CHAPTER 3
OUTLINE OF THE PROJECT

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3-1 Purpose of the Project

In order to improve the current situation of telecommunications services in the Mongolian People's Republic, the Project covers the rearrangement and expansion of their international telecommunications network and its related facilities,mainly for the construction of a new satellite earth station and telephone exchange.

To attain this goal, this Report indicates the results of the investigations and discussions with the people in charge in Mongolia, with regard to the backgrounds in various fields such as the National Projects, recent situation of the country and its economy as well as related telecommunications facilities.

3-2 Results of the Studies for the Request

3-2-1 Feasibility of the Request

The request from the Mongolian People's Republic, the plan to rearrange and expand their international telecommunications network via the INTELSAT satellite mainly by the construction of a new satellite earth station and international telephone exchange is considered appropriate by the following reasons.

(1) With its political reforms, the country is aiming to construct a wealthy nation by introducing the market economy through aggressive approaches to Western countries. It is considered to be an indispensable condition that the Project will secure its international telecommunications to attain smooth operations in political and economic developments.

(2) Present international telecommunications has trouble in the connectivity and quality as well as in its capacity because of the recent rapidly increasing demands.

1) Telecommunications demands (Improvements of telecommunications services will also be an indispensable factor to proceed with the followings.)

a) The country has valuable sightseeing spots. Considerable numbers of tourists are expected.

b) The country wishes to expand its foreign trade with Western counties. There are a lot of mining, meat and fur resources, and the world's largest cashmere plant is in the country.

c) Communications with the International Organizations do not work smoothly. (Urgent connections will be available when the international telephone and facsimile services are improved.)

d) Considerable numbers of diplomatic and human exchanges are expected, for example, those working and studying abroad, residing workers, businessmen abroad, and others.

e) Due to the insufficient services of the current telecommunications media, an extremely high percentage of people tends to give up their communications. Therefore, higher potential demands in this area are expected.

f) The domestic demand for telephone facilities is actively expanding. With the progress of the project to rearrange domestic telecommunications, the waiting list of subscribers will be reduced. It will influence on the demand increase in international telecommunications.

g) Because of "Glasnost", a demand increase in TV transmission is forecasted.

2) The current situation of the international telecommunications (inconvenient cases)

a) Stand-by time to connect Western countries normally takes several hours and it is impossible to connect with some countries.

b) Telephones are unavailable to connect automatically.

c) Due to the poor quality of transmission, it is difficult to continue conversation over phone even when it is successfully connected.

d) It is extremely difficult to use facsimile machines.

e) It is hard to obtain any requested TV programs produced in the Western countries.

(3) The promotion of the Project will contribute to the establishment of fundamental conditions of the country's telecommunication policy and its efficient operation. The MTA has experience in satellite communications; therefore, with appropriate technology transfer, the MTA will be fully available to independently

operate and maintain the future facilities. The required personnel will be minimal and there will be no problems in finance of the MTA.

(4) The priority of the Project is suitable judging from the nation's projects for rearranging telecommunications facilities.
As a new domestic use telephone exchange will be installed prior to this Project at the capital city of Ulan Bator, in which major international telephone users are living, it will be ready to offer high quality International Subscriber Dialing services.

(5) The existing international network via the INTERSPUTNIK satellite is basically inadequate in the fundamental functions of connections, quality, capacity, and so on. Therefore, this network will not meet the future traffic demands only by renovating the existing facilities.

3-2-2 International Telephone Demand Forecast

This long-range traffic forecast is aiming to figure out the appropriate scale of the telecommunications facilities for the country for maintaining such fundamentals in the telecommunications services.

The procedure of the forecast starts off from an investigation into the present situation of international telecommunications services and future trends of the political and economic movements in the country. Then, analysis begin on the data obtained from the investigation. By setting the assumptions on the services, the final result of demand is evaluated by changing the factors in the assumptions. The forecast considers the demands for international telephone in the duration of 15 years after the new earth station puts into commercial use.

(1) The present situation and future trends in telecommunications demand

The country presently has little traffic which is concentrated in with the Soviet Union, in poor quality, particularly with stand-by time of several hours for connection. This is caused by the present network of the INTERSPUTNIK system which provides a very limited capacity and connectivity. Furthermore, the Russian language, officially used in international calls, is understood only by a limited people in the country.

However, under the influence of the "Perestroika" since 1988, the country has started to step forward to carry out political reforms and built up a wealthy nation's economy by promoting the aggressive contacts and expansion of trade with Western countries.

It is supposed that these activities will yield a lot of communications and expanded economic contacts with advanced Western nations. And eventually, this will spread to wider demand increases in international telecommunications services by marching foreign companies, accelerating industrialization, strengthening the linkage with the world economy, increasing residents from abroad, and so on. In addition to these factors, after its decision to introduce the "Glasnost," the country has been trying to promote the spread of the English language, because the government has realized English as a major international language needed for the purpose of promoting information gathering from all over the world. Such a language problem, therefore, will be solved soon.

(2) Fundamental data regarding the traffic demands in telecommunications

The forecast is made by the analysis on the data of outlook of the country together with Tables 3-2-1 through 3-2-4, which are the official statistics of the country's economy. The results are summarized as follows:

1) In these five years, the percentages of increases in international telephone calls were in the range between 0.4 to 37%, compared with the preceding year. Its average annual increase was 14%.

2) GNP increases from the previous year were within minus 1.3% to 7.9% in these five years, and the average was approximately 4.1%.

3) Registered subscribers of telephones reaches about 62 thousands. And the number of telephone sets per 100 inhabitants comes to 3.2 and it is constantly increasing at 6-7% annually. An extremely high potential subscribers of approximately 150 thousands wish to install telephones.

4) In these latest six years, the average percentages of increases in telecommunications annual income indicated approximately 4.4%.

5) Taking into consideration of the peculiarity of its small population, weather condition, transportation and distribution, there will be a restricted factor that the country will not repeat similar traffic patterns of the intensified information society in advanced countries.

Table 3-2-1 Paid Minutes of International Telephone and Telex

Source: MTA Unit: 10^3 minutes
Figures in brackets show increases from the year before in percentages.

Fiscal Year	1986	1987	1988	1989	1990
International telephone	1,321 (–)	1,497 (13.3)	1,503 (0.4)	2,057 (36.9)	2,176 (5.8)
International telex	240 (–)	231 (–3.7)	290 (25.5)	289 (–0.3)	335 (15.9)

Table 3-2-2 Registered Number of Telephone Subscribers

Source: MTA
Figures in brackets show increases from the year before in percentages.

Fiscal year	1985	1986	1987	1988	1989
Number of telephone subscribers	49,323 (5.7)	51,861 (5.1)	54,979 (6.0)	58,298 (6.0)	62,589 (7.4)

Table 3-2-3 Gross National Product per Population

Source: MTI Unit: Million Tugriks or thousand inhabitants
Figures in brackets show increases from the year before in percentages.

Fiscal Year	1984	1985	1986	1987	1988	1989
GNP	7,827 (–)	8,155 (4.2)	8,052(–1.3)	8,350 (3.7)	9,013 (7.9)	9,544 (5.8)
Population	1,774 (–)	1,823 (4.5)	1,872 (2.7)	1,920 (2.6)	1,967 (2.4)	2,049 (4.1)

Table 3-2-4 National Revenue by Industry Categories

Source: MTI Unit: Million Tugriks
Figures in brackets show increases from the previous year in percentages.

Categories	1984	1985	1986	1987	1988	1989	*Note
Telecommunications	104 (–)	109 (4.8)	104(–4.8)	110 (5.7)	119 (8.1)	129 (8.4)	1.5%
Industry	2,383 (–)	2,493 (4.6)	2,442(–2.1)	2,519 (3.1)	2,639 (4.8)	2,919(10.6)	33.8%
Commerce	2,436 (–)	2,516 (3.3)	1,865(–25.8)	2,036 (9.1)	2,129 (4.6)	2,327 (9.3)	26.9%
Transportation	709 (–)	770(37.1)	740 (6.9)	750 (6.8)	786 (4.8)	774(–0.2)	9.0%
Construction	367 (–)	382 (8.6)	422(15.7)	503(19.1)	567(12.7)	617 (8.8)	7.1%
Agriculture	1,250 (–)	1,237(–1.0)	1,520(22.9)	1,405(–7.6)	1,510 (7.5)	1,722(14.0)	19.9%
Others	127 (–)	127 (0.0)	150(18.1)	152 (1.3)	142(–6.5)	154 (7.0)	1.8%
Total	7,376 (–)	7,634 (3.4)	7,243(–5.1)	7,475 (3.2)	7,892 (5.5)	8,642 (9.5)	100.0%

*Note : Constituent ratio in 1989

(3) Procedures of the forecast

1) Setting the assumptions

The following factors are applied to the forecast.

a) Basic conditions in international telephone services, for example, employment of International Subscriber Dialing, are taking into consideration.

b) A certain effect of economic development by the introduction of the market economy is taken into consideration.

c) For the promotion of national and economic activities, the forecast reflects the understanding that international telecommunication should be indispensable.

2) Calculation method

Forecast is made by the following procedures.

a) Based on the analysis of the assumption and the political and economic trends, the model chart for the traffic demand forecast as shown in Figure 3-2-1 is computed.

b) The following items in relation to the traffic demand forecast and accumulated into the model chart are calculated.

i) A compressed traffic (Potential traffic demand for telecommunications)

A compressed traffic is equivalent to the traffic which is abandoned due to the insufficient existing telecommunication network in spite of users intentions. Therefore, the current carried traffic should be revised upward. Calculation is made by classifying the actual traffic into some categories, then applying the estimated compression factors, which are divided into each category, and accumulating these figures.

Based on the analysis, this figure would be considered between 6% and 25% of the current figure of transmissions. Thus 15% is applied.

ii) Ratio of demand increase in telecommunications

The normal ratio of demand increase, as compared with the previous year, and excluding the factor of political reforms, is

analyzed with fundamental data for the nation, the data of the economic indicators and the Development Plan for telecommunications (i.e., the installation plan for registered telephone subscribers).

The important factor, increase ratio of international telephone calls, as the annual average figure is 14%. However, since it fluctuated widely during the initial stage, another factor of the GNP indicator of 4% is also taken into consideration.

Based on these factors, the ratio of traffic demand increase from the previous year as 12% for the period from 1990 to 1999, and 8% for 2000 onward are calculated.

iii) Telecommunication demand created by the new economic policy (effects of political reforms)

The calculation for the effects of political reforms is firstly made by estimating the increase ratio based on the actual data categorized by the industry. Then, these figures are accumulated into each category, applied to the increase ratio of total telecommunications volume, and fixed as the estimation curve of the growth. Since the maturity period for political reforms is estimated at 8 to 12 years, 10 years is applied in the calculation.

Consequently, the increased amount of the telephone traffic created by new economy is calculated as follows:

Increase in percentage from the previous year.	'91	'92	'93	'94	'95	'96	'97	'98	'99	2000
	5%	10%	15%	20%	15%	10%	5%	5%	2%	2%

iv) Traffic volume for each destination

In order to obtain the traffic volume for each destination, the occupancy ratios are calculated by comparing major factors of the telecommunications in the area of commerce, industry, services, and foreign residents on each country. Then, these figures are reflected to the traffic forecast.

Actually, ten factors concerning the origin of the telecommunication, commerce and industry, agriculture and farming, resources, sightseeing, presence of embassy, international

developing aid, information exchange, resident foreigner and others are taking into consideration.

c) The results of the above calculations are accumulated in the model chart.

d) The calculation method specified in the CCITT E-500 series is applied to obtain necessary numbers of international circuits from the demand forecast for international telephone calls in annual paid minutes value, as per the above c.

In the calculation formula, 0.045 is applied for factor d (day to month ratio), judging from the average working days in the country, and 0.1 for h (busy hour to day ratio), from its geographic location, and the standard 0.7 for e (efficiency factor).

For the factor of loss probability, the factor defining connection quality to the users, 0.1 is applied, judging from the connectivity with the domestic network.

Calculation formula

$$A = M \cdot d \cdot h / 60 \cdot e$$

A (estimated mean traffic in the busy hours)	
M (monthly paid minutes)	
d (day to month ratio)	0.045
h (busy hour to day ratio)	0.1
e (efficiency factor)	0.7
the loss probability	0.1 (for formula of erlang B)

From this calculation, A (estimated mean traffic in the busy hours) is fixed as $M \times 0.10714 \times 10^3$.

(4) Calculation results of the forecast

Table 3-2-5 shows the result of the forecast for international telephone traffic demand from 1991 to 2008.

The table shows the total number of circuits including the necessary number of circuits in the Soviet Union and China. The figures in parentheses, from 1997 onward, judging from the installation timing, show the number of direct circuits in which more than 6 circuits are expected.

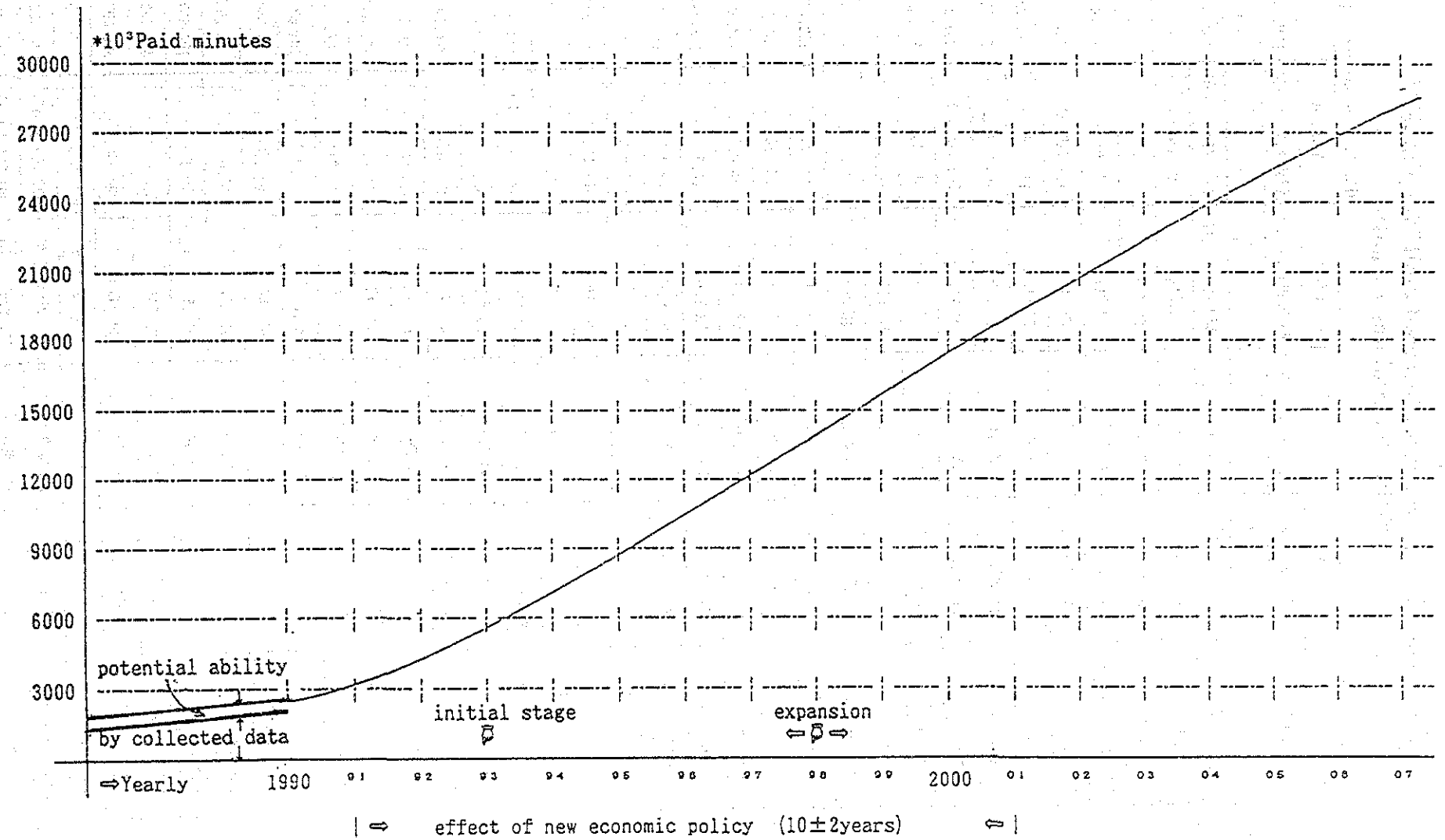


Fig. 3-2-1 Forecast of International Telephone Traffic Demand (Total paid minutes)

Table 3-2-5 (1/4) Forecast of International Telephone Traffic Demand and Circuits

Unit: 10^3 Paid minutes ( ): Circuits

Year		1991	1992	1993	1994	1995
Total Demand (Circuits)		3102.099 (30)	3783.780 (36)	4815.403 (54)	6350.676 (68)	8049.000 (83)
Destination	Country					
U S S R	U S S R	2287.062	2298.240	2352.490 (24)	2370.412 (24)	2390.553 (24)
U.K.	Poland	18.594	34.020	57.612	95.070	128.784
	Bulgaria	18.594	37.800	62.413	95.070	136.833
	Czechoslovakia	24.792	41.580	72.015	114.084	169.029
	Hungary	21.693	41.580	67.214	107.746	152.931
	U . K .	27.891	52.920	86.418	139.436	201.225
	France	30.990	52.920	91.219	145.774	209.274
	Germany	30.990	52.920	91.219	145.774	209.274
	Switzerland	21.693	41.580	67.214	107.746	152.931
	Netherland	15.495	30.240	48.010	76.056	112.686
	Austria	15.495	26.460	48.010	76.056	104.637
	Sweden	18.594	30.240	52.811	82.394	120.735
	Italy	27.891	49.140	81.617	133.098	185.127
	Belgium	15.495	26.460	48.010	76.056	104.637
	Yugoslavia	18.594	34.020	52.811	88.732	128.784
	Rumania	18.594	34.020	52.811	88.732	128.784
	Other Europe	30.990	60.480	96.020	158.450	225.372
	Africa	30.990	56.700	96.020	152.112	217.323
	Total Direct Cct.	0	0	0	0	0
	Total Via U.K	387.375	703.080	1171.444 (13)	1882.385 (20)	2688.366 (27)
Japan	Japan	74.376	132.300	220.846	354.928	507.087
	U S A	68.178	124.740	201.642	329.576	466.842
	Canada	21.693	41.580	67.214	114.084	160.980
	North korea	18.594	37.800	62.413	95.070	136.833
	korea	15.495	26.460	43.209	69.718	96.588
	India	15.495	26.460	48.010	76.056	104.637
	Hongkong	12.396	22.680	38.408	63.380	88.539
	Singapore	12.396	22.680	33.607	57.042	80.490
	Oceania	15.495	26.460	48.010	76.056	104.637
	Other Asia	65.079	120.960	196.841	323.238	458.793
	Other South & North America	46.485	86.940	144.030	234.506	330.009
	Total Direct Cct.	0	0	0	0	0
	Total Via Japan	365.682	669.060	1104.230 (13)	1793.654 (19)	2535.435 (25)
China	China	61.980	113.400	187.239 (4)	304.224 (5)	434.646 (7)

Table 3-2-5 (2/4) Forecast of International Telephone Traffic Demand and Circuits

Unit: 10^3 Paid minutes ( ): Circuits

Year		1996	1997	1998	1999	2000
Total Demand (Circuits)		9810.180 (96)	11512.980 (111)	13429.557 (141)	15355.740 (168)	16957.000 (193)
Destination	Country					
U S S R	U S S R	2415.720 (24)	2435.880 (24)	2460.069 (25)	2559.275 (25)	2561.122 (26)
U.K.	Poland	176.760	206.820	255.417	306.500	337.140 (6)
	Bulgaria	186.580	218.310	268.860	306.500	353.997 (6)
	Czechoslovakia	216.040	264.270	322.632	367.800 (6)	421.425 (7)
	Hungary	196.400	241.290	295.746	337.150 (6)	387.711 (7)
	U . K .	255.320	321.720	389.647	444.425	505.710
	France	265.140	333.210	403.290 (6)	459.750 (7)	522.567 (7)
	Germany	265.140	333.210	403.290 (6)	459.750 (7)	522.567 (7)
	Switzerland	196.400	241.290	295.746	337.150 (6)	387.711 (6)
	Netherland	147.300	183.840	215.088	260.525	286.569
	Austria	137.480	172.350	201.645	245.200	269.712
	Sweden	157.120	195.330	228.531	275.850	303.426
	Italy	245.500	298.740	362.961 (6)	413.775 (6)	471.996 (7)
	Belgium	137.480	172.350	201.645	245.200	269.712
	Yugoslavia	166.940	206.820	241.974	291.175	320.283
	Rumania	166.940	206.820	241.974	291.175	320.283
	Other Europe	294.600	356.190	443.619	505.725	573.138
	Africa	284.780	344.700	430.176	490.400	556.281
	Total Direct Cct.	0	0	1169.541 (18)	2375.375 (38)	3405.084 (53)
	Total Via U.K	3495.920 (32)	4297.260 (40)	4032.900 (38)	3693.325 (35)	3405.144 (33)
Japan	Japan	667.760	815.790	994.782	1149.375	1297.989
	U S A	618.660	758.340	914.124 (11)	1057.425 (12)	1196.847 (14)
	Canada	206.220	252.780	309.189	352.475 (6)	404.568 (6)
	North korea	186.580	218.310	268.860	306.500	353.997 (6)
	korea	127.660	160.860	188.202	229.875	252.855
	India	137.480	172.350	201.645	245.200	269.712
	Hongkong	108.020	137.880	161.316	199.225	219.141
	Singapore	108.020	126.390	147.873	183.900	202.284
	Oceania	137.480	172.350	201.645	245.200	269.712
	Other Asia	599.020	735.360	887.238	1026.775	1163.133
	Other South & North America	432.080	528.540	645.264	750.925	842.850
	Total Direct Cct.	0	0	914.124 (11)	1409.990 (18)	1955.412 (26)
	Total Via Japan	3328.980 (32)	4078.950 (38)	4006.014 (38)	4336.975 (40)	4517.676 (42)
China	China	569.560 (8)	700.890 (9)	846.909 (11)	980.800 (12)	1112.562 (13)

Table 3-2-5 (3/4) Forecast of International Telephone Traffic Demand and Circuits

Unit: 10^3 Paid minutes ( ): Circuits

Year		2001	2002	2003	2004	2005
Total Demand (Circuits)		18205.000 (212)	19662.000 (225)	21233.996 (253)	22933.000 (273)	24686.000 (291)
Destination	Country					
U S S R	U S S R	2657.930 (26)	2870.652 (28)	3100.164 (30)	3348.218 (32)	3618.756 (34)
U.K.	Poland	364.100 (6)	393.240 (6)	424.680 (7)	458.660 (7)	495.720 (7)
	Bulgaria	382.305 (6)	412.902 (6)	445.914 (7)	481.593 (7)	520.506 (7)
	Czechoslovakia	455.125 (7)	491.550 (7)	530.850 (8)	573.325 (8)	619.650 (8)
	Hungary	418.715 (6)	452.226 (7)	488.382 (7)	527.459 (8)	570.078 (8)
	U . K .	546.150	589.860	637.020	687.990	743.580
	France	564.355 (8)	609.522 (8)	658.254 (9)	710.923 (9)	768.366 (10)
	Germany	564.355 (8)	609.522 (8)	658.254 (9)	710.923 (9)	768.366 (10)
	Switzerland	418.715 (6)	452.226 (7)	488.382 (7)	527.459 (8)	570.078 (8)
	Netherland	309.485	334.254 (6)	360.978 (6)	389.861 (6)	421.362 (7)
	Oceania	291.280	314.592	339.744 (6)	366.928 (6)	396.576 (6)
	Sweden	327.690 (6)	353.916 (6)	382.212 (6)	412.794 (6)	446.148 (7)
	Italy	509.740 (7)	550.536 (8)	594.552 (8)	642.124 (9)	694.008 (9)
	Belgium	291.280	314.592	339.744 (6)	366.928 (6)	396.576 (6)
	Yugoslavia	345.895 (6)	373.578 (6)	403.446 (6)	435.727 (7)	470.934 (7)
	Rumania	345.895 (6)	373.578 (6)	403.446 (6)	435.727 (7)	470.934 (7)
	Other Europe	618.970	668.508	721.956	779.722	842.724
	Africa	600.765	648.846	700.722	756.789	817.938
	Total Direct Cct.	4696.890 (72)	5540.705 (81)	6518.834 (98)	7040.431 (103)	7609.302 (107)
	Total Via U.K.	2657.930 (27)	2536.398 (25)	2059.698 (21)	2224.501 (23)	2404.242 (24)
Japan	Japan	1401.785	1513.974	1635.018	1765.841	1908.522
	U S A	1292.555 (15)	1396.002 (15)	1507.614 (16)	1628.243 (18)	1759.806 (20)
	Canada	436.920 (7)	471.868 (7)	509.616 (7)	550.392 (8)	594.864 (8)
	North korea	382.305 (6)	412.902 (6)	445.914 (7)	481.593 (7)	520.506 (8)
	korea	273.075	294.930	318.510	343.995 (6)	371.790 (7)
	India	291.280	314.592	339.744 (6)	366.928 (6)	396.576 (6)
	Hongkong	236.665	255.606	276.042	298.129	322.218 (6)
	Singapore	218.460	235.944	254.808	275.196	297.432
	Oceania	291.280	314.592	339.744 (6)	366.928 (6)	396.576 (6)
	Other Asia	1256.145	1356.678	1465.146	1582.377	1710.234
	Other South & North America	910.250	983.100	1061.700	1146.650	1239.300
	Total Direct Cct.	2111.780 (28)	2280.792 (28)	3142.632 (42)	3738.079 (51)	4262.336 (61)
	Total Via Japan	4878.940 (45)	5269.416 (48)	5011.224 (46)	5068.193 (47)	5155.488 (47)
China	China	1201.530 (14)	1297.692 (15)	1401.444 (16)	1513.578 (17)	1635.876 (18)

Table 3-2-5 (4/4) Forecast of International Telephone Traffic Demand and Circuits

Unit: 10^3 Paid minutes ( ): Circuits

Year		2006	2007	2008
Total Demand (Circuits)		26749.000 (309)	28889.000 (328)	31201.000 (348)
Destination	Country			
U S S R	U S S R	3905.354 (37)	4217.794 (39)	4555.346 (42)
U.K.	Poland	534.980 (8)	577.780 (8)	624.020 (8)
	Bulgaria	561.729 (8)	606.669 (8)	655.221 (9)
	Czechoslovakia	668.725 (9)	722.225 (9)	780.025 (10)
	Hungary	615.227 (8)	664.447 (9)	717.623 (9)
	U . K .	802.470	866.670	936.030
	France	829.219 (10)	895.559 (11)	967.231 (11)
	Germany	829.219 (10)	895.559 (11)	967.231 (12)
	Switzerland	615.227 (8)	664.447 (9)	717.623 (9)
	Netherland	454.733 (7)	491.113 (7)	530.417 (8)
	Austria	427.984 (7)	462.224 (7)	499.216 (7)
	Sweden	481.482 (7)	520.002 (7)	561.618 (8)
	Italy	748.972 (10)	808.892 (10)	873.628 (11)
	Belgium	427.984 (7)	462.224 (7)	499.216 (7)
	Yugoslavia	508.231 (7)	548.891 (8)	592.819 (8)
	Rumania	508.231 (7)	548.891 (8)	592.819 (8)
	Other Europe	909.466	982.226	1060.834
	Africa	882.717	953.337	1029.633
	Total Direct Cct.	8211.943 (113)	8868.923 (119)	9578.707 (125)
	Total Via U.K.	2594.653 (26)	2802.233 (28)	3026.497 (30)
Japan	Japan	2059.673	2224.453	2402.477
	U S A	1899.179 (20)	2051.119 (21)	2215.271 (23)
	Canada	641.976 (9)	693.336 (9)	748.824 (10)
	North korea	561.729 (8)	606.669 (8)	655.221 (9)
	korea	401.235 (6)	433.335 (7)	468.015 (7)
	India	427.984 (7)	462.224 (7)	499.216 (7)
	Hongkong	347.737 (6)	375.557 (6)	405.613 (6)
	Singapore	320.988	346.668 (6)	374.412 (6)
	Australia	427.984 (7)	462.224 (7)	499.216 (7)
	Other Asia	1845.681	1993.341	2152.869
	Other South & North America	1337.450	1444.450	1560.050
	Total Direct Cct.	4707.824 (63)	5431.132 (71)	5865.788 (75)
	Total Via Japan	5563.792 (51)	5662.244 (51)	6116.396 (55)
China	China	1765.434 (19)	1906.674 (20)	2059.266 (21)

3-2-3 Satellite Circuit Plan

(1) Circuit Plan

1) International Telephone Service

a) Initial circuit installation for international telephones is set up with the capacity to meet possible traffic demand increases until 1997, when the next expansion is scheduled, five years after the initial installation.

b) It is considered that the existing communications facilities can be continued to be used in communications to adjacent countries, the Soviet Union and China.

c) Direct circuits are set with the U.K. and Japan as requested by the MTA.

Telephone calls to countries other than the U.S.S.R. and China are connected through either the U.K. or Japan.

Table 3-2-6 shows the initial circuit capacity to U.K. and Japan.

Table 3-2-6 Initial Capacity of International Telephone Circuits (except the U.S.S.R. and China)

Direct circuit	Number of circuit	Country
U.K.	40	Europe, Africa, except U.S.S.R.
Japan	38	Asia, North&South America, Australia, except China

2) International TV Service

Reception of TV 1 ch via the INTELSAT system to be made.

3) International Data Communications

The circuit to be able to transfer to the INTELSAT system is to be considered in order to continue existing service.

(2) Plan for the circuit via satellite system

Table 3-2-7 shows the maximum capacity of each service and the destination in relation to the circuit via satellite.

Table 3-2-7 Plan for the Circuit Via Satellite System

Services	Capacity	Destination	Remarks
Telephone	60ch	Europe, Africa, except U.S.S.R.	IDR
	60ch	Asia, North & South America, Australia, except China	IDR
	Variable rate	Spare	IDR
	5ch	All the Indian Ocean Region	SCPC
TV	1ch	All the Indian Ocean Region	

3-2-4 International Telecommunications System

(1) Facilities for satellite telecommunications system upon request from the Mongolian People's Republic, study team plans an appropriate system taking into consideration of the performance and economic factors regarding telecommunications such as quality and capacity of communication.

Study team worked out several ideas and evaluated them. And a final plan was decided for the idea with highest points.

1) Ideas

The following feasible ideas were evaluated.

Idea 1: Renovating the existing earth station.

Idea 2: Installing a new earth station and utilizing the network via the INTERSPUTNIK satellite system.

Idea 3: Installing a new earth station and utilizing the network via the INTELSAT satellite system.

Idea 4: Constructing a terrestrial network (micro or cable transmission) and connecting all international telecommunications through a third country.

2) Selection of Ideas

After reviewing and evaluating the above four ideas as in Table 3-2-8, Idea 3 of installing a new earth station and utilizing the network via the INTELSAT satellite system was selected.

This decision was made because, compared with others, Idea 3 advantages in its evaluating items, and no particular defects in its overall

evaluation. In other words, Idea 2 will not solve the important factor with regard to connectivity, quality and future capacity; and with Idea 1, it is impossible to satisfy the request as this idea has a lot of pending matters for today as well as tomorrow; and Idea 4 is inferior in the areas of independence and economic factors.

Table 3-2-8 Comparison Chart for Feasibility of Ideas

◎○△× in advantageous order

Comparison items	Idea 1	Idea 2	Idea 3	Idea 4
Connectivity	×	×	◎	△
Communication Quality	×	△	◎	○
Stability	×	△	◎	△
Maintenance	×	○	○	○
Capacity for additional traffic demands	×	△	◎	△
Availability for future networks	×	△	◎	○
Availability for new service	×	×	○	○
Cost of the facility	◎	△	△	×
Cost for its maintenance	×	○	○	△
Rights and interests of telecommunication	○	○	◎	△
Independence of telecommunication sovereignty	○	○	◎	△
Profitability	○	○	◎	×
Overall evaluation	1. The existing pending matters will not be solved. 2. Difficulties in future availability and maintenance.	1. Worse in connectivity and quality of communications. 2. Limited capacity in direct circuits.	Most appropriate.	1. Most important matters are dependent upon a third country. 2. As the relaying route would be long, worse in economic evaluation.
Rank	4	2	1	3

3-2-5 Earth Station Facilities

The new earth station, as requested from the Government of Mongolia, will provide international circuits via the INTELSAT satellite in the Indian Ocean Region.

(1) Satellite to be utilized

The INTELSAT Satellites in the Indian Ocean Region are visible from Mongolia. Therefore, it is planned to utilize the INTELSAT satellite in 60 degree east longitude, which has the best connectivity in this area with foreign countries.

The INTELSAT IV satellite will be launched to this point in the latter half of 1991. Therefore, design of the new earth station facilities and circuits are based on the utilization of INTELSAT VI.

Available frequency band is naturally C band (Transmission 6 GHz/ Receiving 4 GHz) because of its illuminating beam.

(2) Standards of Earth Station

For transmission of international public use telecommunications in C band, the INTELSAT sets forth the standards of earth station classified in 5 grades: old A, new A, B,F and D, by order of facility scale. Table 3-2-9 shows the major specifications of each earth station. Larger the scale of earth station, higher the initial investment. However, the rent to be paid to the INTELSAT comes down which also enable to lower operation cost.

Comparing the new standard A earth station with the standard B earth station, it is clarified that the difference of initial investment is almost the same as that of rent for the satellite within three years. Therefore, new standard A earth station is advantageous if it is employed more than three years. The old standard A station is not appropriate due to higher facility cost. In this plan, new standard A earth station is applied from the above consideration.

Table 3-2-9 Specifications of Standards in Each Earth Station

Items	old A	new A	B	F	D
Earth station G/T at 4 GHz (dB/K)	40.7	35.0	31.7	F-1: 22.7 F-2: 27.0 F-3: 29.0	D-1: 22.7 D-2: 31.7
Typical antenna diameters (meter)	32	16	11	F-1: 4.5 F-2: 6 F-3: 9	D-1: 4 D-2: 11
Available modulation method	· FDM/FM · SCPC · TDMA · FM TV · IDR · IBS	· FDM/FM · SCPC · TDMA · FM TV · IDR · IBS	· CFDM/FM · SCPC · FM TV · IDR · IBS	· IDR · IBS	· SCPC/CFM
Application	Large scale earth station for country gateway	Large scale earth station for country gateway	Medium scale earth station for country gateway	Small scale earth station for business communi-cations	Small scale earth station for rural communi-cation
Circuit capacity	more than 100	more than 100	20-100	less than 50	less than 50

Notes: FDM/FM: Frequency Division Multiplex/Frequency Modulation

CFDM/FM: Companded Frequency Division Multiplex/Frequency Modulation

SCPC: Single Channel per Carrier

TDMA: Time Division Multiple Access

FM TV: Frequency Modulation Television

IDR: Intermediate Data Rate

IBS: INTELSAT Business Services

(3) Modulation method

1) Telephone

It is a world trend that the analog facilities are being replaced with digital ones which have higher quality and reliability and can reduce its facility and operation cost. Taking into consideration of compatibility with foreign countries, IDR (Intermediate Data Rate) system, which is the

digital communication system set forth by the INTELSAT, is applied to the Project. LRE (Low Rate Encoding) units which can increase a channel capacity per one frequency, are also to be installed to reduce the charge for the satellite.

Initial capacity will be two 2 Mbit/s each for Japan and the U.K. And four IDR circuits, which are of small capacity-variable rate type, are to be installed to keep redundancy and for future expansion.

In addition, the SCPC (Single Channel Per Carrier) system with five circuits, which are suitable for establishing small capacity telecommunication circuits, are to be installed.

2) Television

In Mongolia, there is a plan to change the existing television standard from SECAM system to the higher quality PAL system. Therefore, the facilities to be installed in this plan shall be of either type.

Some of international television transmission in the Indian Ocean Region is transmitted by NTSC system transmission as well as PAL or SECAM system. Most countries with the NTSC system have a standard convertor, and it is easy to convert the standard to SECAM or PAL. Therefore, there is no need to install the standard convertor in Mongolia.

(4) Type of Transmit Common Amplifier (HPA) and its Saturation Output Power

As the Transmit Common Amplifier, the TWT (Traveling Wave Tube) amplifier will be used. This amplifier is advantageous in the rearrangements of satellite frequencies conducted by the INTELSAT every several years.

Saturation output power of the transmit common amplifier determines the transmission capacity of the earth station. Since this equipment is placed at a common part of the station, it is impossible to change its output power easily. Thus in this project, a saturation output power of more than 500W is to be selected to meet demand increases for 8 year after its commencement of service (or capacity until the year 2000). If the capacity of HPA runs out by greater traffic increases than expected, it will be replaced by a larger one at the cost of Mongolia.

(5) Spare Parts and Measuring instrument for Maintenance

In order to operate the earth station smoothly, appropriate spare parts and measuring instrument for maintenance as well as tools shall be provided.

3-2-6 International Telephone Switching System

The following three basic plans, as in Table 3-2-10, are reviewed from the points of technical conditions and expenses. These three plans are considered as practical ideas for the target of "rearranging international telephone exchange to meet the demand of international calls". Those ideas are as follows:

- To install a stand-alone-typed electronic exchange which is exclusively used for international calls (INTS).
- To check availability after renovating the existing analog exchange which can be used for both domestic and international calls.
- To install an electronic exchange which can be used for both international and long-distance calls (hereinafter referred to as INTS/TS: International Transit Switch/Toll Switch).

(1) Installation of a stand-alone-typed electronic exchange for exclusive use for international calls.

This exchange is for exclusive use for international calls, handling traffic only for international calls. Another exchange for handling of long-distance calls needs to be installed at the expense of Mongolia. Therefore, Mongolia will have to bear a greater share of the expenses.

The country is now in the course of changes to shift from an analog to a digital network by proceeding its Digital Network Plan for their domestic communications. Therefore, after the domestic digital network is completed, the independent electronic exchange for international calls is to be installed, when traffic for international calls increases in the future.

Thus, at present, it is too early to install the stand-alone-typed electronic exchange for international calls.

(2) To check availability after renovating the existing analog exchange which can be used for both domestic and international calls.

Among the above three ideas, the construction costs of this idea are the lowest but the problems both technical and of services will remain because the exchange is an older step-by-step type. As the exchange is 10 years old, it is extremely difficult to procure facilities and components even if MTA plans to renovate and expand its circuits facility. Furthermore, a signal converter is needed to meet the standard signal system for international telephone calls.

This plan also offers no progress in further functions and services, such as international subscriber dialing calls, and will not keep pace with the country's

promoting to shift their domestic network into a digital type. Therefore, it is not appropriate to utilize the existing exchange in the Project.

(3) Installation of an INTS/TS.

This exchange is equipped with a function for long-distance calls together with a function of the No.5 Signal System which is the standard signal for international calls. Therefore, this exchange is more economically practical in its international call services, particularly for the early stage with relatively few international calls predicted.

Most of the hardware is same as for the exchange for international use with its selection of international and long-distance functions shared by software. Therefore, with the progress of international traffic, it will be possible to change this exchange to international use by replacing the software files. And vice versa, it will be possible to use the exchange for Toll Switch after INTS will be installed by MTA.

The conclusion is that installation of an electronic exchange that can be used for both international and long-distance calls (INTS/TS) is the most appropriate in the Project judging from the present situation of international communications in this country as well as from the scale of the facility, the conditions of applications, and its expenses.

Table 3-2-10 Basic Selection Idea for International Exchange

Evaluation in this plan ○: Appropriate
△: Feasible
×: Not appropriate

	Installation of an INTS	Evaluation	Installation of an INTS/TS	Evaluation	Using the existing analog exchange	Evaluation
1. Traffic handling at the time of service-in of the Earth Station	1) Due to the exclusive use of international calls, only international traffic is t be handled. 2) In order to handle traffic for long-distance calls, another exchange for long-distance calls needs to be installed at the expense of Mongolia.	△	1) Available to handle traffic for both international and long-distance, as the international traffic will be relatively lower in the early stage.	○	1) Expansion of international circuits is needed. However, it is difficult to procure facilities for the circuit.	×
2. Counter-measures to match the interna-tional signaling system (#5)	Possible to meet because of the exclusive use of international calls.	○	Possible to meet provided a facility for international circuit is added, although its main transaction may be for long-distance calls.	○	A signal converter is needed when the No. 5 Signal system is introduced.	△
3. Facility (Hardware/ Software)	1) Considering the international traffic in the early stage, its facility scale is too large. 2) The facilities for operation and maintenance are complete.	△	1) Just by adding a facility with No. 5 to the long-distance facility. Economical. 2) Also economical because of common service in the facilities for operation and maintenance.	○	1) Impossible to meet a capacity increase. 2) A signal converter is needed.	×
4. Additional functions and services	Available to add functions and service with regard to the unique international exchange.	○	Possible to be subject to restrictions when adding functions and services with regard to the unique international exchange.	△	Impossible	×
5. Operation and maintenance	Operation and maintenance to be separated into international and long-distance.	△	Operation and maintenance are mainly for long-distance circuits, partially for international circuits.	○	Operation and maintenance are mainly for long-distance circuits, partially for international circuits.	○
6. Construction cost	Exchange for two stations. (One station is at the expense of Mongolia.)	△	Exchange for one station.	△	Circuit facility and Expansion of signal converter, equivalent to one sixth the cost for an exchange for one station.	○
7. Operation cost	Wages and operation/ maintenance costs are for two stations.	△	Wages and operation/ maintenance costs are for one station.	○	Wages and operation/ maintenance costs are for one station.	○
Overall evaluation	1) Because of exclusive use of international calls, another exchange for long-distance calls needs to be installed, even with this exchange machine. Expense of Mongolia to be increased. 2) It is better to consider installing the facility when the domestic network is to be arranged and international traffic is to be increased.		1) By installing a facility with the function to be able to handle traffic for both international and long-distance call, international service can be offered economically. 2) The hardware is mostly the same as the exchange for the exclusive use of international calls, it is possible to change this exchange into international use by replacing the software.		1) Even with the expansion of the current facility for circuits, it is difficult to procure components because the facility is over 10 years old. 2) A signal converter is needed in order to match the international standard signaling system.	
	△		○		×	

This exchange is a compact system, but is usable both for international and long-distance calls judging from its scale and function, for the purpose of reducing construction costs. However, to meet increased traffic in the future with the progress of social life, this exchange will be able to expand its circuits and introduce new functions/services.

The number of international circuits at the initial stage should be 111 circuits with 21 operator positions, reflecting the projected demand in traffic increase in the next five years after the project start-up. Circuits for national transit calls should be 1000.

International Originating Calls:	Auto and manual
Terminating Calls:	Auto and manual
National Transit Calls :	Auto and manual

The following are the specifications for the basic plan.

(1) To install a digital exchange with the system of stored program control .

(2) To improve reliance of the facility by duplex redundancy configuration or common stand-by system.

(3) To prepare for future expansion of the facilities and new functions, by building block architecture.

(4) To improve operational ability by using intelligent terminals.

(5) To provide a checking function to be able to conduct testing for its maintenance.

(6) To provide a control function for the network in order to utilize international circuits efficiently as well as to provide a function to maintain its circuits.

(7) To prepare software flexible for future expansion of several functions by modulating its programs into function-wise.

(8) To design a facility aiming to enable adding the interface function of CCITT No.7 signaling system and DCME (Digital Circuit Multiplication Equipment).

(9) To receive clock for the network synchronization from the exchange under contemplation by MTA, is available to distribute the clock, with accuracy of clock frequency as 1×10^{-11}, meeting CCITT's Recommendation.

3-2-7 Digital Transmission System

After through the study of the Mongolian request with regard to the digital transmission system of "Construction of digital transmission system for connecting between the Earth Station and the International Telephone Office in Ulan Bator", the idea as follows regarding the construction by connecting from the Earth Station to Ulan Bator International Telephone Office (hereafter called "Central Office") through the TV center should be proposed.

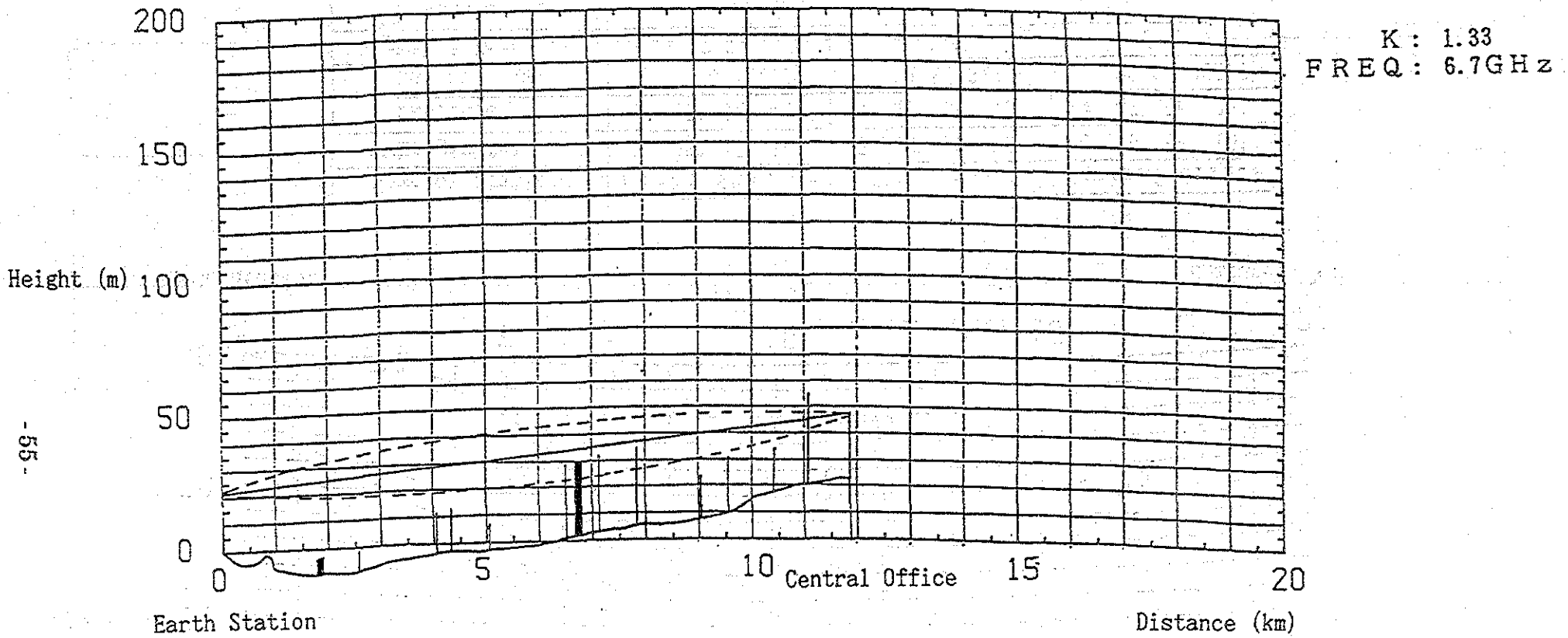
(1) From the studies of the radio path directly between the Earth Station and the Central Office, the clearance for the first Frenel zone cannot be secured by department store and some buildings on the path.

On the other hand, the profiles of the Earth Station - the TV Center and the TV Center - the Central Office, the microwave transmission paths have no problem because of sufficient clearance for the first Frenel zone.

Therefore, the transmission path from the Earth Station to the Central Office is better to take the relaying route through the TV Center.

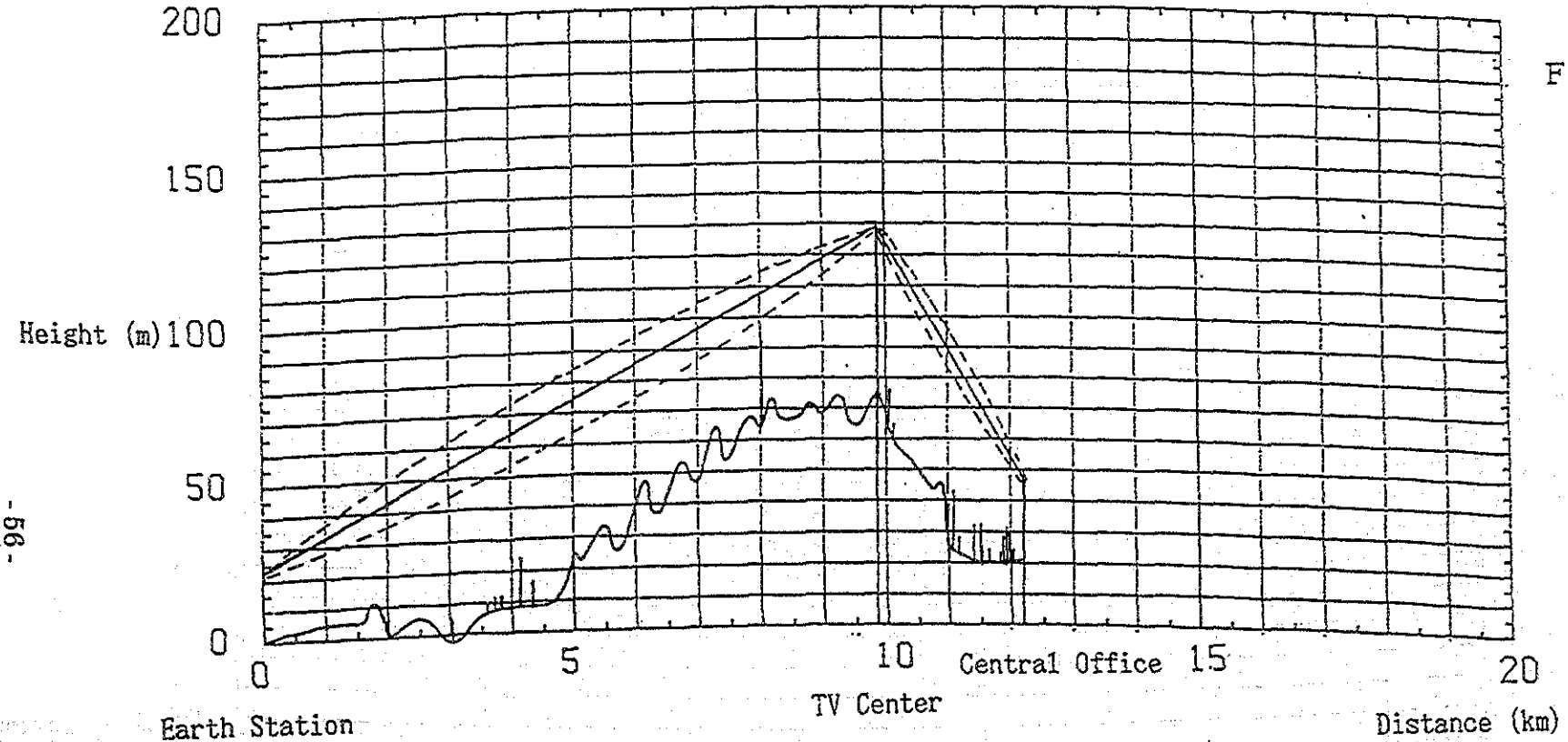
Figure 3-2-2 shows the transmission profile of radio waves between the Earth Station and the Central Office. Also Figure 3-2-3 shows the transmission profiles between the Earth Station and the TV Center as well as the TV Center and the Central Office. A cross section of the transmission path at the point of the department store, which gives interferences to the transmission path, is in Figure 3-2-4.

(2) As the study regarding the possibility of adopting the transmission route via an optical fiber cable system, the country has no underground pipe between the route of the Earth Station - the Central Office and the Earth Station - TV Center, and also no spare underground pipe exists between the TV Center and the Central Office. Therefore, a microwave transmission system is to be applied, as it will not be economical to construct a new underground pipe.



Name of Station	Earth Station	Central Office
Longitude	E 106° 45' 30''	E 106° 56' 10''
Latitude	N 47° 54' 43''	N 47° 55' 25''
Height (m)	0 (1273)	22.2(1259.2)
Height of Tower (m)	22	26
Distance (km)	11.9	

Fig. 3-2-2 Profile between Earth Station and Central Office



Name of Station	Earth Station	TV Center	Central Office
Longitude	E 106° 45' 30''	E 106° 52' 38''	E 106° 56' 10''
Latitude	N 47° 54' 43''	N 47° 55' 40''	N 47° 55' 25''
Height (m)	0 (1273)	74.8(1347.8)	22.2(1259.2)
Height of Tower (m)	22	55	26
Distance (km)	9.88	2.4	

Fig. 3-2-3 Profile between Earth Station, TV Center and Central Office

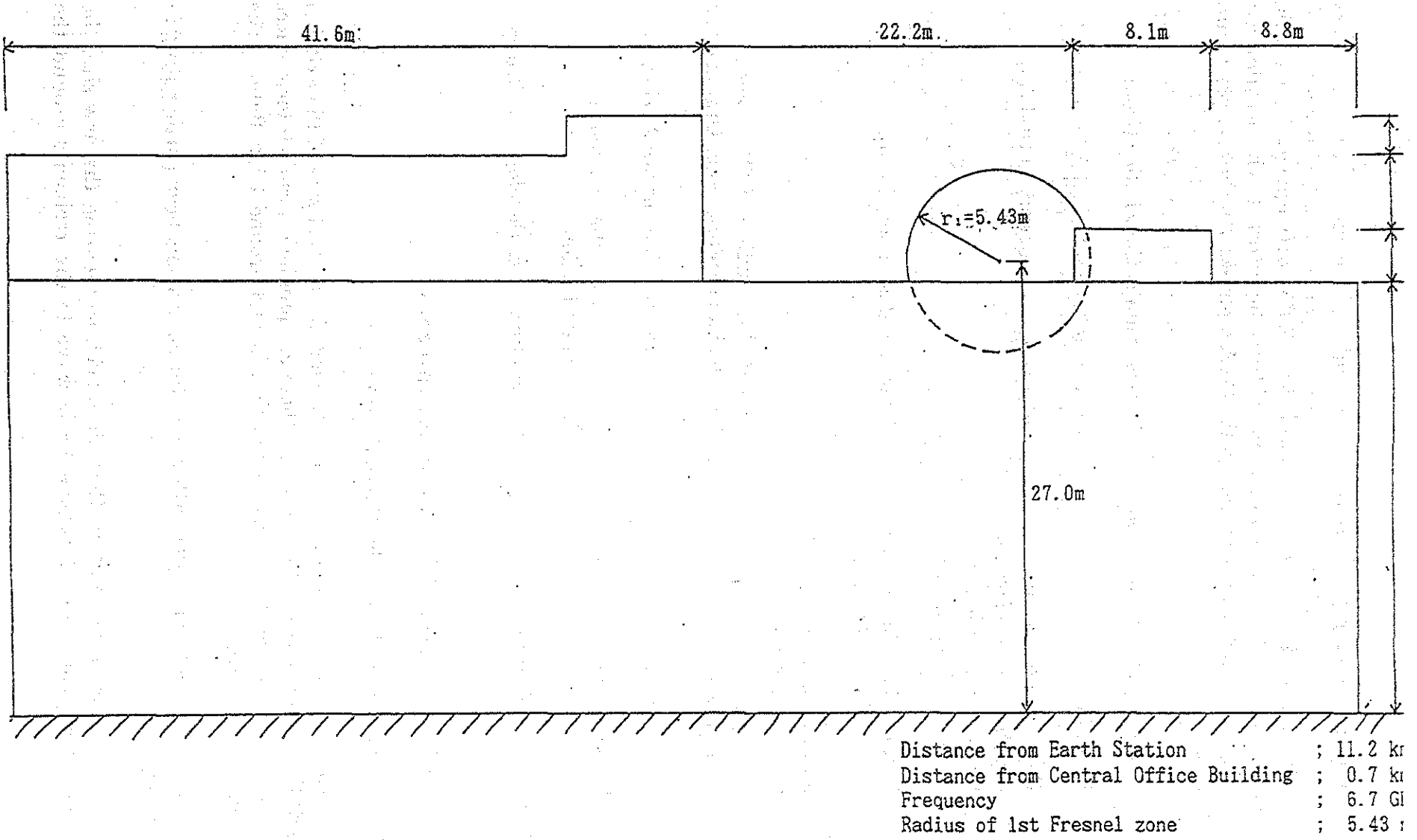


Fig. 3-2-4 Sectional Plan at the Department Store (between Earth Station and Central Office Building)

3-3 Executed Organization

When this Project is completed, the MTA will operate all of the management, operation and maintenance of these facilities. Each operation will be done by the departments specified in the MTA organization chart as per Figure 2-2-1.

Planning and Management :	Telecommunications Policy Group
Planning enforcement:	Center for Technological Advancement
Correspondence and negotiation with foreign telecommunication authorities and related organizations:	International Cooperation Division
Financial matters such as contract, procurement:	Finance and Economy Group
Maintenance and operation after completion	
Satellite and transmission facility:	Radio-Relay, Radio and TV Broadcast Technical and Maintenance Organization
Exchange:	Telecommunication Service Agency
Construction work of facility:	Construction and Installation of Telecommunication
Personnel training:	Human Resources Development Group

3-4 Outline of Satellite Earth Station Site

3-4-1 Selection of Site for the Earth Station

The new earth station is to be constructed at the west side of the existing INTERSPUTNIK earth station although there is a problem of radio interferences with terrestrial microwave transmission link in and around Ulan Bator. The reasons are as follows:

(1) The existing INTERSPUTNIK earth station has long been participating in the society;

(2) Difficulties in seeking another place such as securing the new site, the ecological assessment for electromagnetic wave to the residents around the

station, re-investigation of the site, traffic convenience, manpower for maintenance and management of the facility at the Station, supply of electric power, etc;

(3) The current problem of radio interferences will be possible to solve by reviewing assignment of frequencies for the satellite circuit or by changing frequencies of terrestrial microwave link.

3-4-2 Topography, Geography and Weather, etc.

(1) Skyline in the direction to the INTELSAT Satellite

Figure 3-4-1 shows the results of measurement of the skyline, which indicates no obstacles in the path of the radio wave.

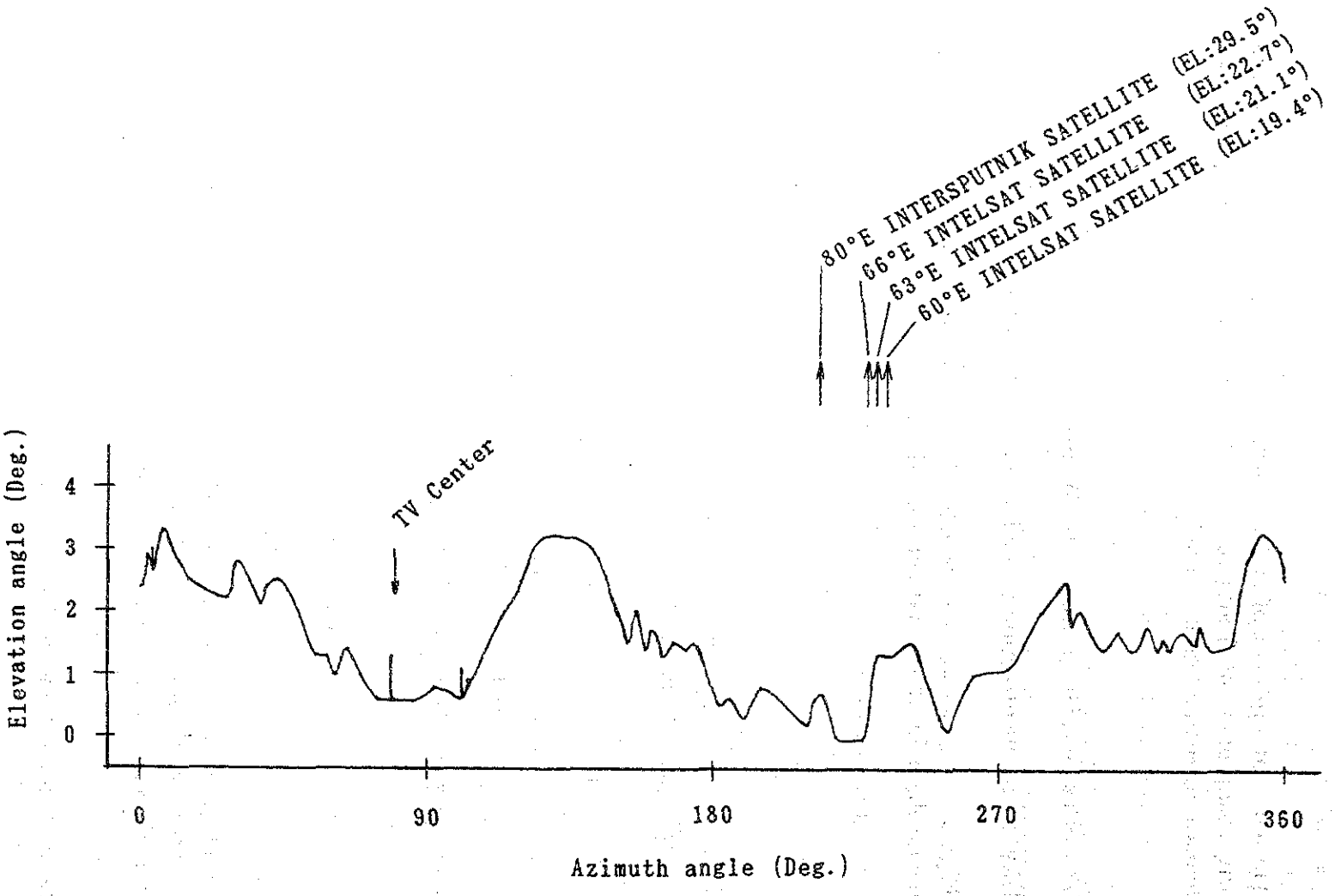


Fig. 3-4-1 Skyline Profile

(2) Topography, Geology and Weather

1) Earth station for the INTERSPUTNIK satellite is located in a spacious site owned by the MTA, together with the shortwave receiving station. Space allotted for the new earth station in the same site is 12,800 m^2 (approximately 118 for East/West direction and 108 m for North/South).

The space is topographically flat and the existing Antenna and Control Center is located in the center of the space with a power receiving station in the east side and a guard house facing the southern side road, the layout is shown in Figure 3-4-2.

2) A record of the subsoil exploration, which had been conducted separately from this investigation, indicates that the soil of this project site is silt including sands and pebbles. Same indication was found during the observation studies on the surface of this site.

According to hearings from the parties related to building construction, ultimate bearing capacity of the soil in Ulan Bator is generally 50-60 t/m^2 at the point of 3 meters deep, therefore, it can fully secure necessary bearing capacity of soil.

3) In Ulan Bator, there tends to be windy days between April and June. However, the average of windless days comes to 30 to 50% throughout the year. It is reported from the record at the Boyantohar Weather Station, which is located nearby the projected site, that the annual average of wind velocity is 1.0 m/s and the monthly average in the period of April to June is 3.4 to 3.7 m/s.

According to the Building Standard Code, stipulated by the Congress of the Mongolian People's Cabinet, at the Boyanhar Weather Station the maximum velocity of winds which usually occur once a year or 5th, 10th and 20th set at 22, 26, 28 and 30 m/s respectively.

The outdoor temperature recorded at the Boyanhar Weather Station shows an annual average of minus 3.1°C, and monthly average of the lowest in January as minus 26.5°C, and the highest in July as 17.6°C. Outdoor temperature in the winter comes down to below minus 35°C and the lowest record at minus 49°C in December 1954. In the summer, the outdoor temperature in the daytime comes up to 35°C, and the highest record was marked in July 1939 at 39°C. However, after dark, it comes down to almost zero, which indicates wide fluctuations within 24 hours.

Humidity is about 50 to 75% throughout the year with an annual average at 64%. Temperature of ground surface shows the lowest of the year in January at

minus 26°C as an average of the month, and the underground temperature in winter comes below zero to the point at approximately 3 meters deep.

The country has little rainfall throughout the year. During the years of 1984 through 1988, rainfalls of 218mm to 369mm were recorded. The rainy season is from June to August, and there are snowfalls during November to next March.

(3) Layout

Antenna and the new building of the earth station for the INTELSAT satellite is to be located west of the existing building, across the road inside the site and the existing sewer pipe. The layout of the new antenna and the new building is shown in Figure 3-4-3.

The present area of the site proposed for the new station is not sufficient for constructing the new antenna and the new building. Therefore, it is necessary to expand its area by moving the existing fence 15 meters west.

This expansion will not be a problem as this site belongs to the MTA.

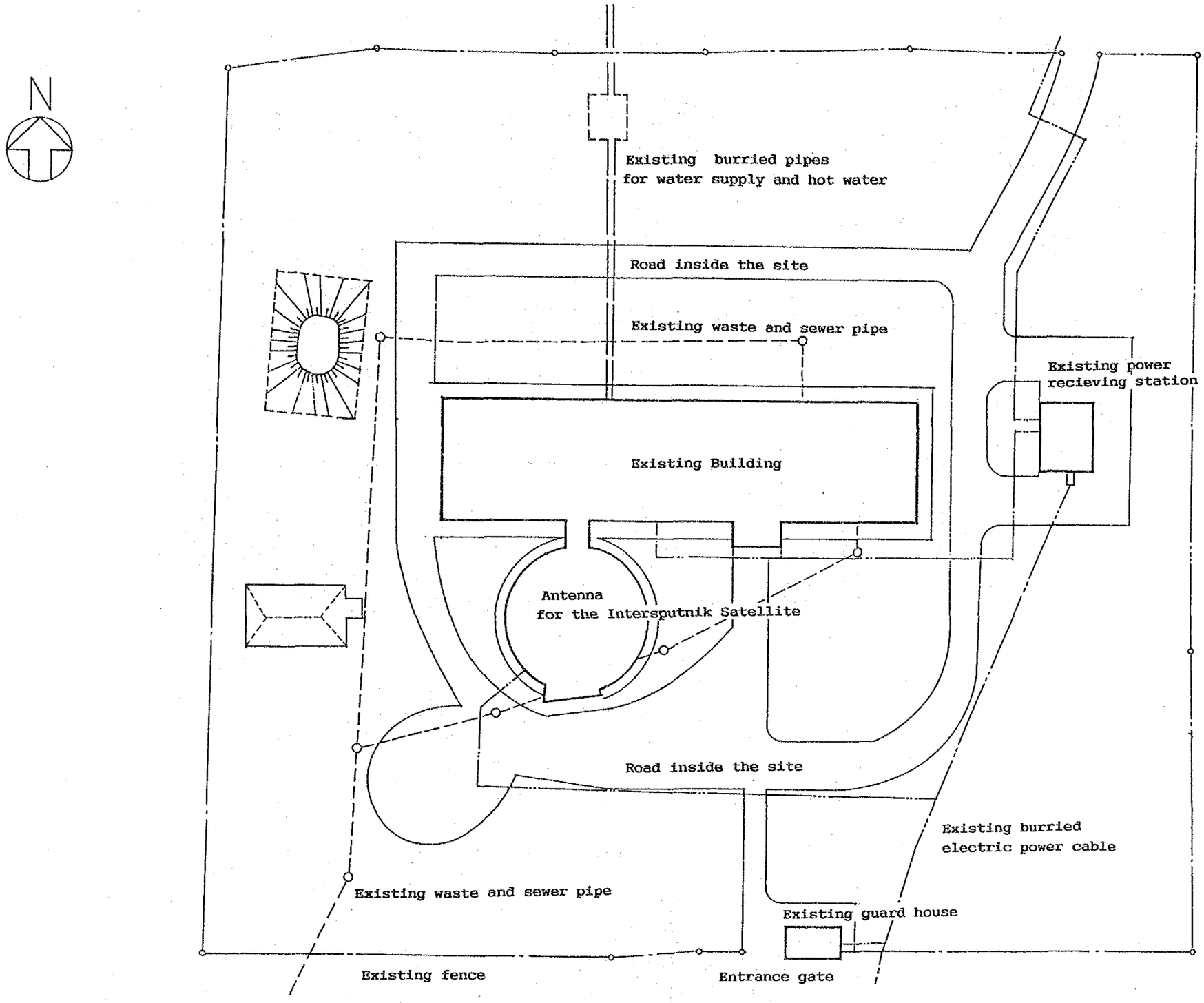


Fig. 3-4-2 Layout of Earth Station for INTELSAT Satellite
Scale 1/500

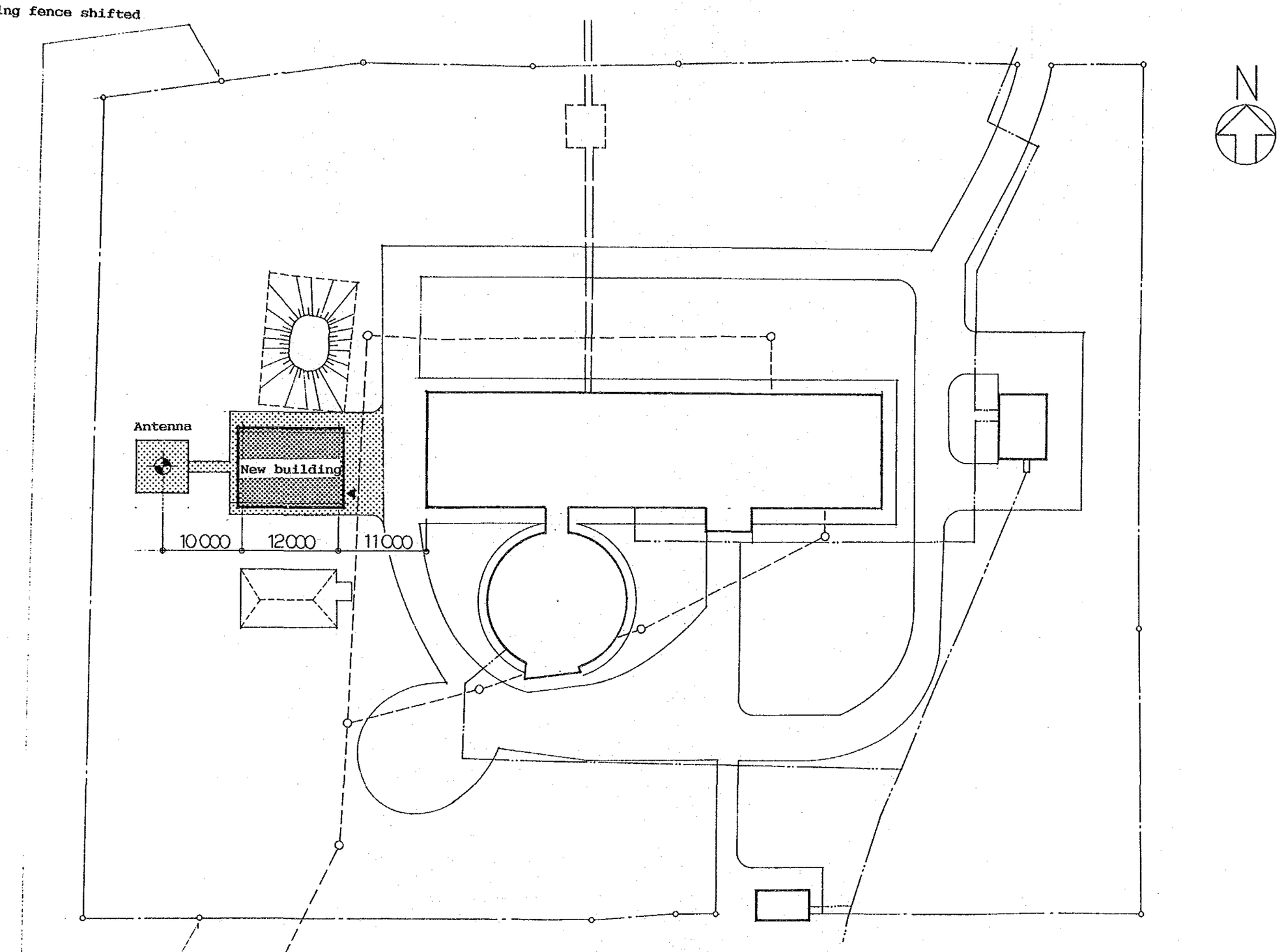


Fig. 3-4-3 Layout of Earth Station for INTELSAT Satellite
Scale 1/500

3-4-3 Electronic Condition

(1) Radio interference

1) Terrestrial microwave link

The existing route for terrestrial microwave link around Ulan Bator is shown in Figure 3-4-4. Theoretical studies were carried out on the radio interference between these terrestrial microwave stations and the newly installed INTELSAT earth station, with the result that the new station will possibly be interfered with four frequencies at 3716.5, 3772.5, 3828.5 and 3384.5 MHz in 4 GHz band microwave from Mt. Ar Hustan uul to TV Center in Ulan Bator. The details are in Appendix 3-3.

As the INTERSPUTNIK assigned its satellite frequencies on a spot basis, there was no problem in such radio interference by changing the frequencies from those of domestic microwave link. However, since the INTELSAT optionally assign its frequencies within the band of 3625 - 4200 MHz, great care is needed against the interference. Notice of the above matter to the INTELSAT in advance would be a countermeasure so that the same frequencies as the terrestrial microwave link are not assigned.

However, as the terrestrial microwave link is not so crowded at present, the earth station may have less chance to have unavailable frequency band by radio interference. The frequencies will be changed to interference-free frequencies at the time that the MTA will complete its plan for digitalization of the terrestrial microwave link. Therefore, this problem may not be serious.

2) Radar

Ulan Bator International Airport is located 8 km, south of the earth station. Further southeast from the airport, on the mountain of 1750 meters above sea level, there is an aviation control radar equipped with output power of 800 kW and frequencies of 2695 - 3115 MHz. It should be better to make a close investigation. However, this radar will not be a problem for reason that the existing INTERSPUTNIK satellite earth station has long been operating without any affects and that any radar waves was observed in the actual radio interferences investigation.

(2) Influence of air route

It has already proven that the signal level fluctuates for several seconds when aircraft across the radio wave path. The chance of crossing the radio wave path by aircraft in taking off or landing on the International Airport, (shown in Figures 3-4-5 and 3-4-6) are that: When a large aircraft lowers its altitude to the

traffic pattern from the holding pattern in rough weather or when a small plane freely flies its own route above the earth station.

However affection, can be negligible because of the small probability of crossing the radio wave path by aircraft: small chance of usage of holding pattern because of stable weather at Ulan Bator throughout the year; and small number of taking off and landing on of small planes. The number of arrivals and departures is about 40 to 80 in a day.

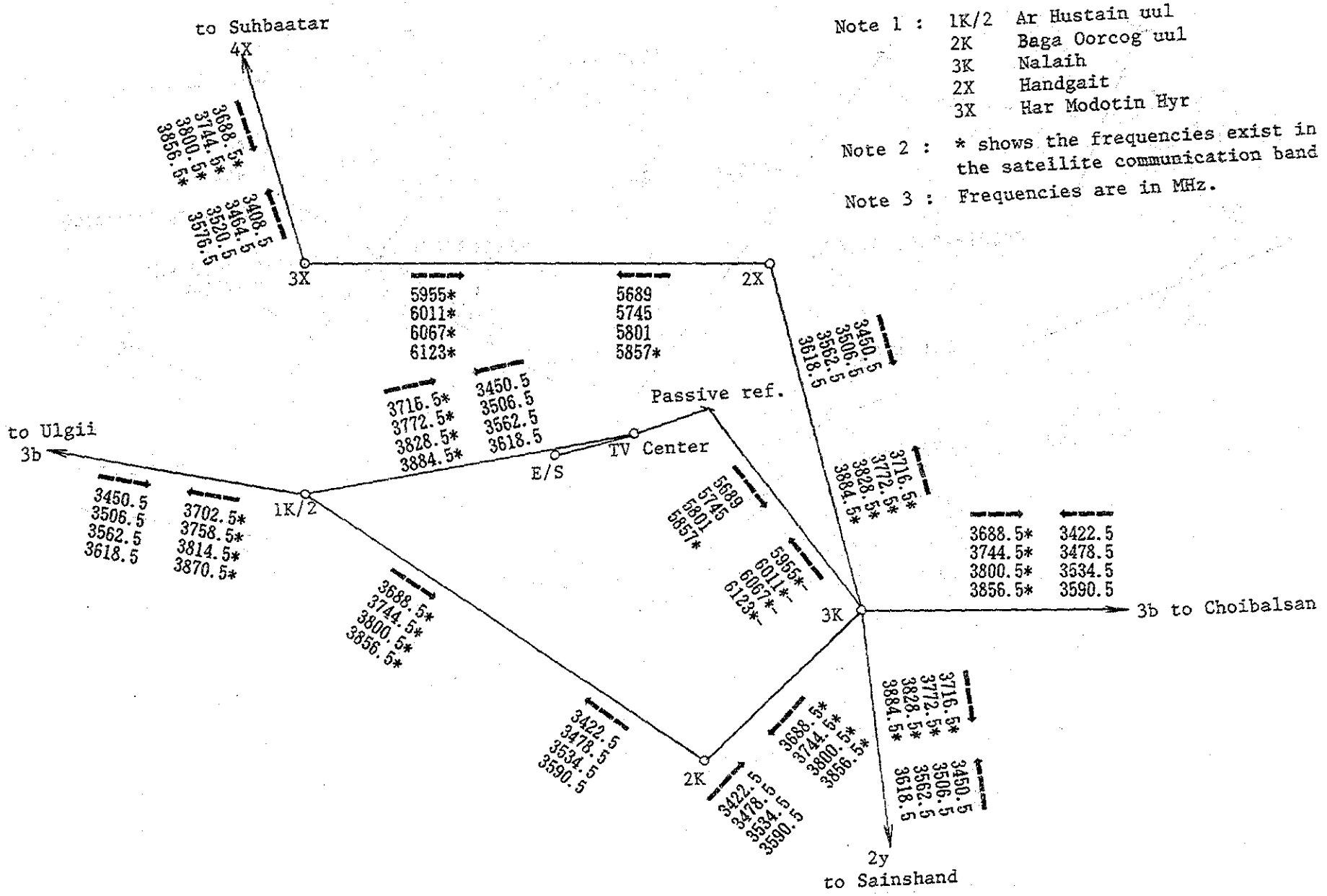


Fig. 3-4-4 Terrestrial Microwave Link in and around Ulanbator

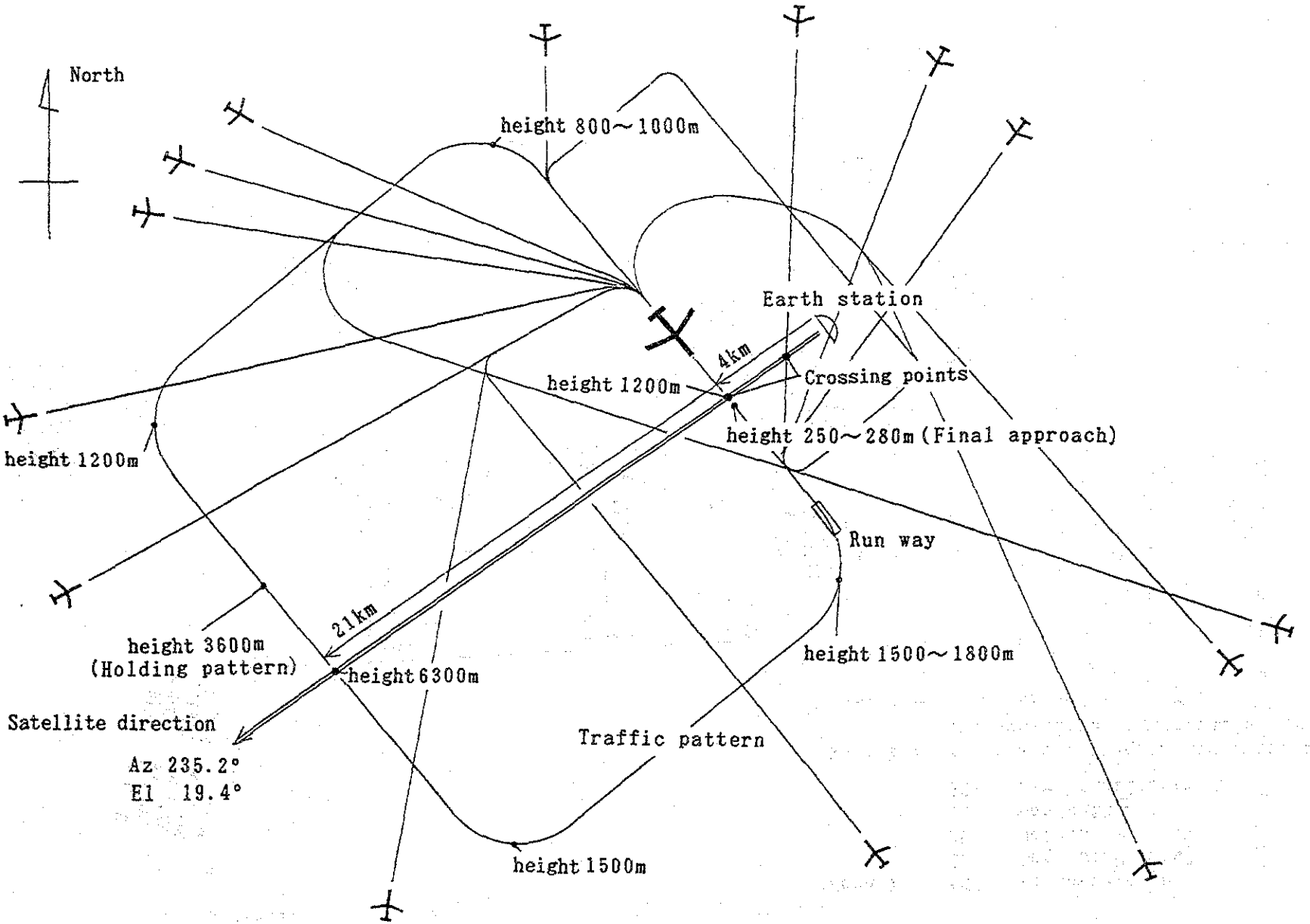


Fig. 3-4-5 Air Routes above the Earth Station (plane geometry)

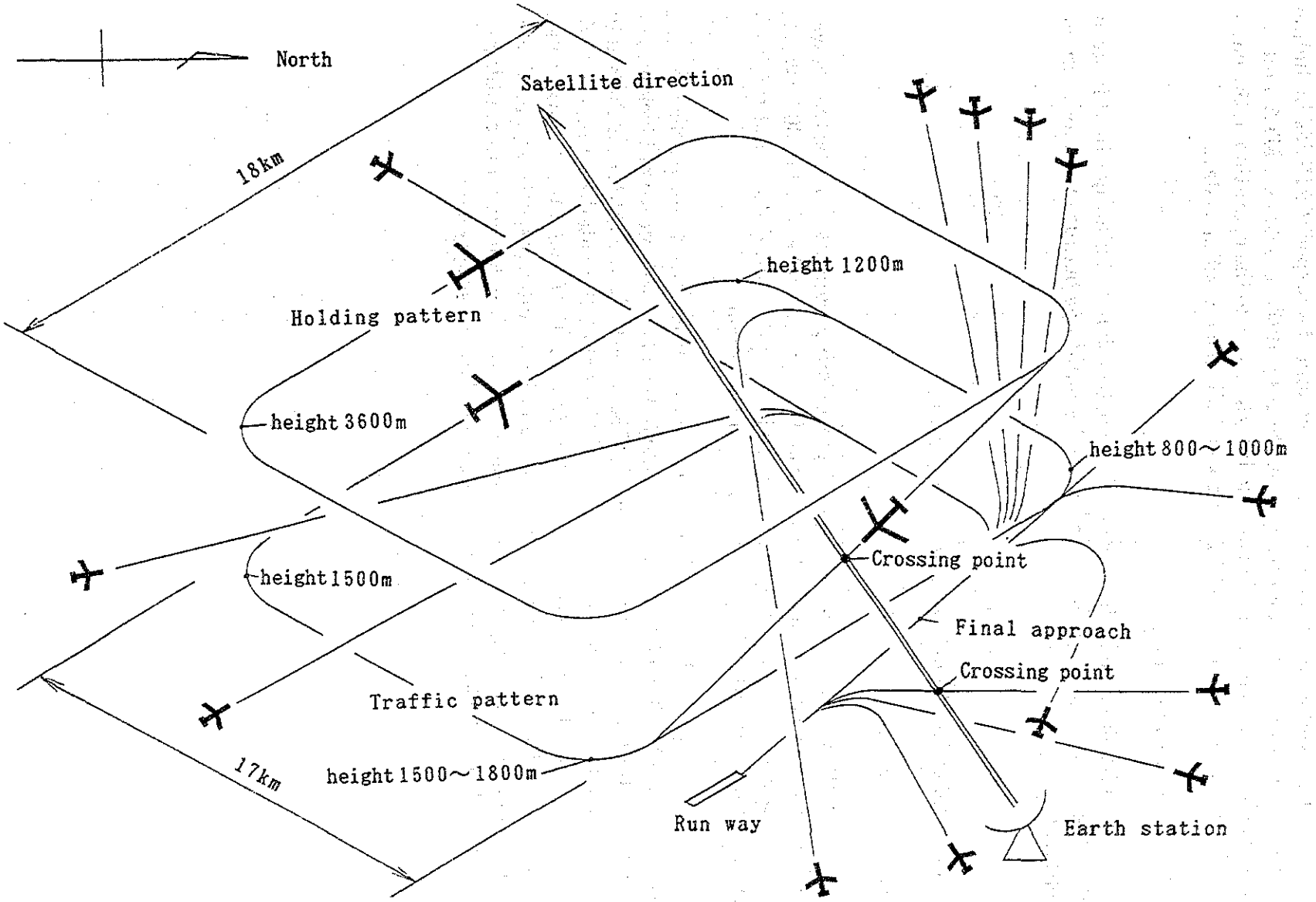


Fig. 3-4-6 Air Routes above the Earth Station (bird's eye view)

Since Mongolian Airlines plans to expand the airport facilities including the new runway, it will definitely need to fully discuss between MTA and the officials in the airport to avoid possible interferences to the operation of the earth station by the new airroute and the airport facilities including radar.

(3) Affects by buildings

As of today, there is no plan for construction of buildings in this area. There is no need to consider the influence by buildings because the environment will be kept as it is.

3-4-4 Electricity, Water Supply, and Roads

(1) Electricity

By 1992, MTA plans to expand the existing capacity of electric power facility, equipped at the earth station, from the current 250 kW×2 to 600 kW×2. The electric power required by this plan, 70 kVA at the initial stage and 100 kVA at the final stage, will be supplied without any problem.

Electric power is supplied by three routes from the steam power stations which are close to the earth station. Table 3-4-1 shows the record of blackouts at the earth station in the past five years (1985-1990) obtained through the study carried out in February 1990. It is considered that the satellite circuits were affected by the blackouts occurred in 16th October 1987 and 14th August 1990, with the duration of 30 seconds and 1 hour and 15 minutes respectively, as shown in Appendix 3-1. There is a small number of electric breakdowns, but shutdowns tend to be long. All the breakdowns were caused by the supply side.

Table 3-4-1 Record of Blackouts in the Past Five Years (1986-1990) at the Earth Station

Year	Frequency	Shutdown time
1986	1	30 minutes
1987	1	20 minutes
1988	2	20 minutes 10 minutes
1989	1	2 hours and 30 minutes
1990	3	1 hour and 15 minutes 1 hour and 05 minutes 2 hours and 30 minutes
Total	8	8 hours and 40 minutes

Situation of electric power supply in Ulan Bator is getting worse in 1991. Table 3-4-2 shows the record of blackouts in the past five months (January-May, 1991) obtained in May 1991. The total down time of these five months exceeds that of five years, and number of blackouts is increasing. The satellite circuits were considered to be affected for 4 minutes in 11th April and 20 minutes in 15th May.

Table 3-4-2 Record of Blackouts in the Past Five Months (January - May, 1991) at the Earth Station

Month	Frequency	Day	Shutdown time	Cause
January	3	14	35 minutes	One feeder failure
		17	10 minutes	ditto
		31	1 hour and 37 minutes	ditto
February	4	1	30 minutes	One feeder failure
		2	1 hour and 50 minutes	ditto
		19	15 minutes	ditto
		20	28 minutes	ditto
March	0	--	----	----
April	3	4	1 hour and 05 minutes	One feeder failure
		11	4 minutes	Total shutdown
		15	20 minutes	One feeder failure
May	2	4	40 minutes	One feeder failure
		15	20 minutes	Total shutdown
Total	12	--	8 hour and 40 minutes	----

To secure the total system availability of the earth station in good condition, the availability of more than 99.99% for the power supply is generally required. It means only one hour of total commercial power blackouts, in which the uninterruptible power supply cannot hold battery backup, is permitted per year.

If there is no expectation of improvement in such degraded condition in the future, installation of engine generator at the earth station should be considered to secure the stable electricity under commercial power failure for many hours.

(2) Water supply

A facility for water supply is already equipped at the existing satellite station; therefore, it will be possible to utilize water by connecting to the existing pipe. Rainfall is naturally penetrated into the ground of the site. The outlook of buried pipes for water supply is in Figure 3-4-2.

(3) Road

A 6 meter wide public road runs at the southern side of the site for access. And paved roads run around buildings at the site. There is no problem, except that some of the existing roads running inside the site should be widened.

3-5 Outline of the Central Office and the TV Center

The central office is located at the MTA Buildings, centered in the capitol Ulan Bator. The main parts of the buildings are 4 stories high with a basement, and there is a 6 story annex, where the headquarter of the MTA, telephone operation room, telex operation room, analog multiplexed terminal equipment room and other facilities are located.

The necessary space for the planned installation of the international switching system, the international telephone operation room and digital microwave transmission facility, is to be secured in the existing Central Office Building, taking into consideration of several advantages in its operation and maintenance as well as the existing facilities are installed in same building, and also AC power and a grounding can be provided from the existing facilities.

Together with the existing facility for domestic microwave system, the facility for relaying digital radio system is to be installed in the same room at the TV Center, which is 3 km away from Central Office. The new switching equipment room is to be equipped with an air conditioner.

3-5-1 Floor Layout

The digital international switching system is to be installed in a part of the space, with 73 m^2, which is now being utilized as the telex operation room. Among the digital microwave transmission facilities, the digital multiplexed equipments are to be installed in the same space. The operator positions, are to be installed in a space of 125 m^2, in the existing operation room for domestic and international calls, by removing operator positions which are not in service.

The radio equipment, as a part of the facilities for the digital microwave transmission, are to be installed on the 6th floor of the annex building and its antenna, on the roof.

The layout of the 3rd floor is illustrated in Figures 3-5-1 and 3-5-2.

3-5-2 Electric Condition

Figure 3-5-3 shows the interface concept of the existing and new facilities at Central Office. The concept in the TV Center is shown in Figure 3-5-4.

(1) Following are the electric conditions for the newly installed switching equipment at the Central Office.

1) AC

220 VAC±10% of single-phase 50 Hz±5%, is to be supplied from the AC distribution board in the basement of the building, with the capacity of 30 kVA.

2) DC

The facilities for the electric power source, i.e., the rectifier and battery, are to be installed in the room for the new switching system by rectifying 220 VAC single-phase 2 wire into direct current of −48 V. The power of −48 V (10 A), which is necessary for the digital microwave transmission system, is also to be supplied from this power facilities.

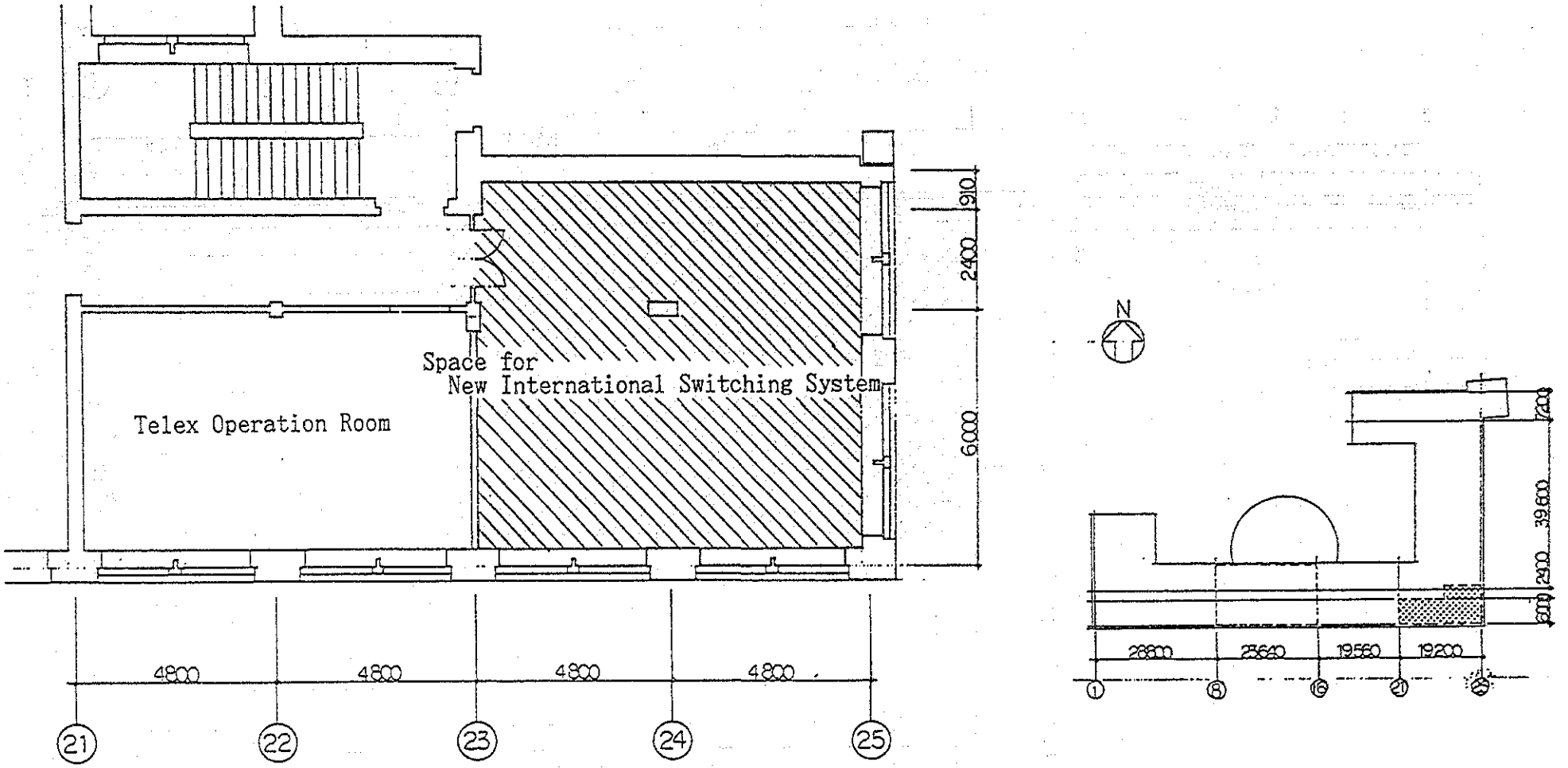


Fig. 3-5-1 Floor Layout of Central Office Building (3F)

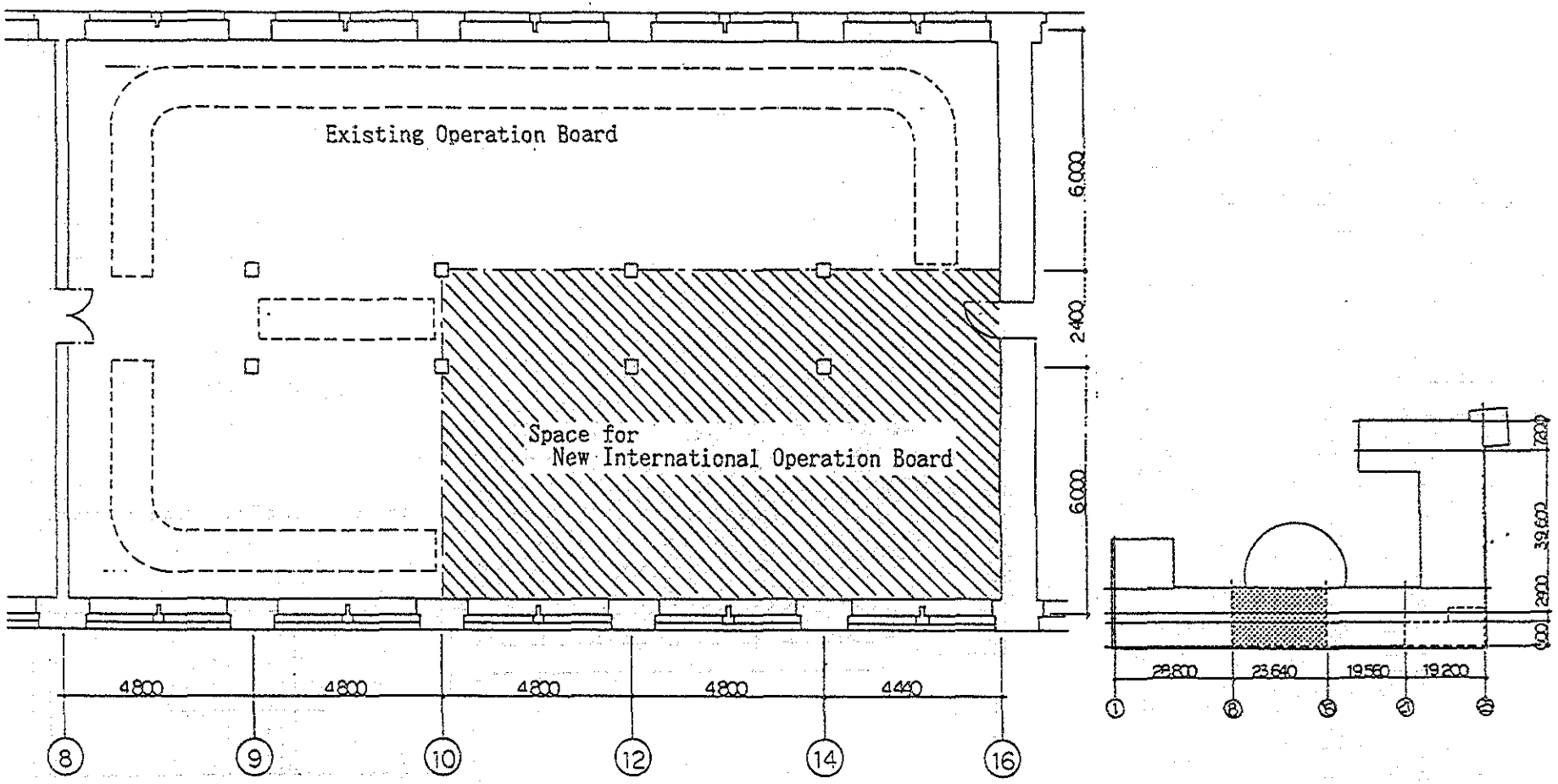


Fig. 3-5-2 Floor Layout of Central Office Building (3F)

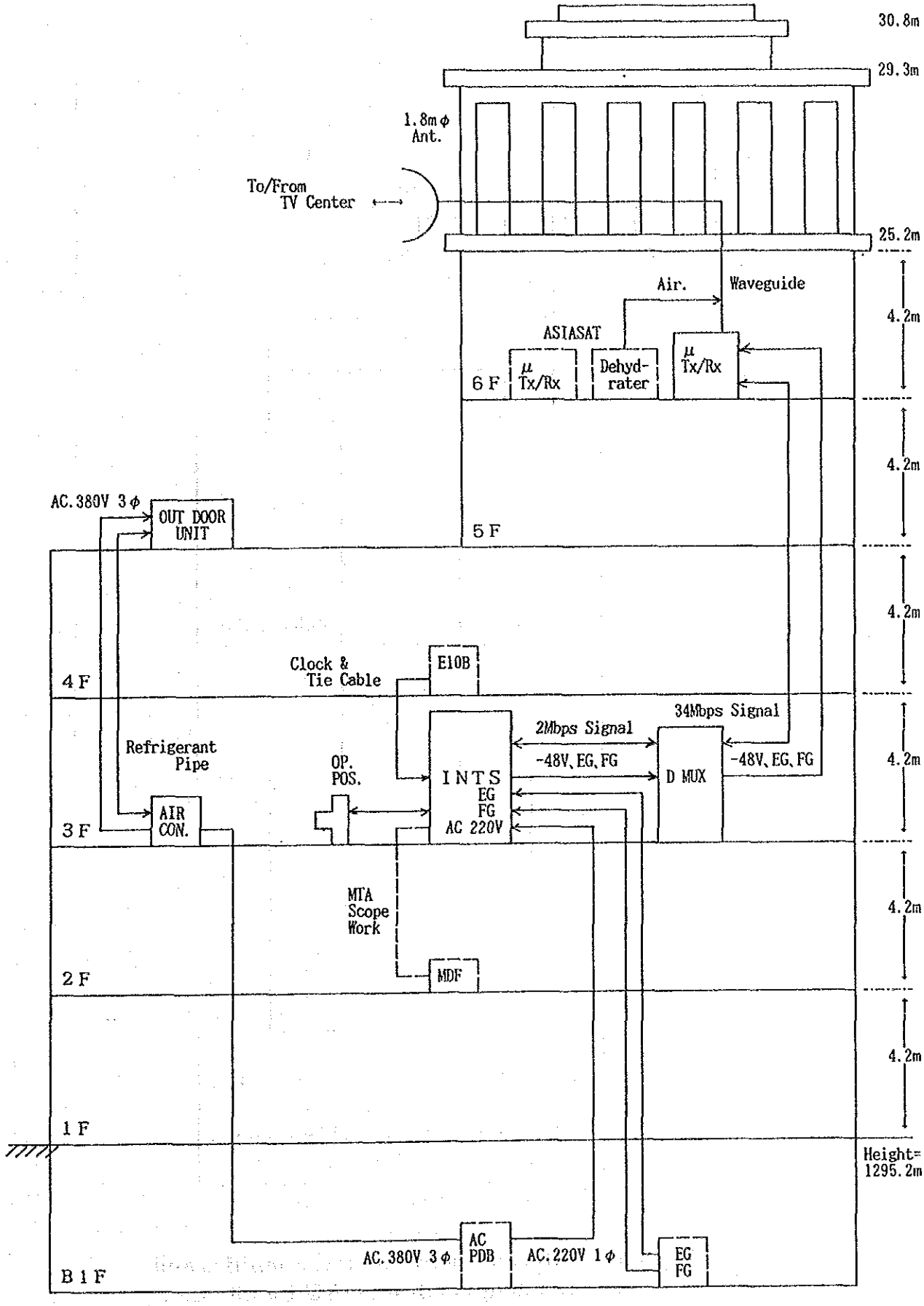


Fig. 3-5-3 Interface between New Facilities and Existing Facilities in Central Office of MTA

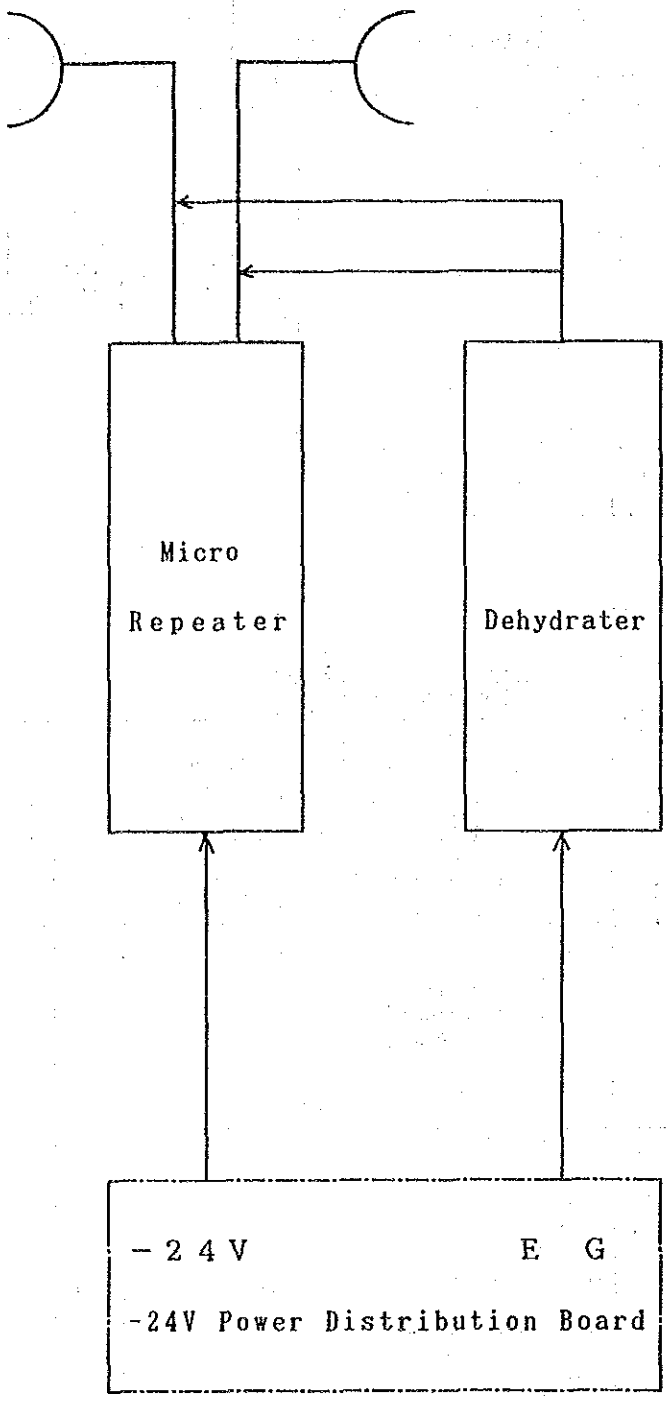


Fig. 3-5-4 Interface between New Facilities and Existing Facilities in TV Center

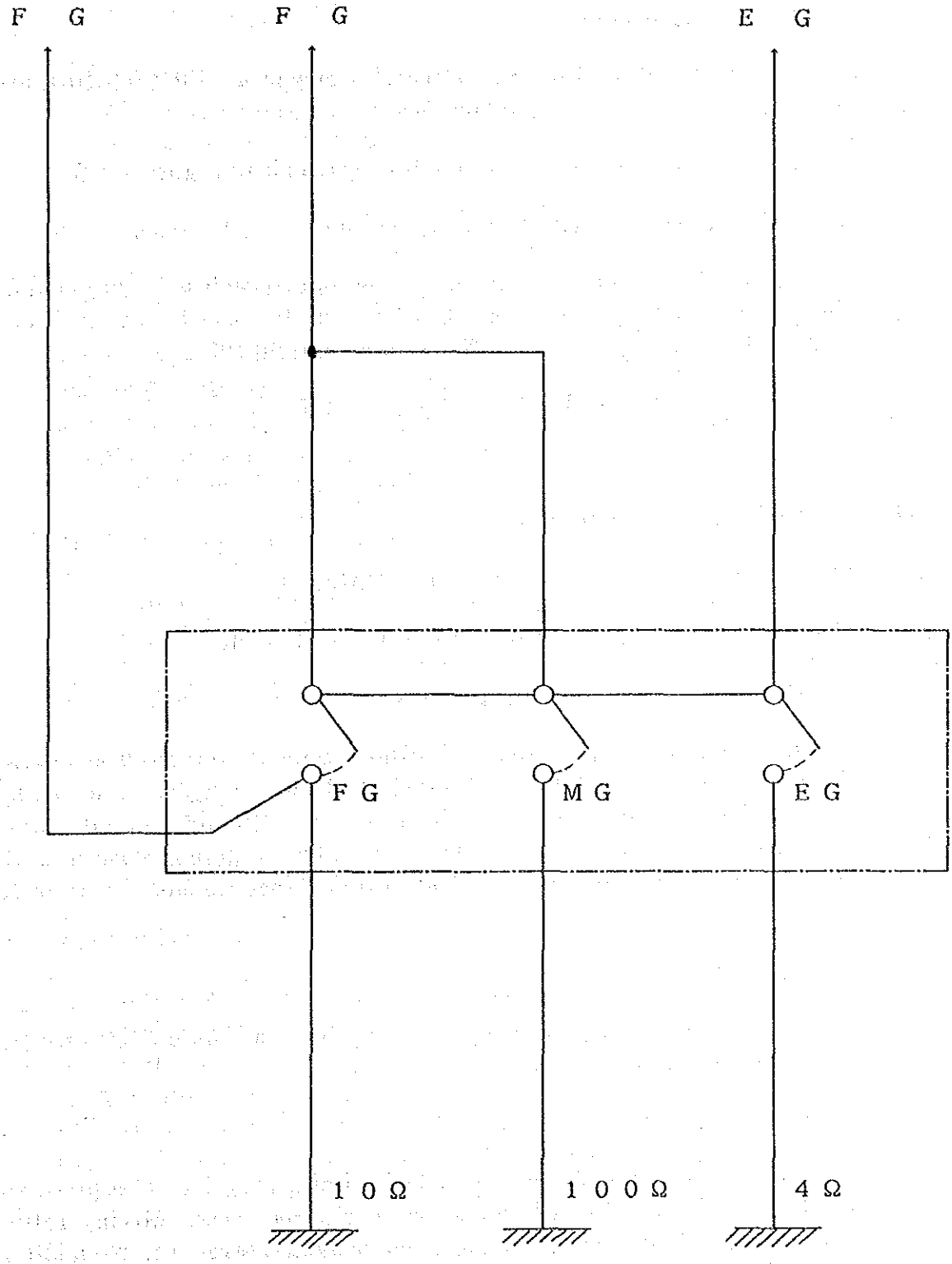


Fig. 3-5-5 Grounding System of Central Office

3) Grounding system

Equipment grounding (EG, 4Ω) and frame grounding (FG, 10Ω) are to be connected from the terminal board at first basement.

A diagram of the existing grounding system is in Figure 3-5-5.

4) Clock signal for network synchronization

The clock signal for the network synchronization is to be supplied from the digital switching system (E10B) which will be installed at the 4th floor of the MTA Building, to be operated around March, 1992.

Accuracy of the clock is better than $\pm 1 \times 10^{-11}$.

3-6 Architectural Conditions

3-6-1 Procurement Plan for Construction Material

(1) Updated situation of construction material in Mongolia

1) Cement

The domestic plants produce portland cement. Its solid strength is classified into 3 types: 300 kg/m^2, 400 kg/m^2 and 500 kg/m^2, among which 400 kg/m^2 is the most popular in this country. Although cement is one of their major export items, its supply is not always stable. Also note that Mongolia depends fully on the USSR in their procurement of coal for fuel use.

2) Aggregate

Aggregate for concrete is produced by domestic manufacturers from river sand or pebbles mined in the country.

3) Concrete

Concrete for main structural part of buildings is mixed at a processing plant and delivered to each construction site by truck. Mixing ratio is determined by bulk factor based on each designing strength. No additives are used. Compression strength of concrete at 200 kg/m^2 is usually applied. According to hearings from the parties related to building construction, the compression test of concrete is not usually made for cast-in-place concrete, however, precast products are spontaneously evaluated by the manufacturer.

4) Reinforcing rod

AI (2400 kg/cm3), AII (2850 kg/m3) and AIII (3700 kg/m3), under the USSR's standard, are imported from the USSR. No tensile strength tests are made, but such testing is available at the Soviet organization in the country.

5) Structural steel

Since all structural steel are imported from the USSR, availability of these products is limited. Domestic manufacturers can only finish simple work. Among the methods of connecting steel, the standard way is by welding at the site or by jointing bolt. However, joints by high-tensile strength bolt have not been made except in building constructed by foreign support. Galvanizing is not available as an anti-rust treatment. Anti-rust paint is the standard method.

6) Finishing materials and others

Commodities manufactured domestically are: Brick, Block, Wood products, doors and window, ceramic tile, roofing tile and the others. On the other hand, glass, water-proof materials, paint, linoleum and other commodities are imported mainly from the USSR.

7) Materials for electrical installation, air-conditioning, Plumbing and Mechanical Services

Most of the materials are also imported from the USSR. Mongolia can only produce simple steel tubes and others.

(2) Material procurement plan

In this plan, we will adopt the native construction method and procure materials in the domestic market as much as possible. However, as some of materials are not always stable in supply, Japan will supply cement, reinforcing rod and structural steel in order to proceed with this construction smoothly to meet the overall progress. In addition to cement supply from Japan, it is advisable to dispatch technical advisors for planning its mixing and controlling its quality.

As for the materials for electrical installation and air-conditioning, Japan will supply necessary materials as most of the procurement for this field has been made by Mongolia's unstable supply of imports.

3-6-2 Conditions for Construction Work at the Site in Relation to the Project, and Others

(1) Some organizations are working as architectural firms or consultants after changing the system at ex-Ministry of Construction which made recently. These organizations are operated with capital from the nation; however, they are now on the course of maintaining self-supporting accounting systems.

These architectural firms are classified by category such as manufacturing plant, railroad facility and apartments, and each office takes over a portion of the designing work according to their category. We will have no problem when we will entrust the designing work of this project, with regard to the building construction, to the native architectural firm, judging from the scale of the building and their achievements in construction works.

(2) There are about 50 to 60 construction companies in the country, ranging from large scale to small scale. Like architectural firms, each construction company is classified by category. Also, China, the USSR and Yugoslavia are now engaged in several construction works.

(3) Concerning laws and regulations in relation to construction, the General Regulation stipulates locations of buildings related to roads and others and an individual regulation stipulates safety facilities for each category of building.

(4) Under the regulation for approval and authorization with regard to construction, such an application should be made to the city office in Ulan Bator by the application form designated by the city. Also, an additional application should be made to the respective government offices or organizations with jurisdiction of heating, water supply and drainage, electricity, telecommunications, fire defense, health care, etc. Such applications differ from the details of the building, and there are some cases that applications to the environmental protection committee, one of the National Committees, are needed.

Judging from the scale and details of this Project, 20 days may be needed for the application procedures.

3-7 Operation and Maintenance Plan

3-7-1 Plan and System

(1) System

The planned international telecommunication network provides both international and domestic telecommunication services together with the existing domestic network. Therefore, after completion of the Project, operation and

maintenance of this international network are maintained under the entire MTA organization. The following related departments are responsible for operation and maintenance of each facility.

1) Facility for Satellite telecommunication:
   Radio-relay, Radio and TV Broadcasting, Technical and Maintenance Organization

2) New Exchange:
   Telecommunication Service Agency

3) Facility for digital transmission link:
   Telecommunication Service Agency

(2) Organization and staff for operation and maintenance

1) Satellite earth station

In addition to the existing staff, the following additional members should be appointed as staff for the operation and maintenance at the INTELSAT earth station.

Maintenance:
- One Chief Engineer responsible for the planning of operation and maintenance
- Two Engineers as assistants to the Chief Engineer

Operation:
- Five Engineers (5 shifts of 1 person)

2) New exchange

Among the present shift, 13 engineers and 80 operators should be assigned as the operation and maintenance staff.

Operation and Maintenance:
- One Chief Engineer responsible for the planning of operation and maintenance
- One Engineer as assistant to the Chief Engineer
- Two Technicians for maintenance and circuits management
- Nine Technicians for the same as the above (3 shifts of 3 persons)

Telephone operator:

- Four Chief Operators for telephone operation and management
- 76 operators for telephone operation (4 shifts of 19 persons)

3) Digital transmission system

Aside from this Project, another domestic digital microwave link is planned, between Earth Station and Central Office, to be completed in the autumn of 1991. Some staff will be assigned to this facility for its operation and maintenance. In addition, some staff have already been assigned to the TV Center and Central Office for the existing analog microwave facility. By transferring the digital telecommunication technology to these staff members, operation and maintenance of the digital transmission facility, to be introduced under the Project, will be made possible. Therefore, there is no need to add staff for its operation and maintenance.

(3) Plan for staff

New technology to be required at the time of completion of the Project would be in the field of digital communication. It will be indispensable to secure and train staff in digital communication in order to operate and maintain the facilities smoothly. As a talented staff will be required for management, operation and maintenance of the systems for the satellite communication, the transmission, and the exchange, it is advisable for the MTA to make a long-range staff training plan and to continuously proceed with the appropriate employment and training plans.

(4) Staff training

1) On-site training by contractor

Training for operating each facilities is to be done by engineers dispatched by the contractor at the site during the construction and on-site adjustment period. An Operation and Maintenance staff and operators will join in this training in order to acquire the necessary knowledge for operation and maintenance work. The training period will be approximately 3 weeks.

2) Training by the MTA

i) To instruct trainees through daily operations by engineers dispatched by the contractor.

ii) To train at the Mongolian Telecommunication Training Center by specially setting up training courses for beginners and those who need improvement.

iii) To let the trainees, who are experienced in digital communication, participate in the training lectures to be conducted by overseas organizations or training centers.

3-7-2 Maintenance Costs

Maintenance costs for the Project include direct expenses such as maintenance costs and charge for the satellite as well as indirect expenses such as overhead charges.

The maintenance costs for the facility include wages for staff members who are engaged in international telecommunication and expenses for repair parts and consumables together with electricity charges. Table 3-7-1 shows total annual costs.

Table 3-7-1 Total Annual Costs

Unit: Tg

Facility	Wages	Electricity charges	Satellite charges	Expenses for maintenance parts and consumables	Sub total
Satellite Earth Station	170,400	241,920	1,078,464	1,015,000	2,505,784
Exchange	1,559,160	90,720	—	40,000	1,689,880
Digital transmission system	—	—	—	—	—
Sub total	1,729,560	332,640	1,078,464	1,055,000	4,195,664

(1) Wages

1) Annual salary of an engineer

(1,500 Tg + 150 Tg)/month × 12 + 1,500 Tg = 21,300 Tg

2) Annual salary of a technician

(1,200 Tg + 120 Tg)/month × 12 + 1,200 Tg = 17,040 Tg

3) Annual salary of an operator

Same as a technician

(2) Electricity charges

Electricity charges for industrial use, 1 kW/h = 0.35 Tg, are applied.

(3) Charge for the INTELSAT satellite

1) 2 Mbit/s IDR carrier

Annual charge is US$98,400 per carrier on a 5-year commitment basis

(4) Annual maintenance charges

1) INTELSAT earth station facilities

a) Wages

Engineers: 21,300 Tg×8 persons = 170,400 Tg

b) Electricity charges

Electricity consumption of the earth station: 80 kW

Monthly electricity consumption: 80 kW×24h×30d = 57,600 kW/h

Electricity charge per year: 0.35 Tg/h×57,600 kW×12 = 241,920 Tg

c) Charge for the INTELSAT space segment

2 Mbit/s IDR carrier: 539,232 Tg×2 carriers = 1,078,464 Tg

d) Expenses for maintenance parts and consumables

A contractor will supply in the first two years. And from the third year onward, 25 million yen (10.15 billion Tg) per year is forecasted for the expenses for the TWT, repair work of units, together with charges for consumables.

e) Annual costs

2,505,784 Tg

2) Annual maintenance costs for the new exchange

a) Wages

Operation and Maintenance:		
Engineers	21,300 Tg×2 persons =	42,600 Tg
Technicians	17,040 Tg×9 persons =	153,360 Tg
Operation:		
Operators	17,040 Tg×80 persons =	1,363,200 Tg
Total:		1,559,160 Tg

b) Electricity charges

Electricity consumption of the exchange:	30 kW
Monthly electricity consumption:	30 kW×24h×30d = 21,600 kW/h
Electricity charge per year:	0.35 Tg/h×21,600 kW×12 = 90,720 Tg

c) Expenses for maintenance parts and consumables

A contractor will supply in the first two years. After that, one million yen (40,000 Tg) is forecasted as maintenance costs for the units and input/output terminals together with charges for consumables.

d) Annual costs

1,689,000 Tg

3) Annual maintenance costs for digital transmission system

a) Wages

Present staff will be able to deal with this area.

b) Electricity charges

Negligible as the consumption is to be small.

c) Maintenance parts and consumables

All materials are to be supplied at the time of construction.

d) Annual costs

Almost unnecessary.

3-8 Technical Cooperation

The modern technology of digital communications is to be introduced to facilities in the Project, i.e., the INTELSAT earth station, the digital exchange, and the digital transmission link. To conduct smooth operation after service-in, the staff for operation and maintenance are required to have more intense technological experience than ever before. The following technical assistance will be desirable for the MTA maintenance staff those are not experienced with the operation of the INTELSAT earth station and has little experience with technology of digital communication. In relation to the Technical Cooperation, further development on the Project would be expected.

(1) Among the International Group Training executed by JICA, the MTA staff should be participated to the following related courses as a part of the training.

1) Satellite communication engineering course

2) Satellite communication engineering (planning and management) course

3) International telephone communication engineering course

4) International telecommunication services course

(2) Two experts are to be dispatched for technical assistance regarding operation and maintenance of satellite communications and exchange facilities for about two years after the completion of the Project.

CHAPTER 4
BASIC DESIGN

4 BASIC DESIGN

4-1 Basic Plan

In general, the facilities and equipment for public use telecommunication services are designed from various view points such as service menu, quality of service, environmental conditions, design life, extendibility in the future, economic efficiency, and ease of operation and maintenance.

This Basic Design is based on the present state of telecommunications in the Mongolian People's Republic. The Project includes mainly a construction of a new satellite earth station and installation of a new exchange for international telecommunications in order to improve and expand the existing international telecommunications networks. Following are the basic concepts of the implementation plan.

(1) Considering the progressing deterioration of the existing earth station, connectivity and circuit quality, the plan should be implemented as early as possible. As the existing facilities and equipment near their final days, there should be a change over to the new system without any hindrance.

(2) The scope of the Project is limited to the construction and installation of facilities as a scale of the initial stage. However, the system should be designed to allow extension with reasonable cost in accordance with increased future demand.

(3) An international telephone network should be designed to have sufficient circuit quality and connectivity to meet future traffic growth.

(4) Considering the future trends of the INTELSAT services and telecommunications system, a system should be established to secure high adaptability between overseas carriers. The system should be designed to operate stably during its design life with ease of maintenance.

(5) The new international exchange should be compatible to the domestic network plan. The new system should aim at improvement of International Subscriber Dialing. The exchange functions such as direct circuits assignment and route alteration should satisfy the performance requirements and allow easy modification.

(6) The new system should be efficient and economical.

4-2 Requirements for System Design

According to the MTA's requirements in the request, demand forecast and the design policy, a new telecommunications system shall be designed to be optimum on the basis described below.

4-2-1 Technological Standards and Specifications

The telecommunications equipment should satisfy all the requirements on compatibility and interface criteria with other countries. As the Mongolia has no technical standards and specifications at present, the system shall conform to the specification set forth by CCITT, CCIR, INTELSAT and Japanese Industrial Standards.

4-2-2 General Conditions

(1) Climatic conditions

As the climatic conditions of the Mongolia are very severe, the facilities and equipment should satisfy the performances under the following environmental conditions:

Outdoor temperature:	−50°C to +40°C
Outdoor relative humidity:	0 to 100%
Indoor temperature:	20°C + 5°C
Altitude:	1400 m above the sea level
Earthquake:	See 4-6-1 (3) "Structure of new INTELSAT earth station building"
Wind resistance:	same as the above

(2) Design life of telecommunications system

A design life of 15 years, that is generally specified for international telecommunications equipment, is to be adopted.

(3) Total availability of equipment

For its design life of 15 year, the system shall keep the availability described below:

INTELSAT earth station facilities:	99.95% (generally used for the INTELSAT earth station)
Digital microwave transmission facilities:	99.99%
Exchange system:	99.9988% (hardware only)

4-3 EARTH STATION FACILITIES AND EQUIPMENT

The INTELSAT earth station should have the following configuration. The facilities and equipment are shown in Figure 4-3-1 Block Diagram of Earth Station, Figure 4-3-2 Floor Layout of Earth Station, and Figure 4-3-3 Floor Layout of Existing Building.

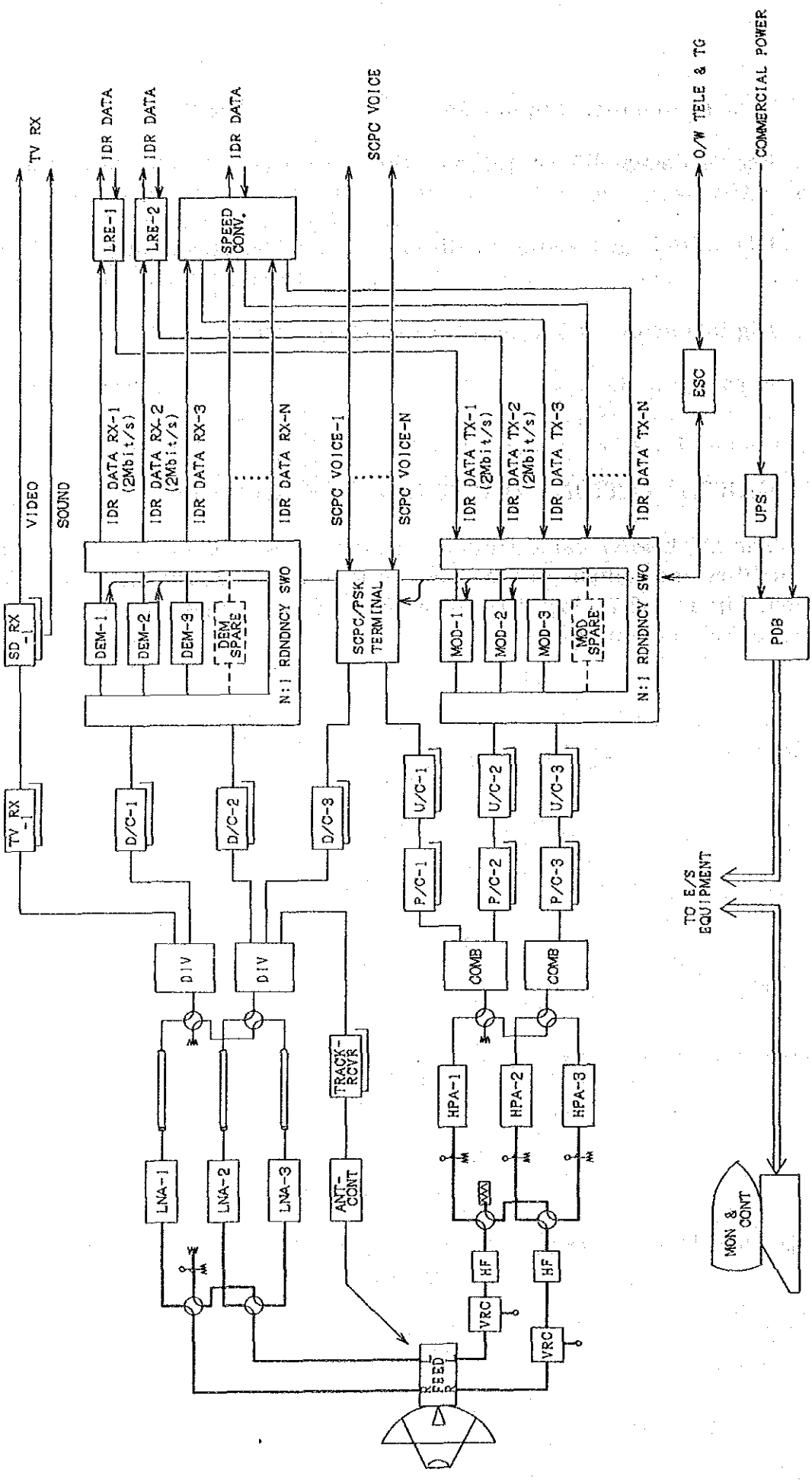


Fig. 4-3-1 Block Diagram of the Earth Station

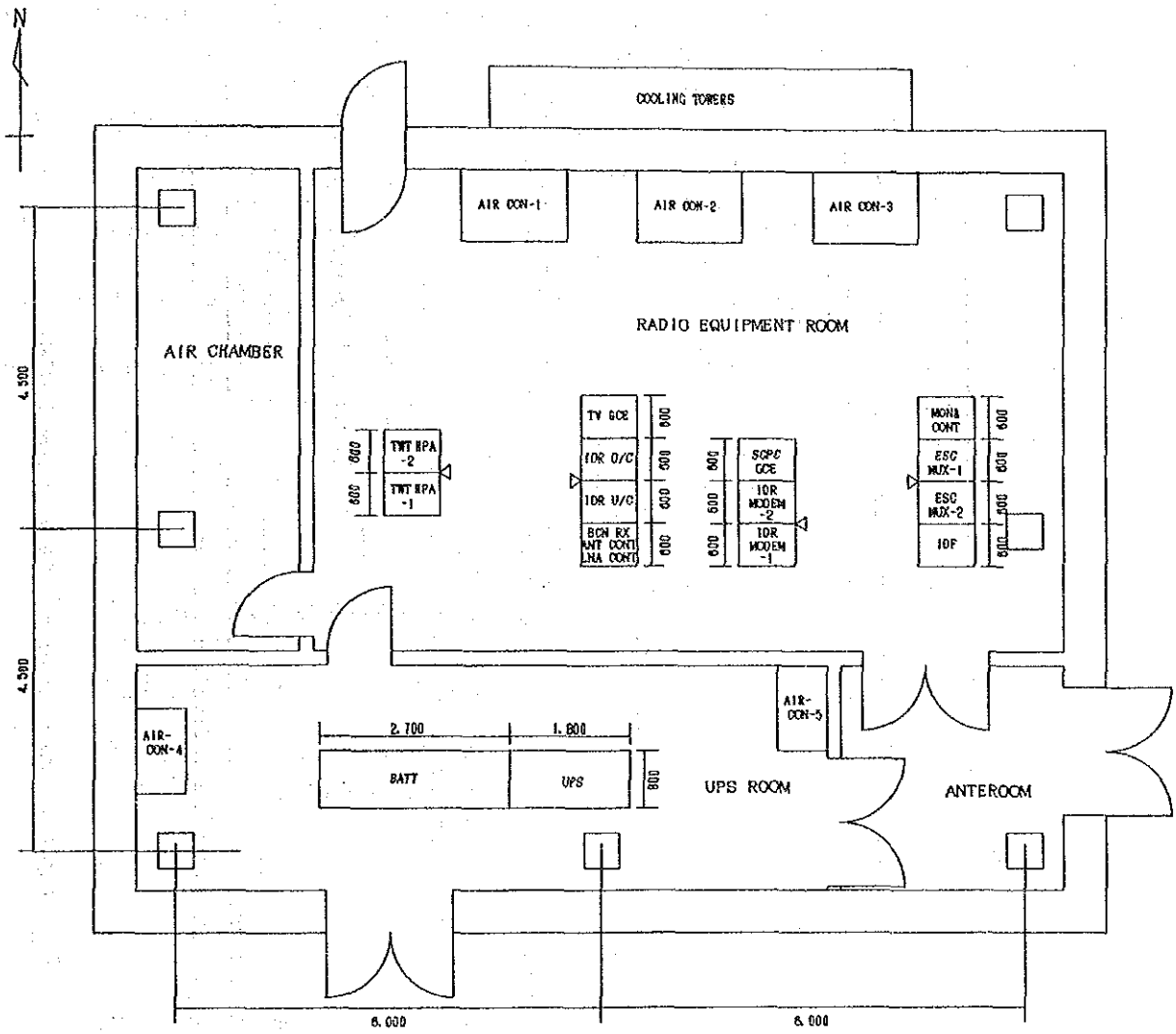


Fig. 4-3-2 Floor Layout of the Earth Station

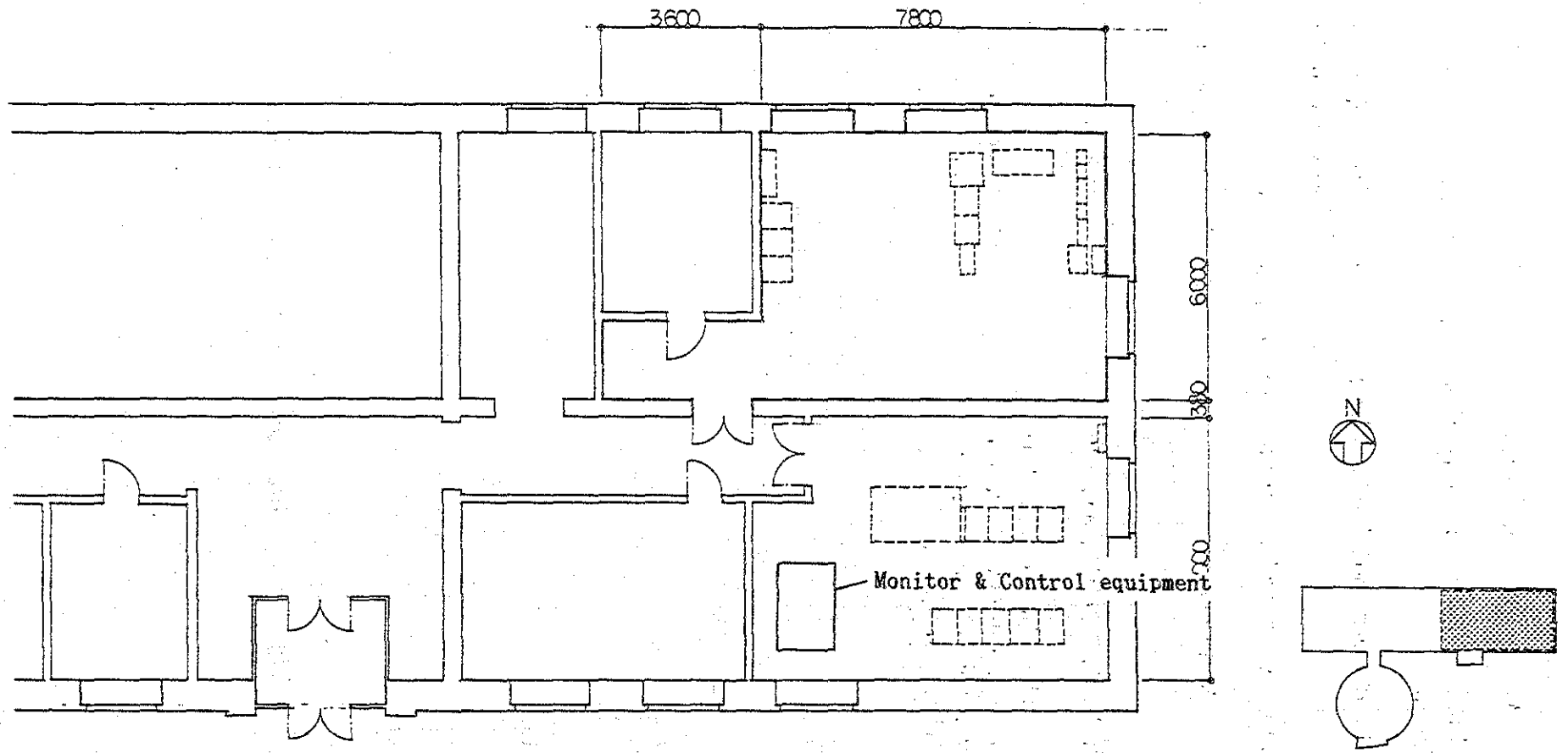


Fig. 4-3-3 Floor Layout of Existing Building

4-3-1 Antenna System

The antenna, which transmits 6 GHz signals to the satellite and receives 4 GHz signals from it, shall comply with the specifications of the INTELSAT New Standard A performance characteristics.

(1)	System G/T:	more than 35.0 dB/K at 4 GHz		
(2)	Operational frequency range:	a.	Transmission	5,850 to 6,425 MHz
		b.	Reception	3,625 to 4,200 MHz
(3)	Polarization:	Left Hand and Right Hand Circular polarization for frequency re-use.		
(4)	Diameter of antenna:	16 m class		
(5)	Tracking, Driving:	Step-tracking, limited motion		
(6)	Wind withstand:	No harmful deformation shall be produced in instantaneous wind velocity of 35 m at operational position or 55 m at storage position.		

4-3-2 Ground Communication Equipment

(1) High power amplifier (HPA)

The HPA amplifies the amplitude of 6 GHz signals to a required power level for transmitting to the satellite.

1)	Amplifier:	TWT (traveling wave tube) amplifier
2)	Capacity:	Saturation output power of more than 500 W shall be required.
3)	Redundancy configuration:	Operation (2)+stand by (1), to meet dual polarization requirement.
4)	Transmission waveguide circuit:	To enable transmission of TV signals in the future, a transmission waveguide circuit should be equipped with a VRC (Variable Ratio Combiner) to combine TV HPA outputs.

(2) Low Noise Amplifier (LNA)

The LNA amplifies 4 GHz weak signals from the satellite.

1)	Amplifier:	FET amplifier, featuring non-cooling and superior maintainability.
2)	Noise temperature:	A system G/T of more than 35.0 dB/K shall be assured in combination with antenna facilities.
3)	Redundancy configuration:	Operation (2) + stand by (1), to meet dual polarization requirement.

(3) Transmit Power Controller

The unit, which controls the transmit power, shall be accessible to three transponders and of redundancy configuration of operation (1) + stand by (1).

(4) IDR/SCPC Frequency Converter

In transmission, the unit converts the intermediate frequency output carriers from the modulator/demodulator to 6 GHz carriers, and in reception, the 4 GHz band output carriers from LNA to intermediate frequency carriers. It shall be accessible to three transponders in transmission/reception and have a redundancy configuration of operation (1) + stand by (1).

(5) IDR Modulator/Demodulator

In transmission, the unit converts the baseband telephone signals from the central office to IDR intermediate frequency carriers, and in reception, it converts IDR intermediate frequency carriers to the baseband signals.

1) Number of satellite channels:

   a) Two circuits of 2 Mbits/s for England and Japan.

   b) Four 64 kbit/s to 2 Mbit/s variable rate circuits for spares

2) Redundancy configuration: operation (M) + stand by (N)
   (M, N are arbitrary, M + N = 6)

(6) Rate Conversion Unit

The unit provides the rate conversion capability between the 64 kbit/s × n IDR data and the 2 Mbit/s data in terrestrial microwave link. The initial capacity should be of redundancy configuration of operation (2) + stand by (1).

(7) LRE Unit

The unit serves band compression of two 2 Mbit/s to one 2 Mbit/s in order to reduce satellite circuits change.

1) Number of satellite circuits:

a) International side two 2 Mbit/s

b) Domestic side four 2 Mbit/s

2) Redundancy configuration: operation (1) + stand by (1)

(8) SCPC Modulator/Demodulator

In transmission, this unit converts the baseband signals from telephone circuits to SCPC intermediate frequency carriers and vice versa in reception.

1) Number of satellite circuits: Five SCPC carriers, including spares, are to be provided for small traffic not covered by IDR.

2) Redundancy configuration: operation (M) + stand by (N)
(M, N are arbitrary, M + N = 6)

(9) TV receiver

The equipment enables the reception of international television programs through the INTELSAT. It shall be designed for TV standard of PAL or SECAM signals, with an audio sub-carrier, with redundancy configuration of operation (1) + stand by (1).

(10) Engineering Service Circuit (ESC)

The ESC enables engineering communication with international earth stations. The circuit should also be available at the central office.

The ESC equipment is to be placed in a new building. For ease of operation, telephone and telex terminals should be installed in the existing INTERSPUTNIK earth station besides the new building.

1) Number of satellite trunks:

Initial capacity should be three circuits for both transmission and reception. Each trunk accommodates one telephone circuit and one telex circuit.

2) Number of equipment for domestic terminals:

The initial capacity should be two telephone circuits and two telex circuits.

4-3-3 Monitor and Control System

In order to monitor and control the whole system unattendedly, a computerized earth station monitoring and controlling equipment will be installed.

The main unit consists of I/O unit and data processing unit will be placed in a new building, and the display and printer units are to be placed in the existing INTERSPUTNIK earth station for ease of operation.

(1) Monitoring function: To monitor the earth station equipment in terms of operation, stand by, and in-hazard status.

(2) Controlling function: To control all the equipment of the earth station.

(3) Metering function: To measure activities of earth station equipment numerically.

4-3-4 Power Supply System

(1) Power receiving facilities

380 V AC, 3-phase, 4-wire, 50 Hz power shall be supplied through the existing power receiving station. About 150 m of underground cable shall be prepared from it to the new building. Electricity will be distributed through a newly-built switchboard.

(2) Engine generator

Taking the availability of commercial power and the implementation cost into consideration, Engine generator is not included.

(3) Uninterruptible power supply

A UPS unit with a capacity of 40 kVA and retaining time of 30 minutes is to be equipped to protect the main facilities from possible power failure.

4-3-5 Instruments, Tools and Spare Parts for Maintenance

(1) Spare parts

Except the electron tubes for the HPA , spare parts necessary for reliable maintenance for five years are to be furnished after the construction of the earth station. If any are further necessary, they should be prepared at the cost of the MTA.

(2) Maintenance instruments and tools

Instruments and tools necessary for maintaining circuit quality and reliability of earth station activity are to be supplied.

(3) Documents

Three sets of documents including operation manuals for maintenance of the earth station and inspection records are to be supplied.

4-3-6 Cable Route

The cable route constructed in this Project is shown in Figure 4-3-4.

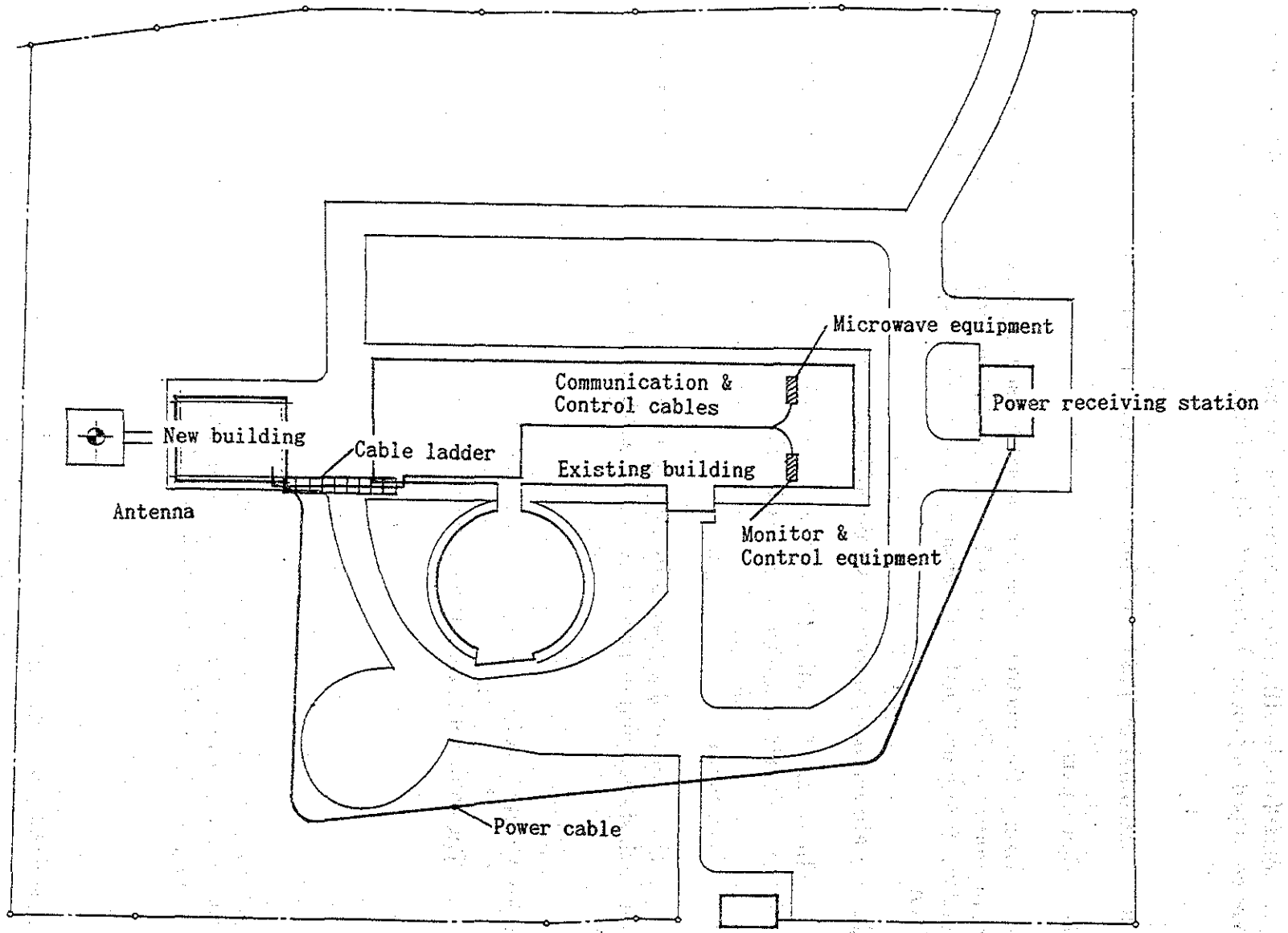


Fig. 4-3-4 Cable Route in the Earth Station

4-3-7 List of Equipment, Instruments and Tools

The equipment, instruments and tools to be provided for the implementation of the plan are listed below.

(1)	Antenna system	one set
(2)	Ground Communication Equipment	
	1) High Power Amplifier	for 3 routes
	2) Low Noise Amplifier	for 3 routes
	3) Transmit power controller	for 3 transponders
	4) IDR/SCPC frequency converter	for 3 transponders
	5) IDR modulator-demodulator	for 6 carriers
	6) Rate Conversion Unit	for 3 carriers
	7) LRE Unit	2 sets
	8) SCPC modulator-demodulator	for 5 carriers
	9) TV receiver	for 1 carrier
	10) Engineering Service Circuit	one set
(3)	Monitor and control system	one set
(4)	Uninterruptible power supply	one set
(5)	Instrument and tools for maintenance	
	1) Spare parts	one set
	2) Measuring instruments and tools	one set
	3) Documents	one set
(6)	Materials for work	one set

4-4 International Transit Switch/Toll Switch (INTS/TS)

4-4-1 Operational Conditions

(1) Network composition

Figure 4-1-1 shows the telephone switching network after the new INTS/TS is introduced.

(2) Number of international/national circuits

Initial number of international circuits 111
Final number of international circuits 350

Initial direct circuits by destination are as tabulated below.

Destination	Via	Number of circuits	Number of DTI
U.S.S.R.	INTERSPUTNIK	14	1
U.S.S.R.	Microwave	10	---
China	Open wire	9	---
United Kingdom	INTELSAT	40	2
Japan	INTELSAT	38	2

DTI: Digital Transmission Interface

Number of initial national circuits 1000

City	Number of circuits	Number of DTI
Ulan Bator, local exchange	421	15
Local cities, intra-city	578	---

Figure 4-4-2 shows the trunking diagram.

(3) Initial number of switch boards

21 sets (for 20 operators and for one supervisor)

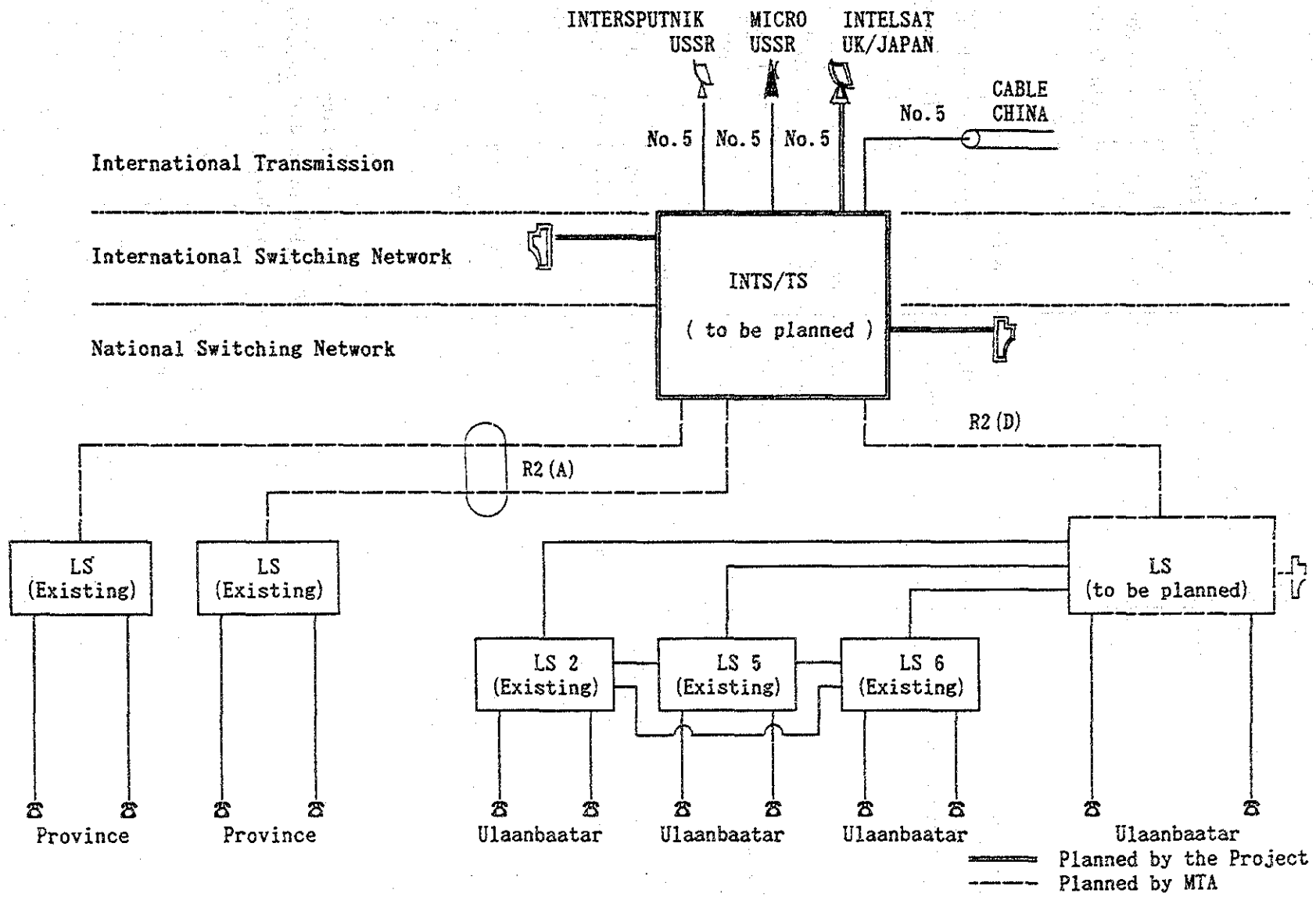


Fig. 4-4-1 Telephone Switching Network (with New INTS/TS)

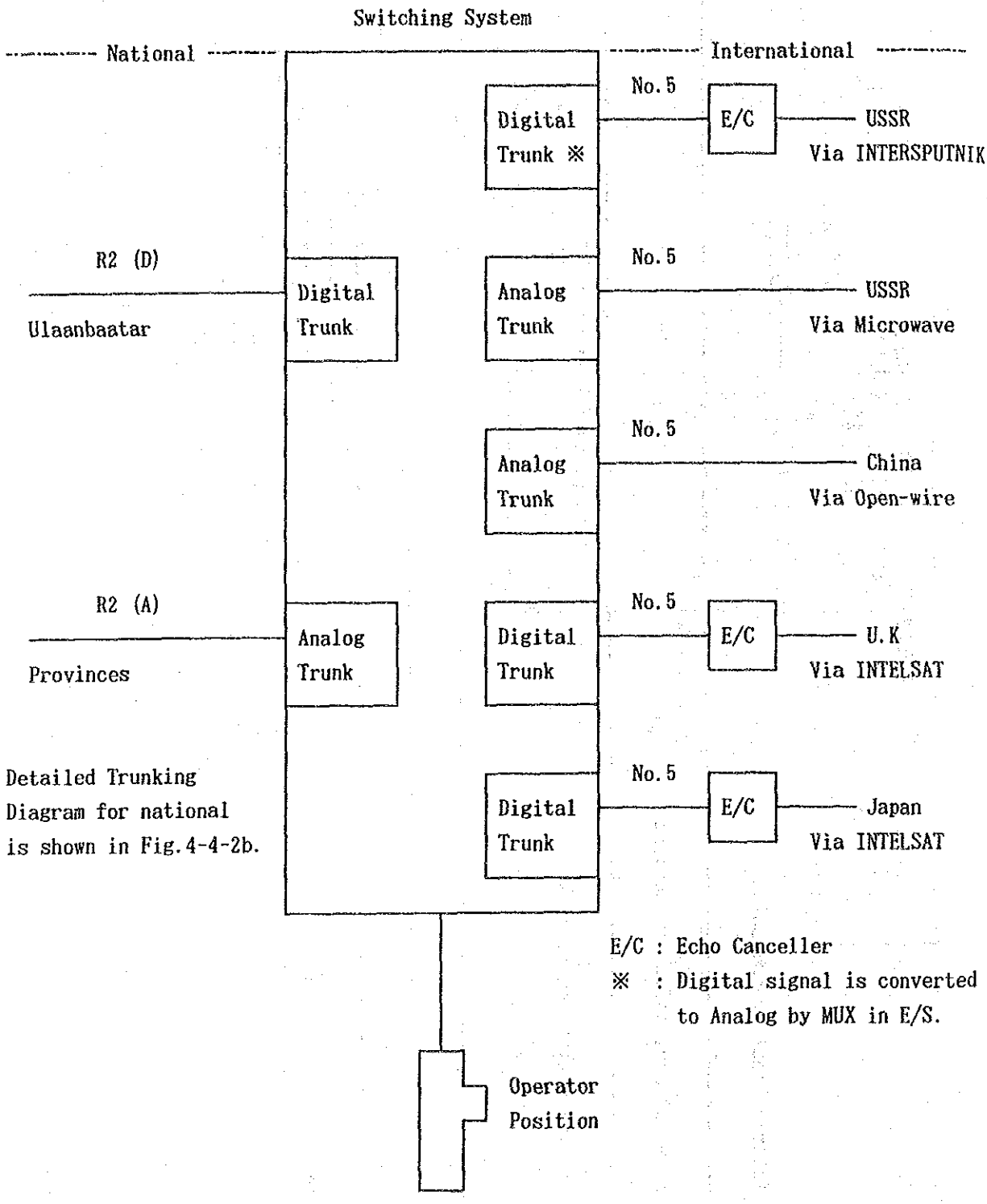


Fig. 4-4-2a Trunking Diagram

Incoming Circuits (I/C)				TDSW	Outgoing & Bothway Circuits (O/G & BW)			
Destination	Analog or Digital	Number of Channels	Signalling System R_2 or Man		Signalling System	Number of Channels	Analog or Digital	Destination
Arhangai	A	9	R2		R2	10	A	Arhangai
					Man.	2		
Baian-Ulgii	A	11	R2		R2	11	A	Baian-Ulgii
					Man.	2		
Baianhongor	A	10	R2		R2	10	A	Baianhongor
					Man.	2		
Bulgan	A	9	R2		R2	9	A	Bulgan
					Man.	2		
Govi-altai	A	10	R2		R2	10	A	Govi-altai
					Man.	2		
Dornogovi	A	9	R2		R2	9	A	Dornogovi
					Man.	2		
Dornod	A	12	R2		R2	14	A	Dornod
					Man.	2		
Dundgovi	A	8	R2		R2	9	A	Dundgovi
					Man.	2		
Zavhan	A	10	R2		R2	11	A	Zavhan
					Man.	2		
Uvurhangai	A	9	R2		R2	10	A	Uvurhangai
					Man.	2		
Umnugovi	A	9	R2		R2	10	A	Umnugovi
					Man.	2		
Suhbaatar	A	8	R2		R2	9	A	Suhbaatar
					Man.	1		
Selenge	A	12	R2		R2	13	A	Selenge
					Man.	2		

Fig. 4-4-2b Trunking Diagram

Incoming Circuits (I/C)				TDSW	Outgoing & Bothway Circuits (O/G & BW)			
Destination	Analog or Digital	Number of Channels	Signalling System		Signalling System	Number of Channels	Analog or Digital	Destination
Tuv	A	10	R2		R2	10	A	Tuv
					Man.	2		
Uvs	A	9	R2		R2	10	A	Uvs
					Man.	2		
Hovd	A	11	R2		R2	12	A	Hovd
					Man.	2		
Huvsgul	A	13	R2		R2	14	A	Huvsgul
					Man.	3		
Hentii	A	10	R2		R2	10	A	Hentii
					Man.	2		
Darhan	A	38	R2		R2	42	A	Darhan
					Man.	1		
Nalaih	A	10	R2		R2	10	A	Nalaih
					Man.	1		
Erdenet	A	23	R2		R2	25	A	Erdenet
					Man.	1		
Baganuur	A	10	R2		R2	11	A	Baganuur
					Man.	1		
Ulaanbaatar								Ulaanbaatar
					R2	421	D	

Fig. 4-4-2b Trunking Diagram

(4) Signaling system

International conforming to CCITT No. 5
National conforming to CCITT R2

In the future, the addition of hardware and software should enable conforming to CCITT No. 7.

(5) Numbering plan

International numbering plan shall comply with the CCITT Recommendation. National numbering plan shall basically conform to the existing numbering plan.

(6) Available services

1) Automatic call

This allows subscribers in Mongolia to dial directly to the international terminating subscriber. In the case of a transit inter-city call, transit connection is to be available automatically. Announce service will be also available.

2) Operator assisted call

Service by operator should include;

a) Station to station call
b) Person to person call
c) Collect call
d) Inquiry
e) Charge notification call

(7) Charging system

A detailed billing system is to be used to register tolls of international calls and national transit calls. Billing information will be collected automatically and output to a printer and a magnetic tape. Recorded information is as listed below.

a) Calling subscriber number
b) Called subscriber number
c) Starting time for charge
d) Call duration time
e) Chargeable time
f) Outgoing route number

The following charging system will be adopted.

International calls	automatic	every 1 minute
	semiautomatic	3 minutes + additional 1 minute
National transit calls	automatic	every 1 minute
	semiautomatic	3 minutes + additional 1 minute

4-4-2 Outline of System

(1) System configuration

1) Hardware

The system should be composed of five subsystems to share the functions. Each subsystem should meet the requirements for addition of function in itself.

a) Central processing subsystem: Function is to be divided into call processing and operation and maintenance.

b) Switching subsystem: To be composed of a time division switch and a speech path controller.

c) Line interface subsystem: To provide both analog and digital trunk interfaces to interface both analog and digital signals.

d) Operation and maintenance subsystem: To be composed of I/O devices, test devices, alarm display and man-machine interface.

e) Switchboard subsystem: To be composed of switchboards that allows manual switching, and a supervisor board to manage its operation.

The configuration is shown in Figure 4-4-3.

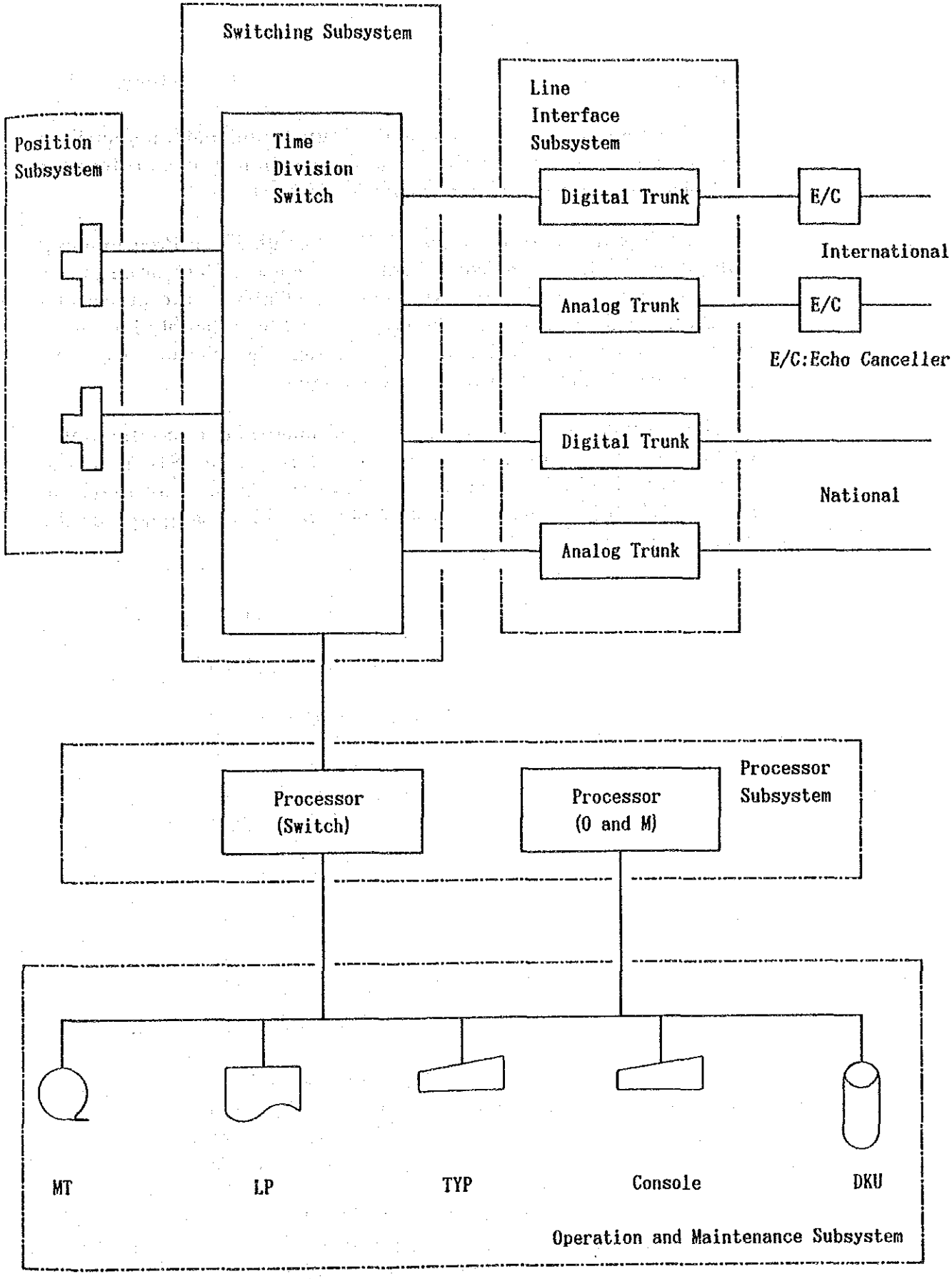


Fig. 4-4-3 System Configuration

2) Software

a) The program is to be composed of functional modules such as circuit control, connection control and operation and maintenance control and configured flexible to addition of functions.

b) As the programming language, CCITT High Level Programming Language (CHILL) or the equivalent shall be used. Such programs as call processing of which real time operation affects the processing capability of the system shall be programmed by assembly language, while auxiliary programs with less of a real time feature are to be programmed by the high level program language.

c) For expression of the functional and operational specifications, CCITT Specification and Description Language (SDL) or the equivalent should be used. Programs concerning man-machine interface shall be written in CCITT Man-Machine Language or the equivalent.

(2) Switching function

1) Switching

a) Call categories and traffic flow

Call categories and traffic flow are shown in Figure 4-4-4.

b) Routing

Sequential and random selection shall be available.

c) Connection control

Connection control should be allowed for any destination.

d) Overload countermeasure

An overload is to be detected and necessary control should be performed manually or automatically.

2) Operation and maintenance

a) System administration

① Man-machine interface

Commands for system test and administration can be entered through terminals with a CRT and keyboard. A message from the system is to be put out to the terminal.

② System control

By entering a command, changing the operation mode of the system, reconfiguration of the system, assign of magnetic tape, and make-busy of the circuit should be performed.

③ System monitor

The system shall be monitored continuously. When a fault occurs, it is indicated so that a maintenance personnel can take a counter-measure in time. Detailed fault information such as alarm of fault, faulty device, and class of fault should be displayed.

- Lamp and audible alarm of fault
- Printing out of fault on typewriter
- Indication of system condition

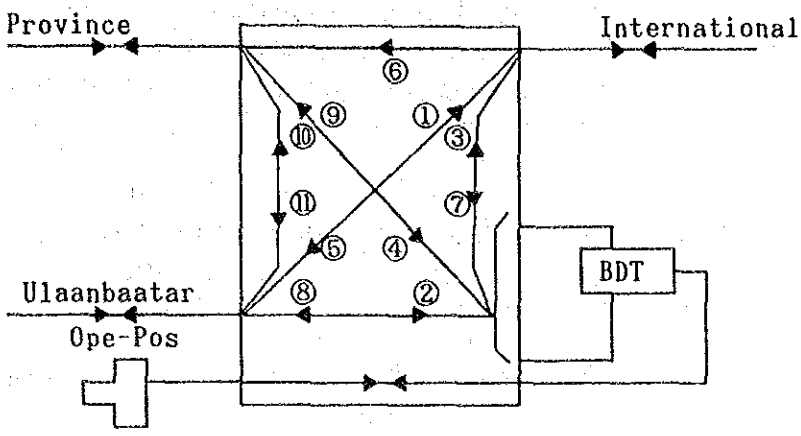
④ Expansion and modification

Extension of devices, expansion of office data, and modification of programs shall be available with ease.

b) Circuit and network administration

① Indication of circuit condition

The following status are displayed on the terminal with a VDU (visual display unit) and keyboard.



BDT : Board Trunk

		Route
(1) International Outgoing		
Automatic (ISD) calls	----------	①
Semi-Automatic calls	----------	②→③
(and manual)		④↗
(2) International Incoming		
Automatic calls	----------	⑤ & ⑥
Semi-Automatic calls	----------	⑦→⑧
(and manual)		↘⑨
(3) National Transit		
Automatic calls	----------	⑩ & ⑪
Semi-Automatic calls	----------	②→⑨
(and manual)		④→⑧

Fig. 4-4-4 Call Categories and Traffic Flow

- Number of total circuits
- Number of circuits in use and not in use
- Number of circuits in trouble
- Status of circuit and route

② System test

The following tests shall be available.

- Circuit monitor
- Access to operating circuit
- Trunk connection test
- Service trunk test
- Transmission characteristic measurement
- Contact with foreign ISMC

③ Network management

As specified in CCITT recommendation E.410 (International Network Management), the system should have the function of identification of abnormal condition and controlling of incoming/ outgoing traffic. For this purpose, the network management terminal should be provided to collect data for discriminating an abnormal traffic. A maintenance personnel shall take such traffic control as incoming call restriction and outgoing connection restriction.

④ Service observation

According to CCITT Recommendation E. series (service observation), a service observation terminal shall be provided to administrate the quality of international traffic service. The items of observation are as follows.

- International circuit observation (call quality, answer delay, false connection, etc.)
- Observation on traffic set up by maintenance personnel
- Observation through test call

⑤ Measurement of automatic transmission (option)

The system shall allow the provision of a function to measure automatic transmission, complying with CCITT Recommendation 0.22, to perform an automatic connection test on international circuits.

⑥ Traffic observation

The traffic shall be monitored at all times, and if necessary, data should be recorded on magnetic tape device or a printer by command input. Following data should be recorded.

- Number of completed call (outgoing, incoming calls)
- Total number of calls (automatic, manual calls)
- Traffic for each route
- Traffic for each destination

c) Fault recovery

① Detection and recognition of fault

A fault shall be detected by both hardware and software. When a fault is detected, it should be identified whether it is temporary or fixed. The system should be reconfigured.

② System diagnosis

Automatic or manual diagnosis should be available.

③ Restarting procedure

If any software or hardware fault occurs, call processing shall be interrupted for fault finding and system reconfiguration, then call processing should be automatically restarted.

④ IPL (Initial Program Loading) function

To recover from system down, one-touch IPL function shall be provided.

3) Switchboard service

Services offered on a switchboard are classified into three categories; connection by manual operation, operation service, and administration observation. A switchboard shall be a cordless type with a display and a keyboard.

a) Function of switchboard

The switchboard shall have the following functions:

Character display:	On VDU (visual display unit)
Input:	Keyboard
Booking/completion ticket:	Memory ticket
Retrieval of ticket:	Possible to be retrieved
Charging:	Automatic

b) Function of operation service

The switchboard shall be provided with the following functions for efficiency.

- Automatic charge calculation
- Automatic commencement of charging
- Retrieval of ticket
- Registration of operator's ID number on seating
- Group busy display indicating the all outgoing routes
- Queuing time display to indicate waiting time

c) Switchboard administrative function

The following switchboard administrative information shall be displayed on the administrative information display.

- Indication of queuing status
- Indication of working switchboards
- Indication of operator's attendance
- Indication of make busy on switchboards

4-4-3 Floor Space

The INTS/TS is to be installed in the telex room on the third floor of the MTA building, and switchboards are to be installed existing operator position room on the same floor. Considering initial installation and extension, necessary floor space are as follows:

Exchange room: $8 \times 8 = 64\,m^2$
Switchboard room: $8 \times 14 = 112\,m^2$

For the floor layout design the preconditions below shall be considered.

1) Floor space for future extensions shall be provided.

2) The path necessary for carrying in equipment shall not be blocked.

3) A maintenance area shall be secured around equipment.

4-4-4 List of Equipment and Instruments

The equipment provided for the implementation of the Project are as listed below. Because the existing measuring instruments in the MTA are for mechanical type exchange and not applicable to the new system, new measuring instruments for digital switching system are to be furnished. Repair parts and consumable parts, that will not be available on site, are also furnished for 5 years maintenance.

(1)	Switching system	
	Central processing subsystem	one set
	Switching subsystem	one set
	Line interface subsystem	one set (International 111 circuits, national 1000 circuits)
	Operation and maintenance subsystem	one set
	Switchboards	21 units (including one for observation)
	Echo canceler	one set
	Distributing frame	one set
(2)	Power supply	
	Rectifier	one set
	Battery (retaining time: 3hr)	one set
	Air conditioner	one set
(3)	Repair parts and consumable parts	one set

(4)	Measuring instruments and tools	one set
(5)	Documents	three sets

4-4-5 Cabling Diagram

Figure 4-4-5 shows the cabling diagram between the main system, power supply, and the subsidiary facilities (cell lights, emergency lights, grounding), as well as allotted share between the MTA and contractors.

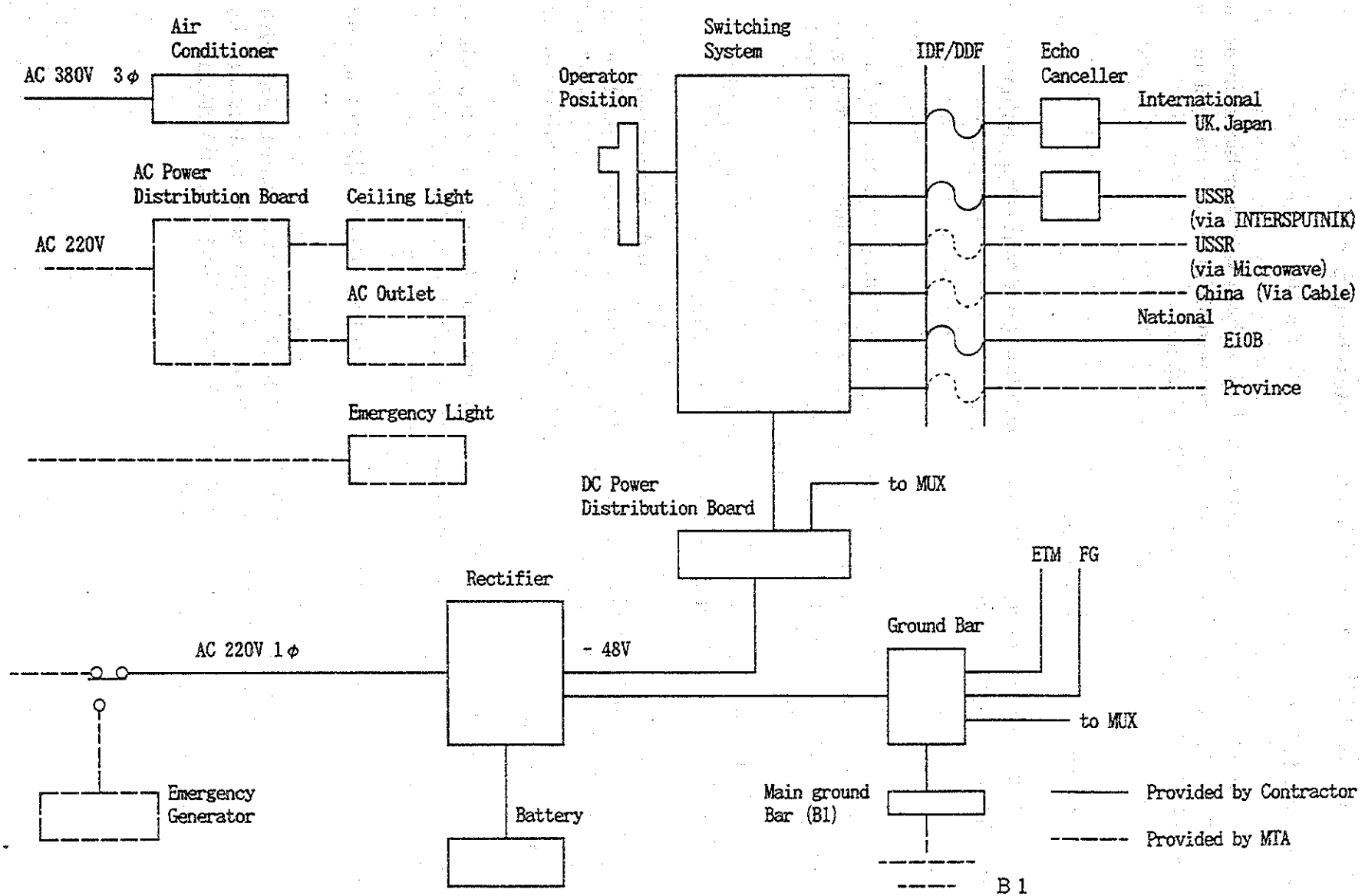


Fig. 4-4-5 Cabling Diagram