25 | 1.40 | 328.0 | 1.7 | 111.41 | 2.26 | 40.3 | 2.4 |
| 43.08 | 1.30 | 331.7 | 1.5 | 114.58 | 2.27 | 43.6 | 2.5 |
| 44.30 | 1.47 | 333.1 | 1.8 | 127.48 | 1.15 | 56.4 | 1.3 |
| 48.26 | 1.24 | 337.0 | 1.4 | 172.27 | 1.18 | 55.7 | 1.3 |
| 55.22 | 2.29 | 344.0 | 1.5 | 175.10 | 1.20 | 58.4 | 1.3 |
| 59.42 | 2.45 | 348.3 | 2.8 | 178.07 | 1.00 | 61.4 | 1.0 |
| 61.59 | 3.00 | 288.6 | 3.0 | 181.47 | 1.22 | 65.0 | 1.4 |
| 65.05 | 3.16 | 353.7 | 3.3 | 191.27 | 0.37 | 74.7 | 0.6 |

Correction formula from Measured Azimuth to Calculated Azimuth :

Calculated Azimuth = Deg. ( Measured Azimuth ) + 243.23 ( Measured Az : 45.22～ 65.22 )
Calculated Azimuth = Deg. ( Measured Azimuth ) + 288.60 ( Measured Az : 23.30～ 69.30 )
Calculated Azimuth = Deg. ( Measured Azimuth ) − 71.55 ( Measured Az : 72.27～127.48 )
Calculated Azimuth = Deg. ( Measured Azimuth ) − 116.76 ( Measured Az : 172.27～352.40 )

## 3-3 Study of Radio Interference in Connection with Terrestrial Microwave Transmission Link

The radio interferences between the planned INTELSAT earth station and the existing terrestrial microwave stations in and around Ulan Bator are studied. The results of calculation show that the earth station would be interfered with the terrestrial microwave station. However, the actual measurement at the INTERSPUTNIK earth station showed no evidence of interference. This can be explained by the fact that the actual interferences are reduced by various factors which suppress them while the calculation is assuming the worst conditions.

Since reached interference level shows considerable variation according to environmental conditions, giving care of the existence of interference shall be required when constructing the INTELSAT earth station.

(1) Results of calculation

1) Passive radio interference at earth station

Table 1 shows the calculation results of radio interference by the terrestrial microwave link on the planned earth station. There is a possibility that the earth station is influenced by four frequencies in the 4 GHz band; 3716.5, 3772.5, 3828.5 and 3884.5 MHz which are transmitted from Ar Hustain uul to the TV center in Ulan Bator.

2) Active radio interference at earth station

Table 2 also shows the calculation results of radio interference by the earth station on the terrestrial microwave link. The earth station has been proved to exert no influence on the neighboring terrestrial microwave link.

(2) Measurement at the INTERSPUTNIK earth station

On February 23, 1991 radio interferences from the terrestrial microwave stations were measured at the LNA output of the existing INTERSPUTNIK earth station, and no interference was observed. The reason for this is considered to be that, in the calculation of radio interference, the most unfavorable environmental condition such as diffraction at knife edge is assumed, whereas in the measurement the corresponding interference is weakened due to the round shape of the diffraction point.

(3) Geometrical relationship between the earth station and the terrestrial microwave link

Figure 1 is a two-dimensional diagram of the geometrical relationship. Table 3 gives the distances between the earth station and each of the antennas of the terrestrial microwave stations, together with the angles of direction.

(4) Propagation loss through multiple ridge diffraction

Except for the path between the earth station and the TV center, interference paths take the mountainous propagation. The results of calculated propagation losses by the multiple ridge diffraction are given in Table 4. Figure 2 to Figure 5 are profiles of propagation paths from the earth station to each terrestrial microwave station.

(5) References for radio interference calculation


1) The diagrams of electromagnetic wave propagation, from "A Basic Atlas of Radio-Wave Propagation", published by Corona Co. Ltd. (Japan)

2) The ITU (International Telecommunication Union) Radio Regulations Appendix No. 28

3) The INTELSAT International Coordination Manual IICM-314

4) The INTELSAT Earth Station Standards IESS-308

5) The radiation patterns of terrestrial microwave antenna, Andrew Co., Ltd. (USA)

## Table 1 Calculation Results of Radio Interference

| M/W link interfering with earth station | 4GHz band satellite link parameters | | | | 4GHz band interference link parameters ( Terrestrial microwave link to earth station ) | | | | | | RFI status (OK/NG) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pt Transmit e.i.r.p. (dBW) | Lp Pass loss (dB) | Ge(φ=0°) E/S Ant. Gain (dBi) | Pr Receive Power (dBW) | Pt Transmit Power (dBW) | Gm(θ) *1 M/W Antenna Gain for E/S (dBi) | Lp' Pass loss (dB) | Z Ridge loss (dB) | Ge(φ) E/S Ant. gain for M/W (dBi) | I Interfering Power (dBW) | |
| 1K/2 to TV Center | *2 -5.7 | -196.5 | 55.0 | -147.2 | -3.0 | 37.1 ( 1.0°) | -134.5 | -33.0 | -6.4 (32-25* log34.3) | -139.8 | NG |
| 1K/2 to 2k | | | | | | -32.9 (38.5°) | | | | -209.8 | OK |
| 1K/2 to 3b | | | | | | -50.5 (160.5°) | | | | -227.4 | OK |
| 3K to 2K | | | | | | -38.9 ( 63.0°) | -137.0 | -49.0 | -10.0 (113.5°) | -215.8 | OK |
| 3K to 2X | | | | | | -32.9 ( 36.0°) | | | | -209.8 | OK |
| 3K to 2y | | | | | | -50.5 (125.0°) | | | | -227.4 | OK |
| 3K to 3b | | | | | | -50.5 (152.0°) | | | | -227.4 | OK |
| Maximum permissible interference power level *3 | | | | | I'(dBW) = -171.7dBW | | | | | | |

*1: Typically used sidelobe levels of 7.0m² Horn reflector antenna with gain of 39.2dBi are used.

*2: From INTELSAT International Coordination Mannual-314 page 2 Table 1(a) for 64kbit/s 3/4FEC IDR carrier.

*3: I' = Pr - C/N - P - 10*log N
where, C/N : C/N required for 3/4 FEC IDR carrier demodulation from Intelsat Earth Station Standard-308 page 43 Table-8
P : Contribution of interference to the C/N degradation, and 10% ( -10*log 0.1 ) is assumed.
N : Number or interference path, and 3 paths are assumed.
therefore,
I' = -147.2 - 9.7 - 10 - 4.8
= -171.7dBW

## Table 2 Calculation Results of Radio Interference

| M/W link to be interferred with earth station | 6GHz band terrestrial microwave link parameters | | | | 6GHz band interference link parameters (Earth station to terrestrial microwave link) | | | | | | | RFI status (OK/NG) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pt Transmit e.i.r.p. (dBW) | Lp Pass loss (dB) | Gm(φ=0°) M/W Ant. Gain (dBi) | Pr Receive Power (dBW) | Pt Transmit Power (dBW) | Pt Transmit Power (dBW/4kHz) | Ge(θ) E/S Antenna Gain for M/W (dBi) | Lp' Pass loss (dB) | Z Ridge loss (dB) | Gm(φ) *1 M/W Antenna gain for E/S (dBi) | I Interfering Power (dBW/4kHz) | |
| 3K to TV Center | 10.0 + 45.0 = 55.0 | *2 -167.8 | 45.0 | -67.8 | *3 1.3 | *4 -12.3 | -10 (152.3°) | -128.0 | 0 | -35.0 (173.5°) | -185.3 | OK |
| TV Center to 3k | | | | | | | -10 (113.5°) | -140.3 | 69.3 | -13.2 ( 25°) | -245.1 | OK |
| 2X to 3X | | -141.5 | | -41.5 | | | -10 ( 75.1°) | -139.5 | 58.3 | -15.2 ( 36°) | -235.3 | OK |
| 3X to 2X | | | | | | | -10 (159.4°) | -136.9 | 49.0 | -17.1 ( 52°) | -225.3 | OK |
| Maximum permissible interference power level *5 | | | | | I'(dBW) = -131.0dBW/4kHz | | | | | | | |

*1: Typically used sidelobe levels of 7.0m² Horn reflector antenna with gain of 39.2dBi are used.

*2:

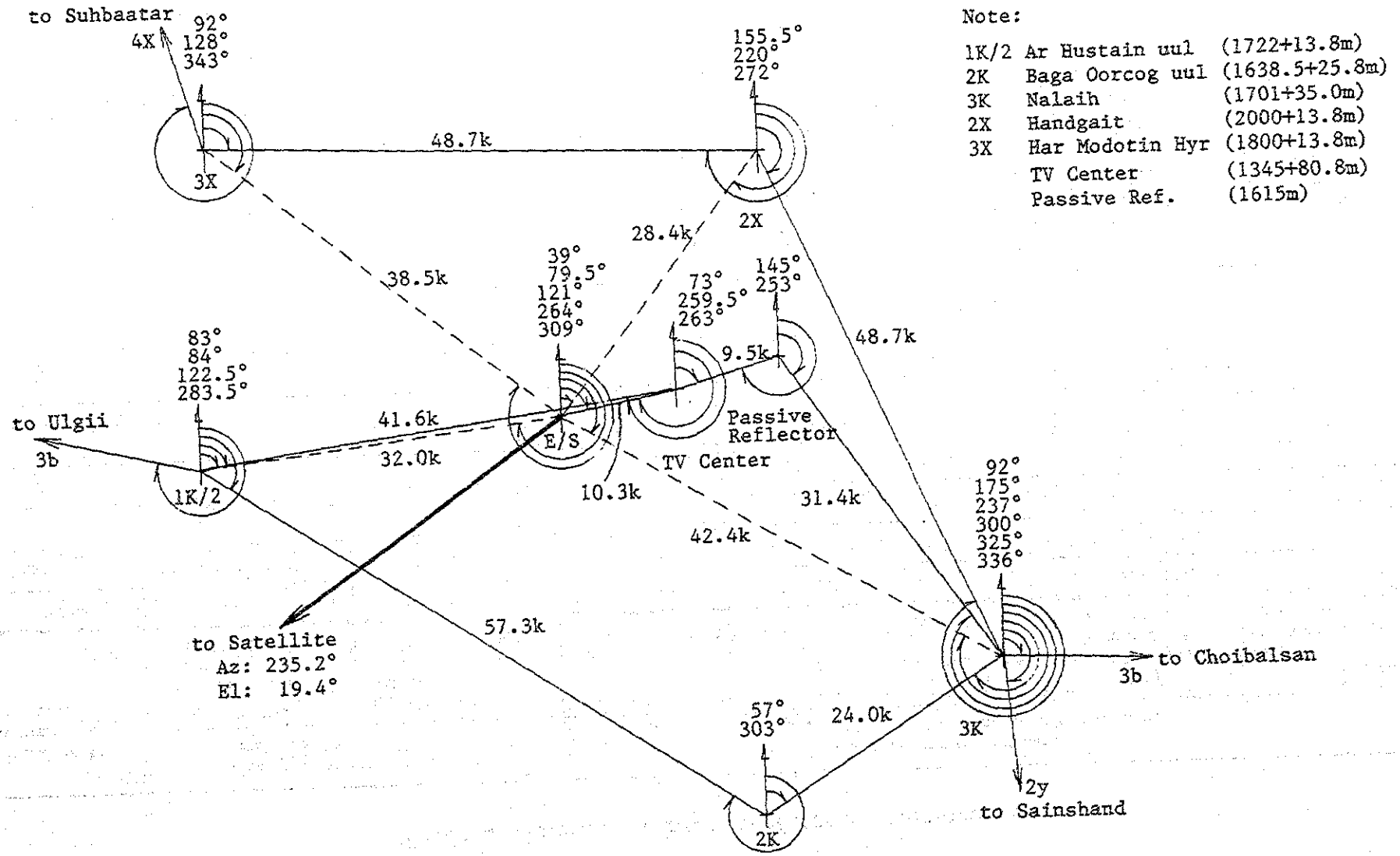
| Br Area of plane reflector(sqm.) | φ Angle of incidence ( °) | Bj Project area (sqm.) | η Plane area efficiency (dB) | εr Performance efficiency (dB) | Gb Actual area gain (dB) | Gref Reflector gain (dB) | Γd Loss of 1st path (dB) | Γr Loss of 2nd path (dB) | Γe Equivalent propagatoin loss (dB) |
|---|---|---|---|---|---|---|---|---|---|
| 50 | 54 | 29.4 | 0.8(typical value) | 6.8 | 104 | 97.2 | - 127.3 | - 137.7 | - 167.8 |

Reference: The above calculation was based on "A Basic Atlas of Radio-wave Propagation" by Shigekazu Shibuya

*3: From INTELSAT Earth Station Standards-308 page 30 Table-1(a), e.i.r.p. for IS-VI Global beam, Low gain mode, Standard-B receiving station, 64kbit/s 3/4 FEC IDR carrier is 59.4dBW. Typical transmit antenna gain of Standard-A earth station is 58.1dBi. Therefore Pt = 1.3dBW.

*4: From INTELSAT Earth Station Standards-308 page 43 Table-8, Occupied BW of 64kbit/s 3/4 FEC IDR carrier is 51.2kHz.

*5: From ITU Radio regulation Appendix 28 page 17 Table-1




Note:

| | | |
|---|---|---|
| 1K/2 | Ar Hustain uul | (1722+13.8m) |
| 2K | Baga Oorcog uul | (1638.5+25.8m) |
| 3K | Nalaih | (1701+35.0m) |
| 2X | Handgait | (2000+13.8m) |
| 3X | Har Modotin Hyr | (1800+13.8m) |
| | TV Center | (1345+80.8m) |
| | Passive Ref. | (1615m) |

**Fig. 1 Geometrical Relationship between the Earth Station and Terrestrial Microwave Link**

## Table 3 Geometrical Relationship between the Earth Station and Microwave Stations

(1/2)

| M/W link interfering with earth station | Distance (km) | | Plane angle ( °) | | Solid angle ( °) |
|---|---|---|---|---|---|
| | M/W to M/W | E/S to M/W | M/W to E/S | E/S to M/W | E/S to M/W |
| 1K/2 to TV Center | 41.6 | 32.0 | 1 (84-83) | 28.8 (264-235.2) | 34.3 |
| 1K/2 to 2K | 57.3 | | 38.5 (122.5-83) | | |
| 1K/2 to 3b | 39.5 | | 160.5 (84-238.5+360) | | |
| 3K to 2K | 24.0 | 42.4 | 63 (300-237) | 114.2 (235.2-121) | 113.5 |
| 3K to 2X | 48.7 | | 36 (336-300) | | |
| 3K to 2y | 14.0 | | 125 (300-175) | | |
| 3K to 3b | 28.8 | | 152 (92-300+360) | | |

(2/2)

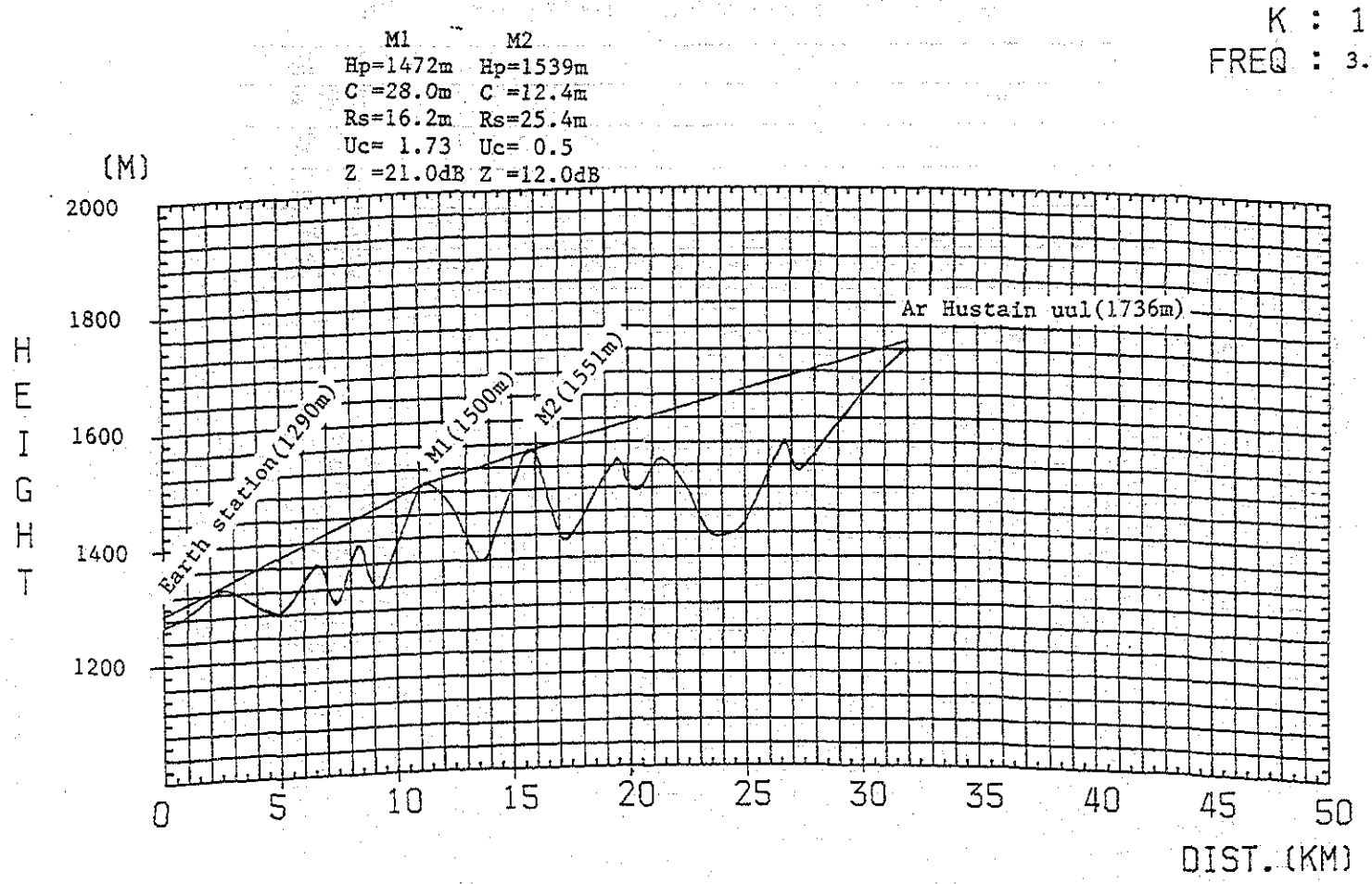
| M/W link to be interferred with earth station | Distance (km) | | Plane angle ( °) | | Solid angle ( °) |
|---|---|---|---|---|---|
| | M/W to M/W | E/S to M/W | M/W to E/S | E/S to M/W | E/S to M/W |
| 3K to TV Center | 9.5+31.4 | 10.3 | 173.5 (73-259.5+360) | 155.7 (235.2-79.5) | 152.3 |
| TV Center to 3K | 9.5+31.4 | 42.4 | 25 (325-300) | 114.2 (235.2-121) | 113.5 |
| 2X to 3X | 48.7 | 38.5 | 36 (128-92) | 73.8 (309-235.2) | 75.1 |
| 3X to 2X | 48.7 | 28.4 | 52 (272-220) | 163.8 (39-235.2+360) | 159.4 |

C.F. Solid angle $\fallingdotseq \cos^{-1}$ ( Cos(Plane angle) * Cos(Elevation angle) ) , Elevation angle : 19.4 °

## Table 4 Calculation of Multi-Ridge Diffraction Loss

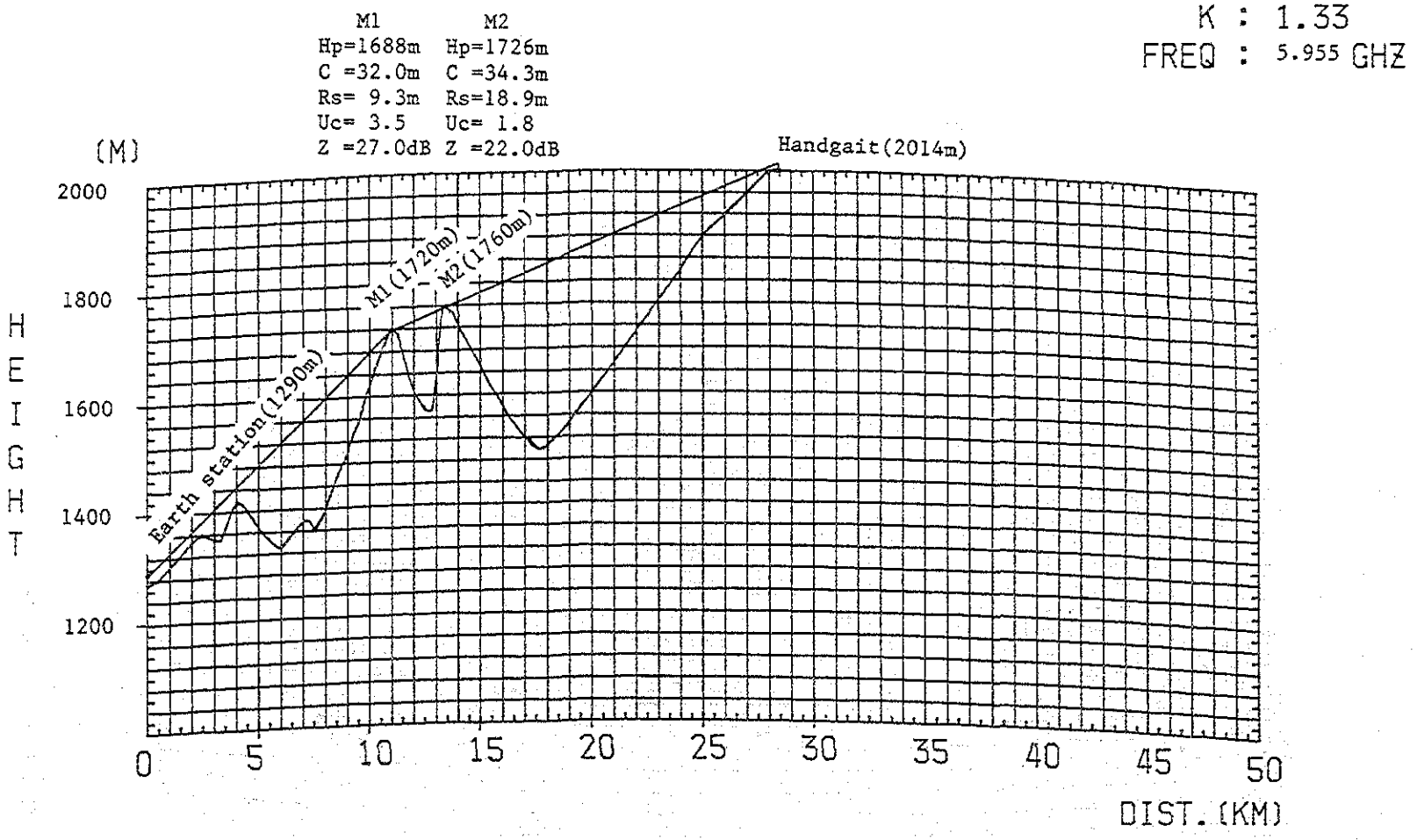
| Name of M/W site | A Height of E/S (m) | A1 Height of imaginary Ant. (m) | hn Height of next ridge (m) | B Height of M/W (m) | hm Height of ridge (m) | D Range (km) | d1 Distance of ridge point (km) | d2 Distance (D-d1) (km) | hp Height of imaginary pass (m) | Cs Depth of ridge (m) | F Freq. (GHz) | rs 1st Fresnel zone radius (m) | Uc Diffraction parameter (Cs/rs) | Z Diffraction loss (dB) | Zt Total diffraction loss (dB) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ar Hustain uul (1K/2) | 1290 (1275+15) | --- | 1551 | 1736 (1722+13.8) | 1500 | 15.8 | 11.2 | 4.6 | 1472 | 28.0 | 3.7165 | 16.2 | 1.73 | 21.0 | 33.0 |
| | | 1376 | --- | | 1551 | 32.0 | 15.8 | 16.2 | 1539 | 12.4 | | 25.4 | 0.5 | 12.0 | |
| Handgait (2X) | | --- | 1760 | 2814 (2000+13.8) | 1720 | 13.3 | 11.3 | 2.0 | 1688 | 32.0 | 5.955 | 9.3 | 3.5 | 27.0 | 49.0 |
| | | 1494 | --- | | 1760 | 28.4 | 13.3 | 15.1 | 1726 | 34.3 | | 18.9 | 1.8 | 22.0 | |
| Har Modotin Hyr (3X) | | --- | 1640 | 1814 (1800+13.8) | 1490 | 12.4 | 6.0 | 6.4 | 1457 | 32.9 | 5.857 | 12.6 | 2.6 | 24.3 | 58.3 |
| | | 1349 | --- | | 1640 | 38.5 | 12.4 | 26.1 | 1477 | 163.0 | | 20.5 | 7.9 | 34.0 | |
| Nalaih (3K) | | --- | 2220 | 1736 (1701+35.0) | 1820 | 21.8 | 11.0 | 10.8 | 1752 | 67.7 | 3.7165 | 21.0 | 3.2 | 26.3 | 69.3 |
| | | 1413 | --- | | 2220 | 42.4 | 21.8 | 20.6 | 1553 | 667.0 | | 29.2 | 22.8 | 43.0 | |
| | | --- | 2220 | | 1820 | 21.8 | 11.0 | 10.8 | 1752 | 67.7 | 5.857 | 16.7 | 4.1 | 28.0 | 73.0 |
| | | 1413 | --- | | 2220 | 42.4 | 21.8 | 20.6 | 1553 | 667.0 | | 23.3 | 28.7 | 45.0 | |

Reference: The above calculation was based on "A Basic Atlas of Radio-wave Propagation" by Shigekazu Shibuya



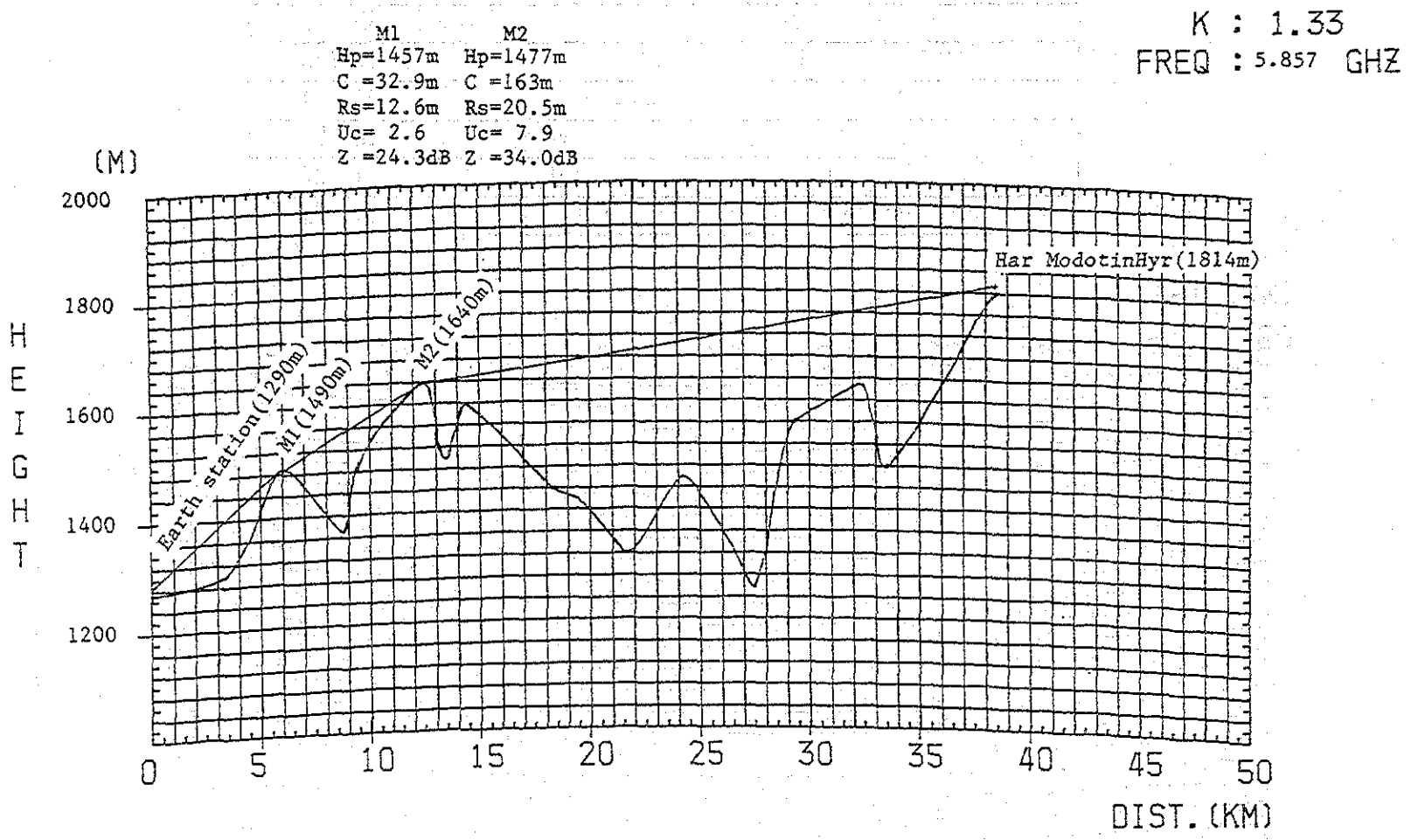

| 局　名 | Earth station | Ar Hustain uul(1K/2) |
|---|---|---|
| 東　経 | E ° ′ ″ | E ° ′ ″ |
| 北　緯 | N ° ′ ″ | N ° ′ ″ |
| 地上高　（M） | 1275 | 1722 |
| 鉄塔高　（M） | 15 | 13.8 |
| 距　離　（KM） | 32.0 | |

**Fig. 2　Propagation Profile (E/S - Ar Hustain uul)**



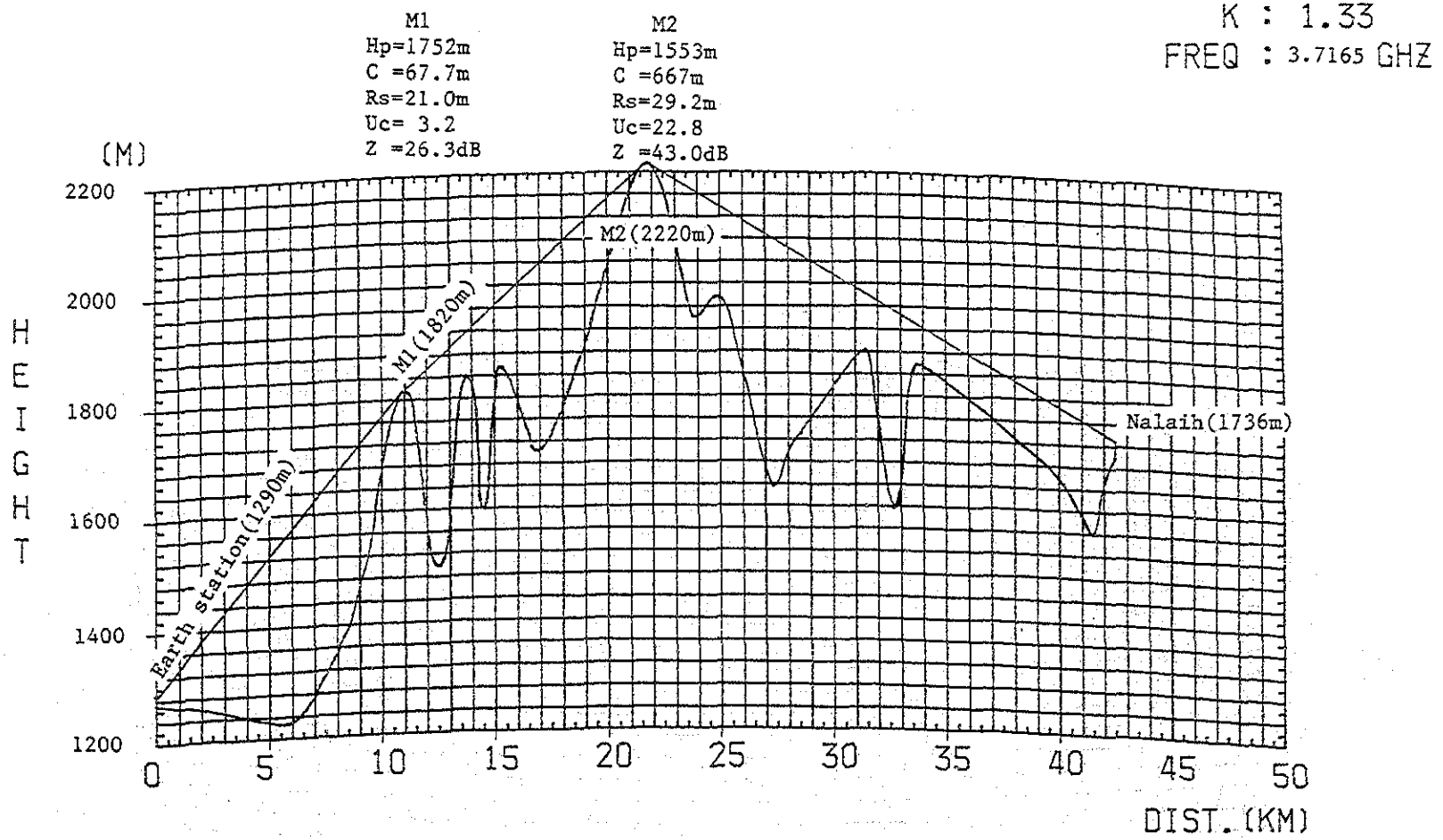

| 局　名 | Earth station | Handgait (2X) |
|---|---|---|
| 東　経 | E ° ′ ″ | E ° ′ ″ |
| 北　緯 | N ° ′ ″ | N ° ′ ″ |
| 地上高　(M) | 1275 | 2000 |
| 鉄塔高　(M) | 15 | 13.8 |
| 距　離　(KM) | 28.4 | |

**Fig. 3　Propagation Profile (E/S - Handgait)**




| 局　名 | Earth station | Har Modotin Hyr(3X) |
|---|---|---|
| 東　経 | E ° ′ ″ | E ° ′ ″ |
| 北　緯 | N ° ′ ″ | N ° ′ ″ |
| 地上高　(M) | 1275 | 1800 |
| 鉄塔高　(M) | 15 | 13.8 |
| 距　離　(KM) | 38.5 | |

**Fig. 4　Propagation Profile (E/S - Har Modotin Hyr)**




| 局　名 | Earth station | Nalaih (3K) |
|---|---|---|
| 東　経 | E ° ′ ″ | E ° ′ ″ |
| 北　緯 | N ° ′ ″ | N ° ′ ″ |
| 地上高　（M） | 1275 | 1701 |
| 鉄塔高　（M） | 15 | 35.0 |
| 距　離　（KM） | 42.4 | |

**Fig. 5　Propagation Profile (E/S - Nalaih)**