CHAPTER 1

BACKGROUND OF THE PROJECT

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Currently, the radio transmitting station of MRTV is obliged to operate the transmitter at about half load of their capacities. This is due to such backgrounds as superannuation of equipments, shortage of spare parts, and increase of operation and maintenance cost. As the result, the broadcasting service area has contracted quickly each year (For the current service area, refer to Appendix-6(4) “Estimation of Project Effects”). Especially, transmission to the remote area cannot be fully performed in satisfactory and the means of information distribution towards the nomads is being lost.

In order to cope with such situation, the Government of Mongolia selected three (3) stations (Ulaanbaatar, Altai, and Murun) among the existing seven (7) radio transmitting stations as for the Project objective location. The Government of Mongolia expects to restore the ratio of service area to the whole country up to 93% by installing a new 50kW transmitting system to Ulaanbaatar Transmitting Station, and 10kW transmitting system to Altai and Murun Transmitting Stations. In order to procure and install the above-mentioned equipments, the Government of Mongolia requested the Government of Japan for the assistance through Japanese Grant Aid.

CHAPTER 2

CONTENTS OF THE PROJECT

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2-1 Basic Concept of the Project

At the existing radio transmitting stations, some transmitters have been forced to stop operation due to technical failures, and, in other cases, superannuation of transmitters are advancing near the life limit of the transmitters. Furthermore, it was obliged to reduce the power output to nearly half of normal operation due to shortage of the spare parts and increase of operation and maintenance cost. For these reasons, the broadcasting service area has decreased quickly. As the result, broadcasting to the remote areas cannot be performed satisfactorily and the means of information distribution towards the nomads is being lost.

In order to cope with such situation, the Government of Mongolia aims to set up an opportune service area, design and determine the specification of short wave radio transmitting systems and then install the equipment at site. Currently, the ratio of service area to the whole land area of the country is approximately 47% when radio propagation conditions are at the optimum case. The objective of the Project is to raise the service ratio up to approximately 93% under the same conditions.

The Project aims at fulfilling the objective by supply and installation of a new 50kW short wave transmitting system to the existing Ulaanbaatar transmission station in Ulaanbaatar City of Central Aimag, and of a new 10kW system each to the existing Altai and Murun transmitting stations, located in Altai City of Govi-Altai Aimag and Murun City of Khuvsgul Aimag, respectively.

2-2 Basic Design of the Requested Japanese Assistance

2-2-1 Design Policy

2-2-1-1 Basic Policy

(1) Scope of the Japanese Assistance

The Project will install new short wave transmitting systems which will enable to improve the nation-wide radio broadcasting service area. The scope of the Japanese Assistance is supply and installation of the short wave transmitting system. However, it is necessary to keep in mind, that short wave transmitting system by itself cannot provide a certain direct benefit to the listener. That is because the benefit of the listener will be recognized only after the following processes are fully completed. First, the radio program made in the broadcasting center of the Mongolia Radio and Television (MRTV) in Ulaanbaatar needs to be sent to each transmitting station using radio or a transmission line. Then, the radio program must be sent out from the transmission station on a radio wave that will reflect on ionosphere and, finally, the program will reach the listener's radio set.

Therefore, it is necessary to connect a series of the following processes continuously for the realization of the benefit.

1) An attractive radio program is made for the listener, using opportune equipments.
2) The radio program is certainly sent to the transmitting station.
3) The radio wave that has the appropriate quality is transmitted from the transmission station.
4) The listener owns the radio set of proper quality.
5) The listener listens to the radio program.

The scope of the Japanese assistance will be limited to the subjects which are deemed difficult to be realized by the self-help effort of the Mongolian side. Therefore, item 3) among the above five items will be covered by the Japanese assistance. The assistance project will install a short wave transmitting system in three existing radio transmitting stations namely, Ulaanbaatar, Altai and Murun. Moreover, it must be understood that above-mentioned item 2) at the Ulaanbaatar transmitting station is indispensable in order to assure the above-mentioned item 3) for the transmitting station. Specifically, this scope of assistance includes improvement of the program transmission system (STL) between the broadcasting center and the transmission each located in Ulaanbaatar.

(2) The Guiding Principle of the Design

The basic design of the Project is decided to be carried out under the following guiding principles.

1) The output power of the transmitting equipment is determined to obtain the required field strength inside the service area. For this reason, the broadcasting frequency is to be appropriately switched by season and hours of the day in order to practically obtain the required field strength throughout the year.

2) In consideration of the step-by-step shutdown of the existing superannuated short wave, medium wave, and long wave transmitting equipment, it is planned to cover the predetermined service area with the short wave transmitting equipment supplied by the Project.

3) Two sets of transmitting equipments will be secured, while one equipment will be operated regularly. In case that any failure occurs to the first equipment, the second equipment will take over the operation. In this way, uninterrupted operation of broadcasting will be secured.

4) The dimension of the transmitting equipment is planned to be as compact as possible since it will be installed in a limited space inside the existing transmitting station.

5) An equipment easy to perform operation and maintenance, and at the same time, that bears severe natural conditions (lowest outdoor temperature recorded is -40 degrees centigrade), and is widely used and robustly made will be selected.

6) The equipment shall adopt proven technology, without limitation to any technological systems or equipment, and have sufficient field records.

7) By designing the transmitting equipment with excellent power-saving efficiency, it can save operation and maintenance expenses and will contribute to mitigation of fiscal burden as well.

(3) Determination of the Service Area of the Short Wave Broadcasting

The public short wave radiobroadcast started operation from the second half of the 1970s in Mongolia. At the beginning, there were seven short wave transmitting stations, namely, Ulaanbaatar, Altai, Murun, Dalanzadgad, Choybalsan, Ulgii and Sainshand. The output powers of these stations were 100kW for Ulaanbaatar and 12kW for other stations. In order to compensate the demerit of unstable short wave propagation due to influence of the solar activity, long wave and medium wave transmitting equipment were also installed in these stations. It was aimed to realize a nationwide radio broadcast by carrying out a mutual supplement of the three radio-wave form and employing them synthetically. However, at the present, most of the short wave transmitting equipment is already out of order or discarded due to failure.

As mentioned above, the existing transmitting stations were constructed to transmit short wave, medium wave and long wave in combination. However, this new Project aims to cover the nation wide service area by an independent operation of the short wave transmitting system. As a judgment criterion, the electric field strength is adopted to evaluate the condition of receivable wave within the service area. Target electric field strength shall be set around 50dBμV/m, considering that minimum audible level of radio receiver widely used in Mongolia is 38dBμV/m and that 50dBμV/m is employed in Mongolia as a satisfactory audible level.

Due to the characteristic of short wave, the electric field strength is strongly influenced by the condition of the ionosphere; therefore, the value greatly changes by season and time. As a conclusion, the target electric field strength is not strictly specified as more than 50dBμV/m. Instead, a certain range is permitted to this numerical value. It should be understood that the area where an electric field strength to that extent can be recognized as the service area.

(4) Selection of the Project Site and Transmitter Output Power

1) Selection Policy

In order to consider the whole country as the service area, an opportune site is selected out of the existing transmitting stations. Then it is necessary to select the transmitter output power that will enable approximately 50dBμV/m electric field strength to be obtained within the service area. For consideration, if the number of sites is lessened and the transmitting system of a large output is installed, the unit cost per output power will become low. However, the interference problem accompanied by the large output transmission may occur which will oblige adjustment with neighboring countries.

On the other hand, reliability will improve when installing the transmitting system of a small output in several sites, even though the unit cost per output power increases. Taking the above factors into consideration, the policy would be to select the optimum transmitter output power that fulfills reliability and economical efficiency to the minimum number of sites to cover the whole country.

2) Selection of the Site

Within the existing transmitting stations, the Ulaanbaatar transmitting station has a function as the central station. And in comparison, both transmitting stations in Altai and Murun are bearing a role of a base station for the western and northern area, respectively. Geographically, these three transmitting stations are in a triangular position relation. The Mongolian side also recognizes that these three transmitting stations are high on the list of priorities when performing a broadcast in a vast country.

Among the mentioned three transmitting stations, main areas of the country can be covered by the service areas of Ulaanbaatar and Altai transmitting stations. However, the role of Murun transmitting station and the meaning to install a short wave transmitting system in Murun is large. The necessity and validity are summarized as follows.

a) If only Ulaanbaatar and Altai transmitting stations will be the stations to serve Murun and its circumference areas, the electric field strength becomes below a permissible level at the time and the season when the propagation condition is not in favor. For this reason, receiving the broadcast in a satisfactory condition would not be possible. In order to obtain the required field strength, it is necessary to install a short wave transmitting system in Murun transmitting station.

b) The Khuvsgul Aimag in which Murun transmitting station is located is an important location based on Mongolia development plan, and also has a large population of 119.8 thousand (statistics of fiscal year 2000). Reservation of the broadcasting means that assure such service area is one of the basic conditions of promoting the development plan. Furthermore, satisfactory listening level is difficult with the usual broadcasting means of medium wave and long wave that employ a ground surface wave, since the mountains zone spreads out in the area. For this reason, a short wave broadcast that utilizes an ionosphere reflective wave and is not greatly influenced by geographical feature is indispensable.

c) In the north of the Khuvsgul Aimag, a small tribe called Tsaatan resides in high mountains living on nomadic life. The only means of the information distribution to this minority tribe is by the radio, and the Mongolian government is performing special consideration for their relief. And as part of it, information distribution by short wave broadcasting is the urgent subject.

3) Authorized Carrier Frequency

Carrier frequencies of each transmitting station of the Project was determined to be used for the Project, as listed below, by the Ministry of Infrastructure (MOI) who is responsible for radio-wave administration in Mogolia.

- Ulaanbaatar: 4,850kHz / 7,260kHz / 9,305kHz
- Altai: 4,830kHz / 5,950kHz / 9,430kHz
- Murun: 4,895kHz / 6,100kHz / 9,560kHz

These frequencies are assigned by International Telecommunications Union (ITU). On this basis, international frequency registration is performed by International Frequency Registration Board (IFRB) that is the internal organization of ITU. Moreover, these frequencies have been or were actually used when domestic short wave broadcasting was commenced in Mongolia. Therefore, these frequencies are employed as a given condition in the basic planning and designing of the Project.

4) Selection of Transmitter Output Power

The output power of the transmitting system is figured to obtain the required field strength within the service area. For this purpose, a widely used short wave propagation predicting method is applied in determining the electric field strength for each hourly time of the seasons and number of sunspots. Consequently, it is determined to install short wave transmitting system that has the following outputs at each transmitting station.

- Ulaanbaatar: 50kW

- Altai: 10kW
- Murun: 10kW

Each of the transmitting systems shall have three transmitting frequencies as mentioned above to obtain the required electric field strength. It has been confirmed by the calculation that the electric field strength practically required could be obtained through the year by switching the frequency corresponding to the condition. The detail operation concept is described in "2-2-2-4 Basic Design".

The output of each transmitting station shown above is nearly the same output power at the time when the existing transmitting station started operation, and it is considered to be the appropriate scale considering the operation and maintenance capability of MRTV.

(5) Measure for Securing the Reliability of the Transmitting System

If the role of a radio broadcast is taken into consideration, it is necessary to avoid a broadcasting discontinuation due to failure or fault of a system at any cost. As a measure for such situation, the system configuration shall enable to start the second transmitter unit quickly when the first unit lapses into an operation stop. Such a kind of standby system (or change-over system) is indispensable to assure a reliable broadcasting.

The two of the transmitting stations to be installed with new equipment are located at remote locations and all three are under severe natural environments. Therefore, in order to correspond in urgent cases, securing proper quantity of opportune kind of spare parts is necessary. Furthermore, installation of emergency power generation system is considered for the site where the reliability of electric power supply is low as experienced at the Altai transmitting station.

(6) Measures for Securing the Sustainability of the Project Effect

In the existing transmitting stations, the electricity expense related to operation of the transmitting system occupies about 80% of the operation and maintenance expense, and this serves as the big burden on fiscal management. By transposing the existing transmitting system to a system excellent in energy-saving performance, it is possible to cut down amount of electricity consumption, and it is expected to contribute to mitigation of fiscal burden.

If reduced amount of electricity expense can be utilized as funds to purchase spare parts, it will contribute to secure the sustainability of the Project effect. According to the trial calculation, possible cost saving from decrease of power consumption was equal to about 40% of the annual expense for purchasing spare parts. Therefore, the Basic

Design of this Project takes into consideration the energy saving design of the transmitting system.

2-2-1-2 Natural Conditions

(1) Altitude

Altitudes of the three subject sites are over 1,000m (the highest altitude is 2,134m of Altai). The design of equipment shall consider the atmospheric pressure of each site to assure stable operation under such condition.

(2) Temperature

According to the meteorological data, the lowest temperature of the subject site is recorded as -40.0 degrees Celsius (lowest recorded at Murun), and the maximum as 36.9 degrees Celsius (lowest recorded at Murun). The design of equipment shall take into consideration the maximum and minimum temperatures of each site in order to ensure the reliable operation of the equipment in such harsh conditions. Likewise, in consideration of the reliability of present heating system of the building, the equipment that is installed indoors shall be designed to correspond to the estimated indoor minimum temperature. Accordingly, the selected equipment to be supplied shall be durable, and at the same time, excellent in cost and performance.

(3) Humidity

According to meteorological data, the relative humidity of all subject sites is 70% or less. The design of the equipment shall take the above into consideration.

(4) Rainfall and Snowfall

The precipitation of the subject site for the past five years is approximately 300mm per year. Equipment such as antenna and feeder that are planned to be installed outdoor shall consider adequate corrosion and waterproofing function, and snow loading. Equipment that will be installed indoor will not consider rainfall or snowfall. Although the snowfall data of the subject site has not come to hand, it is surmised to be approximately 200 to 350mm per year according to nationwide data. In the design of outdoor installed equipment and materials, adfreezing load of 50kg/m^2 will be adopted according to the Mongolian regulation.

(5) Wind

The average wind velocity at the Project sites is approximately 2 to 4m/sec according to the meteorological data available in Mongolia. For the design of the Project, however, recorded maximum wind velocity of 36m/sec shall be considered.

(6) Dust

The Project sites are very dry, reflecting the continental climate. Since most of the surrounding topsoil was found to be clayey or silty sand, the sites are located in a dusty environment. In order to protect the equipment from contamination by the dust, installation of dust filters or collectors shall be considered in the design of the cooling method of the transmitters.

(7) Lightning

According to the meteorological data of the subject site, lightning generation is recorded mainly from June to August every year. It is assumed that inductive lightning from the antenna may damage the transmitter equipment. Hence, lightning protection shall be considered in the design of the antenna.

(8) Soil

Soil condition is a important factor to be considered for determining size and depth of anchor foundations for antennas. Conditions of the existing antenna foundations were examined carefully since new antennas procured under the Project are installed in the middle of the existing antennas. As a result, no serious unequal settlement or lifting was found. Accordingly, the soil data applied for design of the existing foundations are appropriate to be utilized for design of this Project. The outline of the soil data is shown in the Table 2-1.

Table 2-1 Design Data of the Existing Antenna Foundations

1. Ulaanbaatar Transmission Station	
Soil Characteristic : GL±0 to GL-1.5m	Sand
Soil Characteristic : Lower than GL-1.5m	Sand with gravel
Theoretical Freeze Depth (m)	-4.60 m
Design Bearing Capacity of the Soil (t/m^2)	20 t/m^2
2. Altai Transmission Station	
Soil Characteristic : GL±0 ~ -1.8m	Sand
Soil Characteristic : Lower than GL-1.8m	Clayey silt
Theoretical Freeze Depth (m)	-4.40 m
Design Bearing Capacity of the Soil (t/m^2)	20 t/m^2
3. Murun Transmission Station	
Soil Characteristic : GL±0 to -1.2m	Sand
Soil Characteristic : Lower than GL-1.2m	Silty sand
Theoretical Freeze Depth (m)	-4.30 m
Design Bearing Capacity of the Soil (t/m^2)	20 t/m^2

Source: “Ulaanbaatar Transmitting Station Technical Design Data” USSR Ministry of Communication State Design Research Institute 1960, “Murun Transmitting Station Technical Design Data” same as above 1977 and "Altai Transmitting Station Technical Design Data” same as above 1997

(9) Earthquake

It is rare to experience a palpable earthquake in Mongolia. Magnitude of the earthquakes, once it occurs, is not always small. In the Mongolian standards, Ulaanbaatar and Murun are stipulated as scale 7 and Altai at scale 8. Level 7 and 8 of the Mongolian earthquake standard are equivalent to scale 4 to 5 (44 - 250 Gal) of the seismic intensity scale by Japan Meteorological Agency. Accordingly for this Project, the seismic intensity coefficient k_h=0.2 is assumed in the design as for earthquake countermeasure.

2-2-1-3 Social Conditions

Livestock such as sheep, cows and horses play a vital role in the livelihood of the nomads. In order to sustain and stabilize their nomadic life, distribution of timely weather bulletin as well as of market information for the stock farming is deemed to be essential. Furthermore, correction of the information gap can be attained by offering important information from the center of the country (Ulaanbaatar) to the remote areas.

When determining scope of the equipment for this Project, it is important to take into consideration minimum electric field strength that can be received by Russian and Chinese made radio sets widely used in Mongolia.

2-2-1-4 Background of Construction Industry

(1) Applicable Permissions Related to the Project

1) Environmental Assessment and Permission

The Mongolian Law on Environmental Impact Assessment was enacted on January 21, 1998. It is deemed that the affect to the environment will be minimum, since the entire transmitter and related equipment to be supplied by the project will be installed in the existing transmission stations. However, in any case when Environmental Permission is required by the above law, it has been agreed upon the parties that the Mongolian side will take full responsibility to apply and obtain the permit before implementation of the Project. The following article may apply to this Project.

"4.1 Initial environmental examination is required in a project which involves reconstruction or extension of an existing building."

"4.2 Such initial examination shall be conducted before implementation of the Project."

In order to undergo the initial environmental examination, the following documents must be submitted to the Ministry of Nature and Environment.

- Outline of the Project
- Drawings of the Project
- Specification of the antenna
- Radiation field level
- Amount of earthwork
- Consumption amount of tap water

The examiner who will be appointed by the Ministry of Nature and Environment will then review the documents and will make one of the following conclusions regarding the status of the Project.

- Project that do not require Environmental Impact Assessment
- Project that are permitted with condition
- Project that requires Environmental Impact Assessment

2) Necessary Formalities with Regard to Radio Wave Transmission

Current "Radio Law" of Mongolia regulates the assignment, operation and possession form of radio waves. It is confirmed that all formalities required regarding the radio transmission of the Project are the burden matters by the Mongolia side, including the provisions regarded as important shown below.

- "If descriptions do not vary from the Mongolia international treaty, the matters related to radio waves between the neighboring countries will be adjusted in accordance with the procedure enacted by the International Telecommunication Union." (Article 5.2.2)
- "The radio frequency which the right of use is awarded shall be used, protected and dissolve any radio wave interference according to this law." (Article 19.1.2).
- The radio frequency coordination bureau and national communications auditor are responsible for control towards realization of establishing the "Radio Law" in Mongolia." (Article 20.1).

3) Labor Law

Currently, the "Labor Law" revised in 1991 is applicable in Mongolia. The law specifies subjects such as labor contract, office and recess hours, wages, labor regulations and environments, woman and minor labors, labor adjustment, rule execution etc, which will apply also to this Project.

4) Land Acquisition

Since all the equipments of this Project are planned to be installed in the existing transmission station area, it is assumed that additional land acquisition is unnecessary. By any possibility, when land acquisition of a small division is necessary, acquisition of land is agreed to be carried out on the responsibility by the Government of Mongolia.

(2) Design Standards

Major standards related to construction work in Mongolia are SNIP (Russian Standard for structural design) and YCT (material standard based on the Russian Standard for material; GOST). However, at the same time, standards of Japan or Western countries are applied in many cases. It is widely recognized that a foreign standard can be adopted when contents of such work or material are not found in the Mongolian standard and when such foreign standard is equivalent to the international standard.

2-2-1-5 Consideration for Utilization of Local Consultants and Contractors

(1) Local Consultant

In Mongolia, a consultant of a neutral position who provides professional services did not exist until very recent. A few pure consulting firms established in recent years mostly carry out social development or environmental field as their specialty. It is judged that the local consultants have thorough knowledge of the country which can be effectively utilized for the Project under the Japanese Consultant.

(2) Local Transportation Company

Most of the major transportation companies in Ulaanbaatar hold a warehouse and a freight terminal near the Ulaanbaatar railway. The freight terminal is connected by a branch line from the trunk railroad allowing cargo to be carried directly into the warehouse where custom procedures can be performed. By and large, the capacity and security of these warehouse and freight terminal are adequate to be utilized for the Project.

It is common in Mongolia that the local transportation company owns only a few transportation trucks for inland transportation. Normally the transportation company will hire individual truck owners when needed to accomplish their work.

In the event that this project is carried out, it is necessary to examine suitable operating scope for the local transportation company, by taking into consideration of the company's capability.

2-2-1-6 Policy on the Operation and Maintenance Capability of the Executing Agency

Since short wave transmitting systems (25kW, 100kW, and 250kW) are employed at the Ulaanbaatar transmitting station, operation and maintenance organization still exists. On the other hand, both at the Altai and Murun transmitting stations, the 12kW short wave transmitting systems were employed till 1997. The staff who was in charge of the operation is also on the register now. Therefore, at these three transmitting stations, it is not necessary to devise measures, such as newly assigning a staff in connection with implementation of this project. It is judged that the existing operation maintenance organization can properly deal with the new systems. However, the short wave transmitting system introduced for this project applies the latest technology. It differs from the short wave transmitting systems manufactured in the former Soviet Union a few dozens of years ago. Therefore, acquisition of the technology asked in operation and maintenance of the short wave transmitting system supplied under this project is indispensable. It is desirable to perform educational training for that using the scheme of a soft component.

2-2-1-7 Policy on the Setup of Grades on the Equipment and Materials

Three existing transmitting stations, namely, Ulaanbaatar, Altai, and Murun shall be the Project sites, as stated in “2-2-1-1(4) Selection of the Project site and transmitter output power”. Short wave transmitting systems shall be installed at each site. Transmitter output power shall be 50kW at Ulaanbaatar, 10kW at Altai, and 10kW at Murun. The number of transmitter installed at each station shall be; one working transmitter at Ulaanbaatar; one working and one standby transmitters at Altai; and one working and one standby transmitters at Murun.

In addition to these, at the Ulaanbaatar transmitting station, a set of program transmission (STL) system for one channel is installed as a measure for raising the reliability of the program transmission system that is one of the central functions of a short wave broadcast system. Moreover, spare parts of the proper kind and quantity as for the short wave transmitting system installed at the three transmitting stations shall be supplied to assure continuous operation of the short wave transmitting systems. Furthermore, at the Altai transmitting station where power supply situation is poor, emergency diesel generator shall be installed.

Since the Project is expected of continuous Project implementation effect, equipment and materials supplied under the Project need to be excellent in flexibility, durability and cost performance. Furthermore, it is a prerequisite condition that it is easy to carry out operation and maintenance after supply. It is desirable that equipment and materials shall be applied with proven technology, having fair operational records, rather than with highly advanced technology.

2-2-1-8 Consideration of Procurement Method and Implementation Schedule

(1) Procurement Method

The use of local materials is encouraged to curtail the expenditure. However, in the remote area of the country, it has to be taken into consideration that the quality and the quantity of materials are unstable. Accordingly, the Project will purchase all local supplied contents in Ulaanbaatar where above mentioned concerns can be avoided by intensive quality control. On the other hand, Japanese supplied materials and equipment shall be accommodated to the local natural conditions, such as temperature and dust and at the same time it shall be in opportune price.

(2) Implementation Schedule

The implementation schedule of the Project shall consider harsh local conditions, such as very low outdoor temperatures and long-distance inland transportation of the equipment and materials on the unpaved poor roads. It is therefore necessary to carry out the site work in the months from May to October of the year when outdoor work can be easily done and transportation can be made easier.

A comprehensive evaluation was made to the required periods for procurement, transportation, and installation of the equipment and materials, together with a requirement for minimization to the Project cost. As a result, it is judged that the Project should be implemented in a single stage, thus enabling the Project to be implemented in the most practical and efficient manner.

2-2-2 Basic Plan

2-2-2-1 Basic Concept of the Basic Plan and Design

(1) Service Area and Required Field Strength

In accordance with the requests from Mongolia, a service area whose coverage benefits 95% or more of the national land and 97% or more of the population of the country is assumed. Ulaanbaatar, Altai and Murun are selected as the transmitting sites where 50kW, 10kW and 10kW transmitting systems are installed in the respective locations. As the field strength for radio wave reception, 50dB μ V/m is regarded as a guideline; to meet the fluctuation of ionospheric layers, transmitting frequencies should flexibly be switched in the daytime and at night every day as well as in each season so that the said service area and field strength should be secured. Expected service area by implementing the Project is indicated on the Basic Design Drawing C-11.

(2) Measures to Ensure Continuity of the Project

In order to efficiently operate and maintain the radio transmitting facilities on a long time basis, it is essential to increase broadcast revenues as MRTV's capital resources of operation, maintenance and management. However, due to its nature as a public broadcaster, it will not be likely that advertisement sales will drastically increase, so a realistic measure should, in effect, be reduction of expenses.

At the existing transmitting stations, electricity charges required for the operation of the facilities reach near 80% of the total running cost. By replacing the obsolete transmitter facilities with new and highly energy-saving equipment, it is feasible that the operation, maintenance and management costs should be largely reduced. The basic design study should therefore take into consideration introduction of energy-saving facilities.

(3) Considerations for Operation, Maintenance and Management

To realize efficient and long-term use of the modern transmitting facilities to be provided through the implementation of the Project, it is necessary to select items of equipment that are suitable for actual on-site conditions. At the time of selection, the equipment shall satisfy at least the following conditions:

1) the equipment shall have technical specifications that can stand hostile natural environments of the sites,
2) the equipment shall be excellent in flexibility and robustness, and
3) the equipment shall have sufficient filed records and be suitable for easy operation, maintenance and management.

As the existing facilities were made in the former Soviet Union, all the associated drawings, operations manuals, equipment labels, etc. are in Russian. In introducing the new facilities, the English language will be used for descriptions of the transmitting systems and equipment. It is to be considered, however, to apply Mongolian indications, as well as the English indications, of the main equipment and other important functions in terms of easy operation and maintenance.

As skill improvements of local staffs at the transmitting stations are also indispensable for operation, maintenance and management of the facilities, “soft components” training program should also be incorporated into the Project as a measure to educate and train the personnel.

(4) Designs Reflecting Harsh Natural Environments

As the temperature in winter at each site is as low as -30 to -40 degrees centigrade and is very hostile, special countermeasures against cold regions must be required in designing the transmitting systems. Forced air-cooling and forced water-cooling are major methods of transmitter cooling systems, but, in terms of operations in cold regions, the forced air-cooling is more advantageous. If this method is adopted, it is necessary to install dust preventative filters at the outdoor air inlets and to mount filters at the air inlets of the transmitters.

As the frozen depth of the land of each site reaches 3.4m to 3.9m, the foundations for the antenna system must be deeper than the said line in order to prevent any freeze.

(5) Setup of Audible Levels Suitable for Radio Receivers in Use

Radio receivers commonly purchased by local residents (nomads) at their markets ("Zaha") are standard types made in Russia or China, and their signal reception quality is not so high. However, taking into the fact that the people's disposable incomes are low, it is necessary to set up the audible level requirements appropriate for the radio receivers easily available for the nomads.

MRTV, the Mongolian executing agency, states that a type of Russian radio receivers is popular in Mongolia and that it is therefore reasonable to take this receiver into consideration as an example of typical reception performance of the receivers in use in the country. This receiver can receive long, medium and short (6 band) waves and covers a short wave range of 1.6 to 21.75MHz. Its sensitivity in the short wave band is 75μV/m, and its audio output is 150mW. As this receiver is compatible with the audible level of as many as 38dB, it is deemed reasonable to set the minimum field strength within the service area to be 40dB.

(6) Design and Implementation Considerations to Avoid Interruptions of the Existing Transmitting Facilities

At each of the transmitting stations at Ulaanbaatar, Altai and Murun, some of the existing transmitters, antennas, power supplies, program transmission lines, etc. are currently in use for radio program broadcasting. In this Project, some of the existing equipment will be used, so it may be necessary to temporarily shut down the power supplies or interrupt operations of the existing equipment. Even if this becomes necessary, it will be important to minimize the periods of such service interruption.

During the construction periods, it may also become necessary for those working on site to approach or handle the existing equipment, and here again measures to prevent any interference with the operation will be required. Either way, close coordination with MRTV at the time of the Project implementation will be essential.

(7) Safety Measures

In taking such measures as planned power shutdown or service interruption, the first priority is on human and equipment safety. Further, as to the transmitters, antennas and other equipment and facilities to be newly installed, such measures to prevent any easy access by strangers should be taken, for example:

1) Ensuring security (24-hour monitoring by security guards, construction or repair of fences, and multiple security measures at the entrances)
2) Measures to prevent easy tampering of the switches of the important equipment by anyone other than the staffs
3) Installation of mechanical interlocks to restrict unprepared entry into the transmitters

2-2-2-2 Current Situations of the Sites to Install the New SW Transmitting Systems

(1) Current Situations of the Existing Buildings and Indoor Equipment

In installing the planned transmitting equipment, the existing buildings and indoor utilities must be available at least. The current situations of the sites subject to the Project are as follows:

1) Ulaanbaatar Transmitting Station

Built in 1958, the existing building is a 2-story ferro-concrete structure with a total floor area of 1,700m^2. The building offers an efficient arrangement of a management section (office, rest room, lavatory, etc.) and an equipment section (transmitter room, electricity room, control room, etc.) and satisfies the required standard of the transmitting stations.

a) Building Status

According to explanations made by MRTV, the building is generally being decrepit, and its structural issue were pointed out by experts as a result of structural surveys. As a matter of fact, some large cracks were observed during site survey by the study team, particularly, on the walls built between D-7 and D-8 columns on the ground floor, and between D-8 and D-9 columns on the first floor. It appears that applications of epoxy resin and other reinforcing materials might help recover some strength, but detailed surveys and studies are required by the Mongolian side to make measures towards solution to the structural issue.

Since provision of openings on some walls will be required in the course of implementation of the Project, it is necessary for the Mongolian side to make careful measures to prevent occurrence of decrease in the structural strength of the building.

b) Equipment Entrance

In order to install the 50kW transmitter and associated equipment at its final location at the space on the first floor, it will be necessary to expand a part of the wall. At the time of bringing transmitter and equipment into the building, a track crane will be required.

c) Equipment Installation Space

The equipment room on the first floor planned to install the 50kW transmitters once accommodated 2 sets of Russian 50kW transmitters and provides a space sufficient for installing the new transmitter.

d) Equipment Foundation

The compressive strength of the existing foundation at the first floor tested by the Schmidt hammer was approximately 1,500N/cm^2. On the other hand, the load per unit area of the new transmitters is as small as approximately 0.9N/cm^2, so they will hardly affect the foundation in terms of load-bearing capacity.

e) Power and Control Cable Routing

The existing cables and floor ducts are available. However, when cables are laid in these ducts, it will be necessary to mount cable supports, etc.

f) Antenna Feeder Routing

Along with the installation of the antenna system, a through hole in the wall to connect open type feeder must newly be prepared.

g) Indoor Ventilation and Air-conditioning Systems

The indoor ventilation and air-conditioning systems of the building are normally operating at present and can be used as it is.

2) Murun and Altai Transmitting Stations

Built in 1975, the existing building at each station is a single-story ferro-concrete structure with a total floor area of 700m^2. The building offers an efficient arrangement of management section (office, rest room, lavatory, etc.) and equipment section (transmitter room, electricity room, control room, etc.), and satisfies the required standard of the transmitting stations.

a) Building Status

The existing building is presently used without any particular problems. Though some cracks are observed on the walls, no other issue to note is observed.

b) Equipment Entrance

There is a need for widening of the passage door or of part of the wall in order to install the 10kW transmitter at the left hand side of the existing transmitter room. No other issue to note is observed.

c) Equipment Installation Space

Though not fairly wide, spaces to install 2 sets of 10kW transmitters can be provided.

d) Equipment Foundation

The compressive strength of the existing foundation tested at the floor level by the Schmidt hammer was approximately 1,350N/cm^2. On the other hand, the load per unit area of the new transmitters is as small as approximately 0.5N/cm^2, so they will hardly affect the foundation in terms of load-bearing capacity.

e) Power and Control Cable Routing

The existing cables and floor ducts are available. However, when cables are laid in these ducts, it will be necessary to mount cable supports, etc.

f) Antenna Feeder Routing

Along with the installation of the antenna system, a through hole in the wall to lay coaxial cable type feeder must newly be prepared.

g) Indoor Ventilation and Air-conditioning Systems

The indoor ventilation and air-conditioning systems of the building are normally operating at present and can be used as it is.

(2) Fitness as Sites Planned for Installations of SW Transmitting Systems

In this Project, new SW transmitting systems will be installed at the existing transmitter stations, and the planned sites are as if it were given conditions. However, in order to assure that the functions and performance of the SW transmitting systems can fully be taken advantage of, it is essential to determine fitness of the planned sites to this goal.

Given below are basic items of location requirements for transmitting stations, followed by a review of whether these conditions are actually satisfied or not.

1) Spaces for reasonable and robust construction and/or installation of a station building, an antenna tower, a grounding system, etc. shall be available on the station site.
2) Sites must be best suitable for protections against hostile environments surrounding transmitting stations, especially wind, snow and lightning troubles.
3) Sites should not interfere with or be interfered by the existing radio stations.
4) Easy access to power line must be available.
5) Transportation of construction equipment must be easy.
6) Site locations must be selected so that operation and maintenance after constructions / installations should be easy.
7) Good reception with little noises or seasonal variations of field strength must be assured.

The existing 3 stations (Ulaanbaatar, Altai and Murun) are built on site where these conditions are almost fully satisfied. At the Ulaanbaatar station, some large- and medium-scale domestic and overseas SW broadcasting are currently in service. At the Altai and Murun stations, medium-scale SW transmitting systems had been in operation until 1997. None of these stations have ever experienced any trouble caused by their location conditions; therefore, these stations are considered to satisfy the basic conditions required for planned sites of the SW transmitting system installation.

However, in order to install the SW transmitting systems in the existing station buildings, the following measures should be taken:

1) The floor substructures of the planned location for the new SW transmitter in the building must be modified to become suitable for installing the transmitters and associated equipment.
2) Passage doors must be widened and external walls must be modified so that the transmitters and associated equipment can be brought in from the outside.
3) Floor and wall openings must be provided or modified for air ducts, feeders, cables, etc.
4) A reasonable cooling system consistent with the existing ventilation and air-conditioning systems must be planned and designed.
5) The existing program transmission line (STL system) must be improved for the Ulaanbaatar transmitting station.
6) As the mains power is not stable, an emergency power generator must be installed. (This is especially indispensable for the Altai station.)

2-2-2-3 Basic Configurations of the SW Transmitting Systems

(1) Studies of the Operation Systems

The present on-air hours in Mongolia are 17 hours per day. The existing stations have substantially 2 or more sets of transmitters. One is used for the said 17-hour operation and is inspected / maintained after the service and then stopped; meanwhile, the other is prepared for the next day's service and then operated for 17 hours or verse versa. Though the hour of service is 17 hours, a few more hours are actually spent for inspection, maintenance and preparation. In order to avoid service interruptions, the main/standby system (operation switching system) is adopted: when any of these transmitters has become faulty, the other transmitter will be started up. The main/standby system is intended to decrease such loads upon the systems while increasing the lives of the systems, thus securing stability and reliability of the systems.

When the service hours are extended in the near future, hours available for the maintenance, inspection and preparation will inevitably be reduced, which, in turn, will increase loads upon the transmitting systems and shorten the lives of the systems.

If a single transmitter is installed, the above-mentioned life extension or a high level of stability and reliability cannot be expected, so any occurrence of faults or accidents may directly lead to 'incapability to go on-air' and 'service interruption'. Any occurrence of these is not desirable for public broadcasters, and if SW broadcasting becomes unavailable, the existing MW or LW systems must be used for service continuity.

When the operation switching system is adopted in consideration of the above, a 50kW+50kW system will be installed at the Ulaanbaatar station, and a 10kW+10kW system at each of the Murun and Altai stations. As for the Ulaanbaatar station, the Mongolian side explained that it would be possible to use the existing 100kW SW transmitter (TSW-100) installed in 1979 as the standby transmitter though its output power had decreased to its 50% of its rated output. One possible measure to take may therefore be to install a single 50kW transmitter at the Ulaanbaatar station. This is assumed to be a 'quasi-operation switching system'.

The Table 2-2 shows the results of comprehensive comparisons of the above-mentioned 3 systems, namely, the requested system (single transmitter system), the basic operation switching system, and quasi-operation switching system. Among these systems, the 'quasi-operation switching system' is considered to be the transmitting system that will satisfy the requirements of continuity and stability of service as well as the Project scale (restrictions of budgets) and is therefore selected as the operation system for the Project. Equipment configuration of the short wave transmitting system at each station is as shown on Figure 2-1.

Table 2-2 Comparison of basic configurations of the transmitting systems

Station	Requested system (a single operational transmitter system)	Basic operation switching system (main/standby system)	Quasi-operation switching system (System to be adopted in this Project)
Ulaanbaatar	50kW	50kW+50kW	50kW (The existing TSW-100 transmitter will be used as a backup.)
Altai	10kW	10kW+10kW	10kW+10kW
Murun	10kW	10kW+10kW	10kW+10kW
Nos. of transmitters - 50kW - 10kW	 1 set 2 sets	 2 sets 4 sets	 1 set 4 sets
Continuity/reliability of service	△ (inferior)	◎ (exellent)	○ (fair)
Initial Project cost	○ (small)	△ (Large)	○ (medium)
Remarks	The premise is that temporary operations of the existing MW and LW transmitters should be continued in future. However, the system is not valid in the long run.	This system will be the most reasonable as the basic plan, but the budget scale will exceed the requested system.	Though the service continuity is more or less sacrificed, this system may be applied to the Project to satisfy the budgetary restrictions.

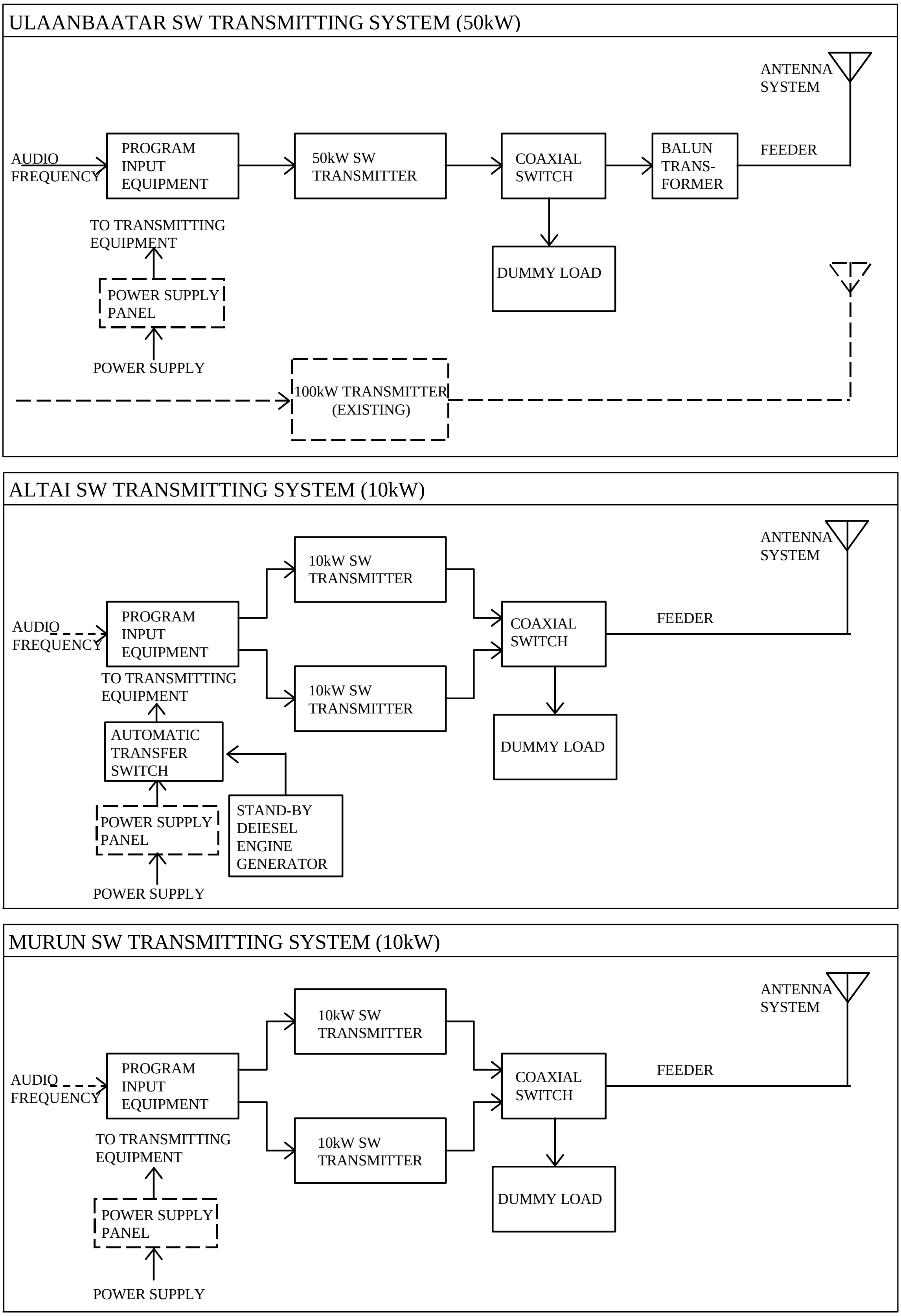


Figure 2-1 SW Transmitting System

(2) Review of the Applied Technology

The Project will procure equipment that satisfies the requirements aforesaid in "2-2-1-7 Policy on the Setup of Grades on the Equipment and Materials". In particular for the transmitting equipment, an already proven technology in the short wave broadcasting will be required to be applied. Furthermore, transmitting equipment that conforms to such technology shall be easily procured on the market and those equipment shall possess abundant records of excellent operation. Bearing such technology in mind, a technology considered to be optimum along with the framework of the Grant Aid Project of Japan is examined for application to the Project.

1) Analog System and the Correspondence to Digital System

There is a movement aimed at transition to the digital system from the present analog system for the medium wave broadcasting which applies the amplitude modulation system.

Especially in Europe, there is an action to enact the Digital Radio Mondiale (DRM) as the proposed universal unification system of digitization in broadcasting. This DRM system is also taken up by ITU and enactment is in progress. Currently, it is in the stage of carrying out field tests for creating a unification standard.

In regard to digitization of short wave broadcasting, determination to permit digital broadcasting in a specific frequency band may be given in the World Radio Communication Conference (WRC) that will be held in the near future. Currently, termination of short wave analog broadcasting is assumed to be December 31, 2015; however, it seems that the date may be reconsidered after taking into consideration the popularization status of digital type transmitters and receivers.

At present, transmitting equipment for the short wave broadcasting which utilizes proven technology and actually possesses many excellent operation records is limited to the analog type. Although it is technically possible to modify the analog transmitting equipment into that of a digital type, there has been no example of carrying out such modification since the merit to do so does not exceed the demerits resulting from the modification. Accordingly, the present analog system is adopted as the system that fulfills the required conditions for the short wave transmitting equipment of this Project.

2) Vacuum Tube System and Full Solid-State System

Currently, the vacuum tube system is applied to the transmitters of 10kW and 50kW class for short wave broadcasting that can be procured on the market in developed countries. It can be said that there is no example to apply a full solid-state system for the transmitter of this class. The merits produced from adopting the full solid-state system, when compared with a vacuum tube system, are no decrease in power output or deterioration in performance both caused by aging, no need for periodical exchange of a vacuum tube. However, the present condition is that there are more demerits than the merits.

There are examples where full solid-state systems are applied to the transmitter; however, those are limited to the short wave communication system. This is possible because of the peculiar requirements, such as a small output and low-quality sound, of the communication system. Such requirements are not acceptable to this Project, which requires larger output and quality sound. Accordingly, a vacuum tube system shall be applied to this Project to the extent that vacuum tubes shall be employed basically to the power amplifier (PA) and modulation amplifier (MOD) units only. In this case, a solid-state system shall be applied to other components of the transmitting equipment.

3) Modulation System

There are basically three types of modulation systems available for the short wave transmitting equipment on the market; the final stage high-level plate modulation system, the pulse step modulator (PSM) system, and the serial modulation system. The last system can be further classified into the pulse width modulation (PWM) system or the pulse duration modulation (PDM) system. The PSM system can be said to be similar to the high-level plate modulation as a modulation system. The advantages of the final stage high-level plate modulation system are; technology is well established, operation is stable, there are a large number of operation records over many years. Consequentially, this type of modulation system is widely applied to the transmitting equipment for short wave broadcasting, and can be procured on the market in developed countries. For this reason, the Project will adopt the final stage high-level plate modulation system.

As stated above, analog system, vacuum tube system, and final stage high-level plate modulation system shall be applied as key technology to the transmitters procured under the Project. However, in the case that function and performance of any transmitting equipment are equivalent or superior to the above stated systems, and yet satisfy all of the requirements stated previously, application of such technology shall also be permitted.

(3) Cooling System Review

As the cooling system for the transmitters with 50kW or less outputs to be introduced in the Project, the following conditions must be met:

1) No technical or operational issues should occur even if they are installed in hostile environmental conditions.

2) Operational and maintenance loads on the Mongolian side should not be excessive.
3) The system to be adopted must be field-proven in similar environmental conditions.

The transmitting systems will be installed at the existing transmitting stations located in the hostile environmental conditions where the outdoor temperature in winter will drop down to as low as -40 degrees Celsius. As the transmitter cooling system required to be operable with high reliability in a long period of time under such adverse conditions, it appears advantageous to adopt the forced air-cooling system that offers easy operability and simple configuration. Further, from the viewpoint of the Mongolian side that will actually operate the transmitters, a cooling system with easy maintainability requiring smaller costs will be desirable, and, in this regard again, it is planned to adopt the forced air-cooling system to this Project.

The point to be paid attention to in adopting the forced air-cooling system is the fact that the equipment may be contaminated by the dust in the air, etc. In actual designing of the cooling system, how cooling air will be taken in must be carefully planned.

(4) Review of Program Transmission Systems

1) Ulaanbaatar Transmitting Station

The program transmission system (STL: studio-to-transmitter link) at the Ulaanbaatar station is capable of sending radio programs produced at the MRTV building to the Ulaanbaatar station via the Bayanzurukh relay station. This STL is currently in operation with the following issues:

a) Received signals contain a lot of noises that prevent good reception (poor reception evaluation results).
b) Only a single operation line (STL) is available, so, if any trouble occurs to this line, all the programs for the broadcasting will be interrupted.

If the Project is executed with the above weakness left as it is, it is feared that such issues as a smaller coverage area or reduced audible level might occur. Though the former is mainly associated with the audio quality and may be acceptable to some extent in consideration of the current broadcasting status of the country, the latter is more serious because it may directly lead to 'stopped broadcasting' or 'service interruption'.

The existing STL system built in 1996 has been the sole lifeline of transmission at Ulaanbaatar, and the single UHF band program transmission line covers all the broadcasting regardless of domestic or overseas services, and of SW, MW or LW and even telephone communications. If this weak yet important line experiences any trouble, all the broadcasting services will immediately be interrupted. From the viewpoint of reliability and continuity of the entire broadcasting services, this issue is inseparably related to this Project, and the improvement of the STL system is therefore absolutely necessary.

2) Murun and Altai Transmitting Stations

Programs are first transmitted from Ulaanbaatar to Murun or Altai via radio transmission line supervised by the Post and Telecommunications Authority under the Ministry of Infrastructure. From the Murun or Altai relay stations, the programs are carried to the transmitting stations via local telecommunications stations using underground communications cables. Though the transmission lines are rather obsolete, no trouble to cause any program transmission has occurred so far, and the line is expected to stand the use for the time being. The relay stations are built with 40 to 50km intervals, and the operation frequencies of the links are in 3GHz band. It is also reported that the frequencies used for program transmission by the communications cables are in a range between 50Hz to 10,000Hz.

2-2-2-4 Basic Design

(1) Applicable Standards and Design Conditions

1) Applicable Standards and Requirements

In accordance with Item "2-2-1-4 Background of Construction Industry", the following international and Japanese standards shall be applied to designs, procurements, manufacturing and installations of the equipment, facilities, materials, etc. subject to any procurement in this Project:

* International Telecommunication Union (ITU) recommendations
* International Electrotechnical Commission (IEC) recommendations
* Japan Industrial Standards (JIS)
* Standards of the Japan Electrical Manufacturers' Association (JEM)
* Standards of Electronic Industries Association of Japan (EIAJ)
* Standards of the Standards Committee, the Institute of Electrical Engineers of Japan (JEC)
* Japan Cable Standards (JCS)

2) Electrical Requirements

The specification of the power distribution system available at the existing stations is 380/220V (3-phase, 4-wire, neutral grounding), 50Hz. The distribution system has been operated without any particular problems and will be used as it is for the power supply of the SW transmitting systems procured in this Project. Each station has a 380/220V power distribution board near the room to install the SW transmitters, so cables will be laid between this power distribution board and one to be newly installed for the SW transmitting system.

At the Ulaanbaatar station, main power supply from the power grid can be used as it is because of its stability. However, power supply situation is quite different at the Altai and Murun stations, where power interruption often occurs because of unstable main power supply. The Altai station will cover a wider service area when compared to the Murun station, playing a more important role in broadcasting. Taking this into consideration, an emergency generator will be installed at the Altai station in order to continue the SW transmitting system operation even at the time of power interruption of the power grid. Major specifications of the proposed power generator are: rated capacity of around 100kVA, 380/220V (3-phase, 4-wire, neutral grounding), and 50Hz.

3) Site and Meteorological Conditions to be Applied to the Designs

In accordance with the Item 2-2-1-2 “Natural Conditions”, the site and meteorological conditions to be applied to the designs in this Project is as per Table 2-3 below:

Table 2-3 Site and meteorological conditions to be applied to the designs

Station	Ulaanbaatar	Altai	Murun
Latitude	N47 ° 55'	N46 ° 30'	N49 ° 30'
Longitude	E107 ° 00'	E96 ° 10'	E100 ° 10'
Altitude (MSL)	1,500m	2,200m	1,500m
Temperature	-29 to +27 degrees centigrade	-38 to +32 degrees centigrade	-40 to +37 degrees centigrade
Relative humidity	Up to 80%	Up to 90%	Up to 80%
Maximum annual precipitation	329mm	225mm	305mm
Maximum daily precipitation	100mm	100mm	100mm
Maximum instantaneous wind speed	45m/sec.	45m/sec.	45m/sec.
Seismic factor (Kh)	0.2	0.2	0.2
Frozen depth	GL -4.6m	GL -4.4m	GL -4.3m

(2) Ulaanbaatar SW Transmitting System

In this section, the outline of the basic design, basic layout and operation plan of the 50kW SW transmitting system as well as the STL system is discussed.

1) Basic Design

Design on the transmitting system is described below. Block diagrams to be employed for the system are as indicated on the Basic Design Drawings U-21 and U-22.

a) Construction of the Transmitter

Regarding the transmitting tubes, main components of the transmitter, a total of 3 sets at the maximum will be employed: one for the modulated amplifier (PA) and two for the modulator amplifier (MOD). The high frequency amplifiers (exciter, high frequency amplifier and oscillator), audio amplifiers (audio driver and audio amplifier), control circuit, etc. other than the said tubes will be all solid-state for efficiency and simplification.

The transmitter must have an integrated chassis and have a configuration to incorporate all the equipment including its power supply. Overview of the transmitter is as indicated on the Basic Design Drawing U-31.

The blower is to be separate from the transmitter in order to assure flexible arrangements of inlet and exhaust of cooling air. Also, to prevent contamination of the inside of the transmitter by dusts, etc., a filter is to be established at the air inlet of the transmitter.

As is often the case of the shortwave transmitters, extremely high DC and high frequency voltages will be applied to the inside of the transmitter. In order to assure security and safety of operators, key-type mechanical interlocks shall be introduced and mounted at the transmitter doors.

b) Cooling System of the Transmitters

The larger the transmitter output becomes, the more volume of cooling air will be required, and as a result, indoor air of the transmitter room will become insufficient. The blower will also become larger to cause noise problems. In order to solve these issues, it is a common practice for 50kW-class transmitter installations to position a blower in a sealed room so that the air inlet for the transmitter should be integrated and that noises should be shut off.

Dusts in the air will degrade performance of the transmitter, so, to avoid this issue, it is required to clean cooling air. To this goal, 2-stage air filters are to be mounted at the air inlet of the blower room, and cleaned air after the filters will be fed to the transmitter.

Heated air dissipated from the transmitter will be exhausted to the outdoors via ventilator in the exhaust duct, volume damper and check damper. The equipment configuration shall be so designed that manual operation of the dampers will enable the heated air to be used for heating the room.

Equipment overview of the cooling system based on the above-mentioned design is indicated on the Basic Design Drawing U-32.

c) Transmitter Coaxial Equipment

The coaxial equipment comprises of a coaxial switch, a dummy load and coaxial feeder and feeds the transmitter output to the balun transformer equivalent to the input point of the antenna system. The outlines of the respective equipment are as follows:

i) Coaxial Switch

The transmitter output is first fed to this coaxial switch via coaxial feeder. As the coaxial switch is capable of switching and transmitting high frequency power, special consideration must be given to its switching contacts.

There are several types of the coaxial switches available in the market, but as the motor-driven type has an enclosed structure and is very effective in dusty installations, this type is to be adopted in this Project.

This coaxial switch is to have a 4-way structure with 2 input and 2 output points; thus, the outputs from the 2 transmitters can be connected to the coaxial switch, and each of the outputs can be fed both to the dummy load and to the antenna system.

ii) Dummy Load

The dummy load is used for transmitter adjustments and testing in place of the actual antenna system. Some cooling methods for dummy load exist, but, for the same reason as that for the transmitters, the forced air-cooling is to be employed. This type of dummy loads normally uses a chassis incorporating a cooling blower, so the Project will require this approach to the dummy load structure.

iii) Indoor Coaxial Feeder

In order to minimize high frequency interference to other equipment in the station building, a type of coaxial feeder with an enclosed structure should be adopted. In consideration of the nature of this feeder to transmit high frequency powers among the system equipment, a coaxial tube type using high quality materials should be adopted.

d) Antenna System

In this Project, the service area is limited to Mongolia, so the radio wave emitted from the antenna will mainly be radiated vertically to the sky. In other words, omnidirectional antennas will be required. In employing this type of antenna, its vertical directional pattern is important, and a higher antenna gain is more advantageous.

The antenna system comprises of the following elements:

i) Antenna structure
ii) Feeder
iii) Balun transformer

The antenna element should be supported by 2 units of approx. 40-meter-high steel towers and will require about 97 x 100 meters as its mounting space. The antenna gain should be 9dBi or better, and input impedance for antenna should be 300 ohms. The antenna feeder with 300 ohms impedance should be set up with 4 lines in parallel. The appropriate feeder pole height should be about 3.5m.

One issue common with all the 3 existing stations is the frozen ground. Special attention shall therefore be paid to foundation designs of the towers, feeder poles, etc. in consideration of the respective frost lines so that any frost heaving should be avoided.

For basic configuration, general view, etc. for the antenna system, details can be seen on the Basic Design Drawings U-61 to U-64.

2) Basic Layout

Design on the basic layout of the transmitting system is described below. Key plan to be employed for the system is as indicated on the Basic Design Drawings U-11.

a) Selection of the Transmitter Installation Positions

The 50kW transmitter and its associated equipment are planned to be installed in an unused room on the second floor in the central building as the room satisfies the following conditions:

i) Sufficient space to install the equipment is available.
ii) The transmitter can be located in a reasonable position seen from the antenna location and feeder route.
iii) Easy power feed is available from the existing power distribution board.

This room is also advantageous because, as SW transmitters were once installed there, utilities and equipment layout back then can be effectively utilized:

i) As the existing audio line terminals are located nearby, cables and other connections between the transmitter and audio input lines can be minimized.
ii) As the control and monitoring room where staffs are stationed is close to this room, monitoring and maintenance of the transmitter is easy.
iii) On the floor right below, there is a power distribution board available, so the lengths of cables can be minimized.
iv) A blower room to inlet cooling air can be secured on the ground floor right below the transmitter room.

For these advantages, the above-mentioned room is deemed suitable for installing the 50kW SW transmitter.

b) Transmitting Equipment Layout

Basic Design Drawings U-12 to U-15 shows the layout of the transmitting equipment. As shown on the Drawing U-13, 50kW transmitter currently in operation at a lower output power is installed in a room on the right hand side of the corridor. An unused room on the left hand side of the corridor will be assigned for installation of the new 50kW transmitter.

The transmitter and its dummy load will be forced air-cooled. In order to reasonably inlet and exhaust cooling air and to reduce noises from the transmitter, the transmitter blower and the dummy load shall be installed in a transformer room on the ground floor, directly below the transmitter room. This transformer room actually consists of smaller compartments accommodating transformers currently not in use. These transformers can easily be taken out from respective compartments on the rails, and it has already been confirmed that the Mongolian side will remove all the items in these compartments including the transformers.

A small room at the center (small central room) will be used as the air chamber room, and the blower and the dummy load will respectively be settled in rooms next to this small room. The entrance door of the small central room will be modified to mount air filters. Similarly, on the walls of the adjacent rooms, air filters will also be installed.

c) Partial Modifications / Working of the Floors and Walls

Though the location to install the transmitter is on preferable conditions in terms of the equipment layout, there still remain old foundations of the SW transmitter once installed, which cannot be used for the installation of the new equipment supplied under this Project. It is therefore necessary to modify the floor prior to the new installation works.

Further, as no sufficient space to bring in the transmitter from the ground floor to the transmitter room on the second floor, it is necessary to build an entrance to directly carry the transmitter into the transmitter room from the outside. In addition, the walls must be modified to create an opening to connect the exhaust duct of the transmitter cooling system to the outdoors.

As these works involve the modifications of the floor and walls of the building, it was confirmed that they would be in the scope of work of the Mongolian side. As also confirmed by the Mongolian side, it is necessary for experts of the Mongolian side to conduct technical studies and make careful design and modification work so as not to decrease structural strength of the building in any event.

d) Antenna System Layout

The Ulaanbaatar transmitting station is the central station providing domestic and international LW, MW and SW broadcasting services. The site is surrounded by bristling antennas and feeder poles. The situation is that most of the spaces near the station building are occupied by antenna feeders and feeder switches, and that spaces available for the new installations are quite limited.

After review of the place to secure a space for the installation of the new 50kW antenna, it is found that the space between the existing No.9 and No.10 antennas satisfies the requirement and is duly selected for the new installation though the antenna feeder length will be slightly longer. The No.9 and No.10 antennas are for the domestic SW services but are not currently in use.

The location to install the new antenna is well away from high power transmitting antennas and is not within the directions of their main beams, so it is safe to consider that mutual radio interference will be small, if any. When one assumes a straight line between the feeder outlet of the new 50kW SW transmitter and the new 50kW antenna, the line will intersect with many of the existing feeder lines for a distance of about 50m. To avoid these intersections, the new feeder will be installed at the height of about 6m in the said 50m distance.

The Drawing U-61 shows the layout of the proposed new 50kW antenna location, feeder route and transmitter room.

3) Operation Plan

In executing this Project, operations of the new SW transmitting system will be planned as follows:

In order to assure the Channel-1 reception with good signal strength in the service area of this transmitting station, the transmitter shall be operated at the 3 frequencies allocated to this station (4,850 / 7,260 / 9,305kHz) by switching them, as appropriate, based on the seasons and hours of the day. Table 2-4 shows an example of this frequency switching where frequencies that offer field strength enough to provide a 700km radius area with an audible level of service are selected on the basis of reference months and times of day.

Since it can become a burden on the radio listeners to tune in to a few different frequencies in a day, it is desirable to make an operation plan that will minimize the transmitting frequencies in evaluating audible level. This also applies to the operation plans for the Altai and Murun transmitting stations.

At the station, the 50kW transmitting system to be installed in this Project will always be operated solely for Channel-1. In case that this transmitting system should experience some faults or errors, the existing 100kW SW transmitting system (TSW-100) normally used for the domestic Channel-2 service will temporarily take over the Channel-1 service. After the 50kW transmitting system is restored, it will resume the transmitting service of Channel-1, and the 100kW system will restart to transmit Channel-2 programs.

Table 2-4 An example of frequency switching of the Ulaanbaatar SW transmitting system

Ref. Month	Local Time	SSN=10 Frequency (kHz)			SSN=100 Frequency (kHz)			SSN=150 Frequency (kHz)		
		4,850	7,260	9,305	4,850	7,260	9,305	4,850	7,260	9,305
Mar.	6-9	x				x			x	
	10-17		x				x			x
	18-22	x				x			x	
Jun.	6-9	x				x			x	
	10-17		x				x			x
	18-22	x				x			x	
Sep.	6-9	x				x			x	
	10-17		x				x			x
	18-22	x				x			x	
Dec.	6-9	x			(x)	x		(x)	x	
	10-17		x			(x)	x		(x)	x
	18-22	x			(x)	x		(x)	x	

Note: In the table, 'x' indicates that necessary field strength can be obtained by operating the transmitter at the frequency. '(x)' means that operation at the frequency is desirable as required. SSN means sun spot number.

4) STL System

An STL system to relay the Ulaanbaatar Broadcast Center, Bayanzurkh Relay Station and the Ulaanbaatar transmitting station is to be built. The existing tower and the hut to accommodate the equipment will be used as there are, and new VHF band transmitter / receiver units and associated antennas only should be procured, and their installation as well as procurements and installations of antenna poles should be the scope of the Mongolian side. For details, see the Basic Design Drawing U-23.

5) Electrical Installations

As power supply for the transmitting system, the existing 380V/220V power distribution panel will be used. A cable will be directly connected with bus bar inside the panel for power supply to a new AVR & PDB, which then distributes power to the transmitter and its associated equipment.

The power supply system is as indicated on the Basic Design Drawing U-41, and grounding system on the Drawing U-51.

(3) Altai SW Transmitting System

In this section, the outline of the basic design, basic layout and operation plan of the 10kW SW transmitting system to be installed at the Altai transmitting station is discussed.

1) Basic Design

Design on the transmitting system is described below. Block diagrams to be employed for the system are as indicated on the Basic Design Drawings A-21 and A-22.

a) Construction of the Transmitters

Regarding the transmitting tubes, main components of the transmitter, a total of 3 sets at the maximum will be employed: one for the modulated amplifier (PA) and two for the modulator amplifier (MOD). All the circuits other than the said tubes will be all solid-state for efficiency and simplification.

The transmitter must have an integrated chassis and have a configuration to incorporate all the equipment including its power supply and blower. Overview of the transmitter is as indicated on the Basic Design Drawing A-31.

As safety devices, key-type mechanical interlocks shall be employed.

b) Cooling System of the Transmitters

As the 10kW transmitters require a small amount of cooling air, indoor air will be used for cooling of the transmitter and then exhausted to the outside. The exhaust duct will be equipped with exhaust fans, volume damper and check damper so that heated air should be exhausted to the outside in summer and to the inside of the room in winter to take advantage of it as heating source. Further, in consideration of dusty air, a filter box with high performance filters should be installed to remove dusts. Equipment overview of the cooling system based on the above-mentioned design is indicated on the Basic Design Drawing A-32.

c) Transmitter Coaxial Equipment

The coaxial equipment for the 10kW transmitters should have essentially the same design concept as that of the 50kW transmitter.

d) Antenna System

As is the case with the 50kW transmitter, the 10kW antenna system should have omnidirectional antenna to cover a wide band. The structure should basically the same as that of the 50kW antenna system. However, as the transmitter output impedance and the antenna impedance are same 50 ohms, no balun transformer will be required.

The antenna element should be supported by 2 units of approx. 26-meter-high steel towers. For details, see the Basic Design Drawing A-62. The antenna gain should be 8dBi or better, and input impedance for antenna should be 50 ohms. The antenna feeder should be coaxial type cable that is advantageous in terms of both maintenance and installation. The coaxial cables have cold tolerance to stand underground burial, so they will be placed underground.

2) Basic Layout

Two sets of 10kW output transmitters will be installed at the Altai transmitting station. The transmitters and their associated equipment will be installed at an unused space where a 12kW SW transmitter was once installed but is now removed. As this space is as small as 4m x 4m, a part of the hall in the transmitter room will effectively be utilized for the new transmitter installation.

The space required for the installation of the new 10kW SW antenna system is expected to be about 76m x 46m. On the station site, there remains an unused antenna system for the removed 12kW SW transmitter. This old antenna is scheduled to be removed by the Mongolian side, and, by installing the new 10kW SW antenna on the open space after the old antenna removal, interference and other issues with the existing 150kW antenna (commonly used for MW and LW) can be avoided.

Key plan to be employed for the system is as indicated on the Basic Design Drawing A-11; layout of the transmitter and associated equipment on the Drawings A-12 to A-14; and layout of the antenna system on the Drawing A-61.

3) Operation Plan

In order to enable satisfactory reception of Channel-1 with good signal strength within the service area of this station, the transmitter shall be operated at the 3 frequencies allocated to this station (4,830 / 5,950 / 9,430kHz) by switching them, as appropriate, based on the seasons and hours of the day. Table 2-5 shows an example of this frequency switching where frequencies that offer field strength enough to provide a 400km radius area with an audible level of service are selected on the basis of reference months and times of day.

At the station, 2 sets of 10kW transmitters are to be installed in this Project, so their operation will be planned in a manner that they should be operated by turns every other day or every few days.

Table 2-5 An example of frequency switching of the Altai SW transmitting system

Ref. Month	Local Time	SSN=10			SSN=100			SSN=150		
		Frequency (kHz)			Frequency (kHz)			Frequency (kHz)		
		4,830	5,950	9,430	4,830	5,950	9,430	4,830	5,950	9,430
Mar.	6-9	x				x			x	
	10-17		x				x			x
	18-22	x				x			x	
Jun.	6-9	x				x			x	
	10-17		x				x			x
	18-22	x				x			x	
Sep.	6-9	x				x			x	
	10-17		x				x			x
	18-22	x				x			x	
Dec.	6-9	x			x			x		
	10-17		x			x			x	
	18-22	x			x			x		

Note: In the table, 'x' indicates that necessary field strength can be obtained by operating the transmitter at the frequency.

4) Electrical Installations

As power supply for the transmitting system, the existing 380V/220V power distribution panel will be used. A cable will be connected with the panel for power supply to a new AVR & PDB, which then distributes power to the transmitters and associated equipment. In preparation for sudden power outage at the side of the power grid, emergency diesel engine generator rated at 100kVA will be provided for power supply to the transmitting system. Changeover of the power will be made with provision of automatic transfer switch.

The power supply system is as indicated on the Basic Design Drawing A-41, and grounding system on the Drawing A-51.

(4) Murun SW Transmitting System

In this section, the outline of the basic design, basic layout and operation plan of the 10kW SW transmitting system to be installed at the Murun SW transmitting station is discussed.

1) Basic Design

The basic design of the SW transmitting system for this station will be identical to that for the Altai station. Block diagrams of the transmitting system are as indicated on the Basic Design Drawings M-21 and M-22; overview of the transmitter on the Drawing M-31; and cooling system on the Drawings M-23 and M-32. General views of the antenna system are shown on the Drawing M-62.

2) Basic Layout

The basic layout of the transmitter equipment and the antenna system for this station will be the same as that for the Altai station. Key plan of the transmitting system is as indicated on the Basic Design Drawing M-11; layout of the transmitter and associated equipment on the Drawings M-12 and M-13; and layout of the antenna system on the Drawing M-61.

3) Operation Plan

In order to enable satisfactory reception of Channel-1 with good signal strength within the service area of this station, the transmitter shall be operated at the 3 frequencies allocated to this station (4,895 / 6,100 / 9,560kHz) by switching them, as appropriate, based on the seasons and hours of the day. An example of the frequency switching is to be the same as shown in Table 2-5.

At the station, 2 sets of 10kW transmitters are to be installed in this Project, so their operation will be planned in a manner that they should be operated by turns every other day or every few days.

4) Electrical Installations

Power supply system for the transmitting system is as indicated on the Basic Design Drawing M-41, and grounding system on the Drawing M-51.

(5) Spare Parts Planning

As SW transmitting systems are designed and manufactured based on established and proven technologies, their reliability is high. However, it is necessary to take into consideration that the main component of the system, SW transmitter, may become faulty in process of a long time use because of tubes employed on the power amplification stage, high DC voltage used, employment of amplitude modulation, etc. Further, the sites in this Project will be subject to hostile environmental conditions that greatly affect occurrence of faults. Variations of environmental temperature and humidity, air contamination, entries of dirt, dusts and sands as well as mains voltage variations and lightning strikes will be major causes of the faults.

It is therefore imperative to procure spare parts as one of the system components of the transmitting systems, and it is preferable that MRTV, the Mongolian executing agency, should procure all the spares necessary after the equipment handover at its own cost. However, in consideration of the fact that MRTV's financial conditions are not good at present, it is assumed that it should take a few years for MRTV to be ready to procure spare parts on its own, and the Japan side will procure spare parts necessary for 3 years operation after the system handover.

In this Project, in order to assure normal and continuous operation and performance of the SW transmitting system, the following spare parts to satisfy the requirements below should be procured:

1) Those parts that will be aged or deteriorated by constantly applied power and that may affect normal operation of the transmitters and their associated equipment.
2) Those parts incorporated in the equipment having rotating or mechanically driven sections that naturally tend to experience wear and tear.
3) Consumable parts that require periodical replacement or refill.

2-2-2-5 Outline of Main Equipment and Materials

Outline of the equipment and materials supplied under the Project is described below. Since each equipment and material is used under the severe natural conditions at each site, the equipment and materials shall be reliable and be of rigid construction to withstand long-term and continuous operation.

Any equipment and materials that meet such demanding conditions and that are deemed as the equivalent or superior technically and technologically may be procured under the Project.

(1) 50kW SW Transmitting System at Ulaanbaatar

Major equipment included in the 50kW SW transmitting system to be installed at the Ulaanbaatar station is as follows:

1) Transmitter
2) Cooling system for transmitter
3) Dummy load
4) Cooling system for dummy load
5) Coaxial switch
6) Indoor feeder
7) Program input, monitoring and control equipment
8) Measuring rack
9) AVR (Automatic voltage regulator) & PDB (power distribution board)
10) Measuring instruments
11) Antenna system
12) Cabling materials
13) Spare parts
14) STL system

1) SW Transmitter

The transmitter shall basically employ analog system, vacuum tube system, and final stage high-level plate modulation system as key technology. The transmitter consists of power amplifier section, modulator section, power supply section, exciter section, control section, and cooling section.

The transmitter shall meet the following technical and technological requirements:

- Rated Power Output:	50kW
- Frequency Range:	3.2 to 15.6MHz
- Audio Frequency Response:	50Hz to 7,500Hz, within ±1.0dB
- Audio Frequency Distortion:	Less than 3.5%, 50Hz to 7,500Hz
- Noise Level:	Better than 55dB
- Carrier Shift:	Less than 4%
- Carrier Frequency Stability:	Within ±10Hz
- Spurious Radiation:	Below 50mW complying with ITU-R recommendation
- Audio Input Level:	0dBm at 1,000Hz for 100% modulation
- Audio Input Impedance:	600Ω ±15%, balanced
- Output Impedance:	50Ω, unbalanced
- Overall Power Factor:	More than 90%
- Cooling System:	Forced air cooling

2) Cooling System for Transmitter

Cooling system for transmitter shall consist of fans, air filters, volume dampers, check dampers, air ducts, and temperature sensors.

3) Dummy Load

Dummy load shall meet the following requirements:

- Frequency Range:	3.2 to 15.6MHz
- Impedance:	50Ω, unbalanced
- Rated power output:	75kW (50kW carrier + 100% AM)
- VSWR:	Less than 1.1
- Cooling System:	Forced air cooling

4) Cooling System for Dummy Load

Cooling system for dummy load shall consist of fans, air filters, volume dampers, check dampers, and air ducts.

5) Coaxial Switch

The coaxial switch shall meet the following requirements:

- Frequency Range: 3.2 to 15.6 MHz
- Impedance: 50Ω unbalanced
- Rated Power: 75 kW (50kW Carrier + 100% AM)
- VSWR: Less than 1.1
- Insertion Loss: Less than 0.1 dB
- Isolation: More than 60 dB

6) Indoor Feeder

Indoor feeder shall be 4-1/16" rigid coaxial transmission line or equivalent.

7) Program Input, Monitoring and Control Equipment

Program input, monitoring and control equipment shall consist of audio limiter / compressor, monitor speaker & monitor amplifier, monitor switcher, audio level meter, audio jack panel, and control panel. The equipment shall be mounted in the standard equipment rack.

8) Measuring Rack

Measuring rack shall consist of distortion meter/oscillator, oscilloscope, audio variable attenuator, and audio jack panel. The components shall be mounted in the standard equipment rack.

9) AVR & PDB

Automatic Voltage Regulator (AVR) and Power Distribution Board (PDB) shall be indoor use self-standing type. AVR by-pass switch shall be provided. AC output power of AVR shall be cut-off automatically at a preset incoming voltage. The AVR & PDB shall meet the following requirements:

- Number of Phase: Three phase, four wire
- Rated Frequency: 50 Hz ±2%
- Output Capacity: 200kVA
- Input Voltage Fluctuation Range: 380/220V ±10%
- Output Voltage Regulation: 380/220V ±2%
- Output Voltage Adjustable Range: ±5% (at rated input voltage)
- Rating: Continuous

10) Measuring Instruments

The following measurement instruments necessary for maintenance of the transmitter shall be procured under the Project:

- Oscilloscope (Quantity: 1)
- Circuit Tester (Quantity: 2)
- Insulation Tester (Quantity: 1)
- Clamp Meter (Quantity: 1)
- Impedance Bridge (Quantity: 1)
- Receiver / Generator (Quantity: 1)
- Field Strength Meter (Quantity: 1)

11) Antenna System

50kW antenna system shall meet the following requirements:

a) Antenna
   - Polarization: Horizontal
   - Radiation Pattern: Omni-directional
   - Frequency: 3.0 - 18 MHz
   - VSWR: 2.5 maximum, 2.0 or lower over most of the band
   - Input Impedance: 300Ω balanced, nominal
   - Power: 75kW average, 200kW peak (50kW AM carrier)
   - Gain: 9 dBi or better
   - Design Wind Velocity: EIA RS-222C for loading of 160km/h wind, with ice
   - Aircraft warning painting: Required to match ICAO specifications

b) Balun Transformer
   - Frequency Range: 3.2 - 18 MHz
   - Power Rating: 75kW average, 200kW peak (50kW AM carrier)
   - Input Impedance: 50Ω unbalanced
   - Output Impedance: 300Ω balanced

c) Open Feeder
   - Type of Feeder: Open wire feeder
   - Impedance: 300Ω balanced
   - Power Rating: 75kW average, 200kW peak (50kW AM carrier)
   - Length: Total length approx. 380m

d) Earth Mat
   - Size: 55m x 90m (approx.)
   - Wire: 2.6mm dia., hard drawn copper

12) Cabling Materials

All the cabling materials shall be provided for the complete transmitting system and equipment. Outdoor cables shall be low temperature resistant type that must stand –40 degrees centigrade. The following is major specifications of the cabling materials:

a) Power Cables: 600V XLPE insulated PVC sheathed cable
b) Control Cables: 600V PVC insulated PVC sheathed control cable with copper shielding
c) Instrumentation Cables: Polyethylene sheathed HF coaxial cord
d) Cable Ducts: Zinc galvanized steel plate
e) Grounding Wires: 600V PVC insulated copper conductor

13) Spare Parts

As described in (5) Spare Parts Planning under Clause 2-2-2-4 Basic Design, spare parts for three years operation shall be procured. Specific items of the spare parts and their quantity will be set forth in the Technical Specifications issued separately.

14) STL System

Studio-to-Link (STL) system based on 160MHz band VHF wave shall be provided in accordance with the following requirements:

a) Transmitter (TX)
- Frequency: Specified 2 frequencies between 162MHz - 170MHz
- Output Power: more than 25W
- Output Impedance: 50Ω
- Audio Frequency Response: Less than +1/-2dB (50Hz - 10kHz)
- Distortion: Less than 1% (50Hz - 10kHz)
- Signal to Noise Ratio: 65dB at 0dBm input (1kHz, 100% modulation)

b) Receiver (RX)
- Frequency: Specified 2 frequencies between 162MHz - 170MHz
- Audio Output Level: More than 0dBm
- Output Impedance: 600Ω
- Audio Frequency Response: Less than +1/-2dB (50Hz - 10kHz)
- Distortion: Less than 1% (50Hz - 10kHz)
- Signal to Noise Ratio: More than 63dB at 30dB input

c) Antenna for TX/RX
- 6 Element YAGI Antenna for VHF band

(2) 10kW SW Transmitting Systems at Altai / Murun Stations

A complete set of 10kW SW transmitting system each to be installed at the Altai and Murun stations shall consist of the following equipment and materials. Quantity of the equipment and materials shall be one unit or one set for each system, except for the transmitter that shall be two in its quantity.

1) Transmitter
2) Cooling system for transmitter
3) Dummy load
4) Coaxial switch
5) Indoor feeder
6) Program input, monitoring and control equipment
7) Measuring rack
8) Automatic voltage regulator (AVR) & power distribution board (PDB)
9) Measuring instruments
10) Antenna system
11) Cabling materials
12) Spare parts and consumables
13) Emergency diesel generator (only for Altai)

Major technical specifications of the equipment and materials are described below:

1) SW Transmitter

The transmitter shall basically employ analog system, vacuum tube system, and final stage high-level plate modulation system as key technology. The transmitter consists of power amplifier section, modulator section, power supply section, exciter section, control section, and cooling section.

The transmitter shall meet the following technical and technological requirements:

- Rated Carrier Output Power:	10kW
- Frequency Range:	3.2 to 15.6MHz
- Audio Frequency Response:	50Hz to 7,500Hz, within ±1.0dB
- Audio Frequency Distortion:	Less than 3.5%
- Noise Level:	Better than 55dB
- Carrier Shift:	Less than 3.5%
- Carrier Frequency Stability:	Within ±10Hz
- Spurious Radiation:	Below 50mW complying with ITU-R recommendation.
- Audio Input Level:	0dBm at 1,000Hz for 100% modulation
- Audio Input Impedance:	600Ω ±15%, balanced
- Output Impedance:	50Ω unbalanced

- Cooling System: Forced air cooling

2) Cooling System for Transmitter

Cooling system for transmitter shall consist of fans, air filters, volume dampers, check dampers, and air ducts.

3) Dummy Load

The dummy load shall meet the following technical and technological requirements:

- Frequency Range: 3.2 - 15.6 MHz
- Impedance: 50Ω unbalanced
- Rated Power: 15kW (10kW carrier + 100% AM)
- VSWR: 1.15 or less
- Cooling System: Forced air cooling

4) Coaxial Switch

The coaxial switch shall meet the following technical and technological requirements:

- Frequency Range: 3.2 - 15.6 MHz
- Impedance: 50Ω unbalanced
- Rated Power: 15 kW (10kW carrier + 100% AM)
- VSWR: Less than 1.1
- Insertion Loss: Less than 0.1dB
- Isolation: More than 60dB

5) Indoor Feeder

Indoor Feeder shall be 3-1/8" rigid coaxial transmission line or equivalent.

6) Program Input, Monitoring and Control Equipment

The program input, monitoring and control equipment shall consist of audio limiter/compressor, monitor speaker and monitor amplifier, monitor switcher, audio level meter, audio jack panel, and control panel. The equipment shall be mounted in the standard equipment rack.

7) Measuring Rack

Measuring rack shall consist of distortion meter / oscillator, oscilloscope, audio variable attenuator, and audio jack panel. The components shall be mounted in the standard equipment rack.

8) AVR & PDB

Automatic voltage regulator (AVR) and power distribution board (PDB) shall be indoor use self-standing type. AVR by-pass switch shall be provided. AC output power of AVR shall be cut-off automatically at a preset incoming voltage. The AVR & PDB shall meet the following requirements:

- Number of Phase:	Three phase, four wire
- Rated Frequency:	50Hz ±2%
- Output Capacity:	80kVA
- Input Voltage Fluctuation Range:	380/220V ±10%
- Output Voltage Regulation:	380/220V ±2%
- Output Voltage Adjustable Range:	±10% (at the rated input voltage)
- Rating:	Continuous

9) Measuring Instruments

The following measuring instruments necessary for maintenance of the transmitter shall be procured under the Project:

- Oscilloscope (Quantity: 1)
- Circuit Tester (Quantity: 2)
- Insulation Tester (Quantity: 1)
- Clamp Meter (Quantity: 1)

10) Antenna System

10kW antenna system shall meet the following requirements:

a) Antenna

- Polarization:	Horizontal
- Radiation Pattern:	Omni-Directional
- Frequency:	3.0 - 30 MHz
- VSWR:	2.5 maximum, 2.0 or lower over most of the band
- Input Impedance:	50Ω nominal
- Power:	15kW average, 40kW peak (10kW AM carrier)

- Gain: 8 dBi or better
- Design Wind Velocity: EIA RS-222C for loading of 160km/h wind, with ice
- Aircraft warning painting Required to match ICAO specifications

b) Coaxial Cable
- Type of Feeder: Coaxial cable
- Impedance: 50Ω
- Power Rating: 15kW average, 40kW peak (10kW AM carrier)

c) Earth Mat
- Size: 55m x 30m (approx.)
- Wire: 2.6mm dia., hard drawn copper

11) Cabling Materials

All the cabling materials shall be provided for the complete transmitting system and equipment as for the 50kW transmitting system.

12) Spare Parts

Spare parts for the 10kW transmitting systems shall be provided as for the 50kW system. Specific items of the spare parts and their quantity will be set forth in the Technical Specifications issued separately.

13) Emergency Diesel Generator

As a back-up power supply for the transmitting system at the Altai station, emergency diesel generator with the following specifications shall be provided:

a) Engine
- Type: Turbocharged
- Output: 120kVA
- Number of Rotations: 1500rpm
- Fuel: Diesel oil
- Fuel Tank Capacity: 240 liter

b) Generator
- Frequency: 50Hz
- Output Rating: 100kVA
- Rated voltage: 380V (3 phase, 4 wire)
- Power Factor: 0.8 (lagging)
- Voltage Regulation: Within ±1.5%
- Excitation: Brushless, rotating exciter (with AVR)

- Insulation: Class F

c) Associated Equipment
   - Control Panel
   - Battery and Charger
   - Exhaust Pipe and Duct
   - Automatic Transfer Switch

2-2-2-6 Test and Inspection of Equipment and Materials

In order to check that equipment and materials procured for the Project meet the requirements, performance, functions, etc. specified in the technical specification, all necessary tests and inspections shall be conducted at the factory of the Contractor or his manufacturer.

The manufacturer shall carry out 100% test and inspection at his factory for all the equipment and materials. Witness test and inspection shall be conducted by the Consultant for the main equipment and materials. The Consultant examines 100% test / inspection data, and permits the Contractor to ship the equipment and materials, provided that they proved to meet all the contractual requirements.

Furthermore, all items of equipment and materials shall be checked by the third nominated inspection organization for compliance with description and quantity specified in the technical specifications or packing list.

Factory test and inspection by the Contractor shall be conducted about the following items, according to the contents of equipment and materials:

(1) Appearance inspection
(2) Dimension inspection
(3) Quantity check
(4) Name plate inspection
(5) Insulation resistance measurement
(6) Dielectric strength test
(7) Ground resistance measurement
(8) Protective device interlock test
(9) Function and performance test
(10) Others

The Consultant shall check that the equipment and materials are properly installed in accordance with the construction drawings, after arrival of the equipment and materials at site. Moreover, all the equipment and materials shall be subjected to test and inspection after installation, trial operation, and function and performance test.

2-2-2-7 Audible Level Verification and Transmitting Frequency Switching

In this Project, check and verification of the audible level in the service area as well as performance tests after installation will be important in evaluating the effects of the Project implementation.

In Mongolia, this task of check and verification is assumed by the Radio Wave Supervision Office. The Office has established a fixed monitoring station in the city of Ulaanbaatar, makes broadcasting frequency-wise field strength measurements every 3 hours and rates them on a 1-to-5 scale, using the SINPO code. Other than Ulaanbaatar, the Office also carries out yearly measurements and ratings taking advantage of 19 traveling mobile stations, for example, in the western part of the country.

According to the explanation by the Office, the field strength of 50dB or better will be ranked ‘4’ and the lowest rating among various ratings in the SINPO code will be selected as the overall rating. If any rating is ‘3’ or worse, it is determined that the reception is not satisfactory. The Office will then recommend MRTV to take measures for improvement via the Ministry of Infrastructure.

Short wave has a characteristic that it is strongly affected by the ionosphere and that how much it is affected constantly changes. It is therefore desirable not only to grasp trends shown by appropriate frequencies by applying radio propagation forecasting but also to experimentally switch frequencies in order to select appropriate frequencies.

As the wideband transmitting systems are planned in this Project, it will be possible to operate the transmitters at frequencies other than those allocated to each station. As a future issue in operation planning, a new phase where possibilities of operating these transmitters at frequencies other than those allocated may be reached. In that case, coordination with International Telecommunication Union (ITU) or Asia and the Pacific Ocean broadcasting union (ABU) will become necessary. Therefore, the Mongolian side will also be required to devise comprehensive operation plans.

2-2-3 Basic Design Drawings

Drawings as referred to in "2-2-2 Basic Plan" are contained in this part as Basic Design Drawings for the three short wave transmitting systems.

In the course of the review of the basic design of the transmitting systems, some changes may be added to a part of the system configuration, equipment dimensions and arrangement, etc. These basic design drawings are, therefore, to be dealt as reference only.

BASIC DESIGN DRAWINGS 基本設計図

COMMON 3 局共通

C-11 SW TRANSMISSION SERVICE AREA PLAN

URAANBAATAR STATION ウランバートル送信所

U-11 GENERAL LAYOUT
U-12 GENERAL EQUIPMENT ARRANGEMENT, GROUND FLOOR
U-13 GENERAL EQUIPMENT ARRANGEMENT, FIRST FLOOR
U-14 GENERAL EQUIPMENT ARRANGEMENT, SECTION 1/2
U-15 GENERAL EQUIPMENT ARRANGEMENT, SECTION 2/2

U-21 TRANSMITTING SYSTEM BLOCK DIAGRAM
U-22 PROGRAM INPUT EQUIPMENT BLOCK DIAGRAM
U-23 STL BLOCK DIAGRAM

U-31 50KW SW TRANSMITTER OVERVIEW
U-32 COOLING EQUIPMENT OVERVIEW

U-41 POWER SUPPLY SINGLE LINE DIAGRAM

U-51 GROUNDING SYSTEM

U-61 50kW SW ANTENNA SYSTEM ARRANGEMENT
U-62 50kW SW ANTENNA OVERVIEW
U-63 50kW SW ANTENNA FEEDER, TYPICAL SECTION
U-64 50kW SW ANTENNA FEEDER ARRANGEMENT AT TX BUILDING END

ALTAI STATION アルタイ送信所

A-11 GENERAL LAYOUT
A-12 GENERAL EQUIPMENT ARRANGEMENT 1/2
A-13 GENERAL EQUIPMENT ARRANGEMENT 2/2
A-14 GENERAL EQUIPMENT ARRANGEMENT, EMERGENCY GENERATOR

A-21 TRANSMITTING SYSTEM BLOCK DIAGRAM
A-22 PROGRAM INPUT EQUIPMENT BLOCK DIAGRAM

A-31 10KW SW TRANSMITTER OVERVIEW
A-32 COOLING EQUIPMENT OVERVIEW

A-41 POWER SUPPLY SINGLE LINE DIAGRAM

A-51 GROUNDING SYSTEM

A-61 10kW SW ANTENNA SYSTEM ARRANGEMENT
A-62 10kW SW ANTENNA OVERVIEW

MURUN STATION ムルン送信所

M-11 GENERAL LAYOUT
M-12 GENERAL EQUIPMENT ARRANGEMENT 1/2
M-13 GENERAL EQUIPMENT ARRANGEMENT 2/2

M-21 TRANSMITTING SYSTEM BLOCK DIAGRAM
M-22 PROGRAM INPUT EQUIPMENT BLOCK DIAGRAM

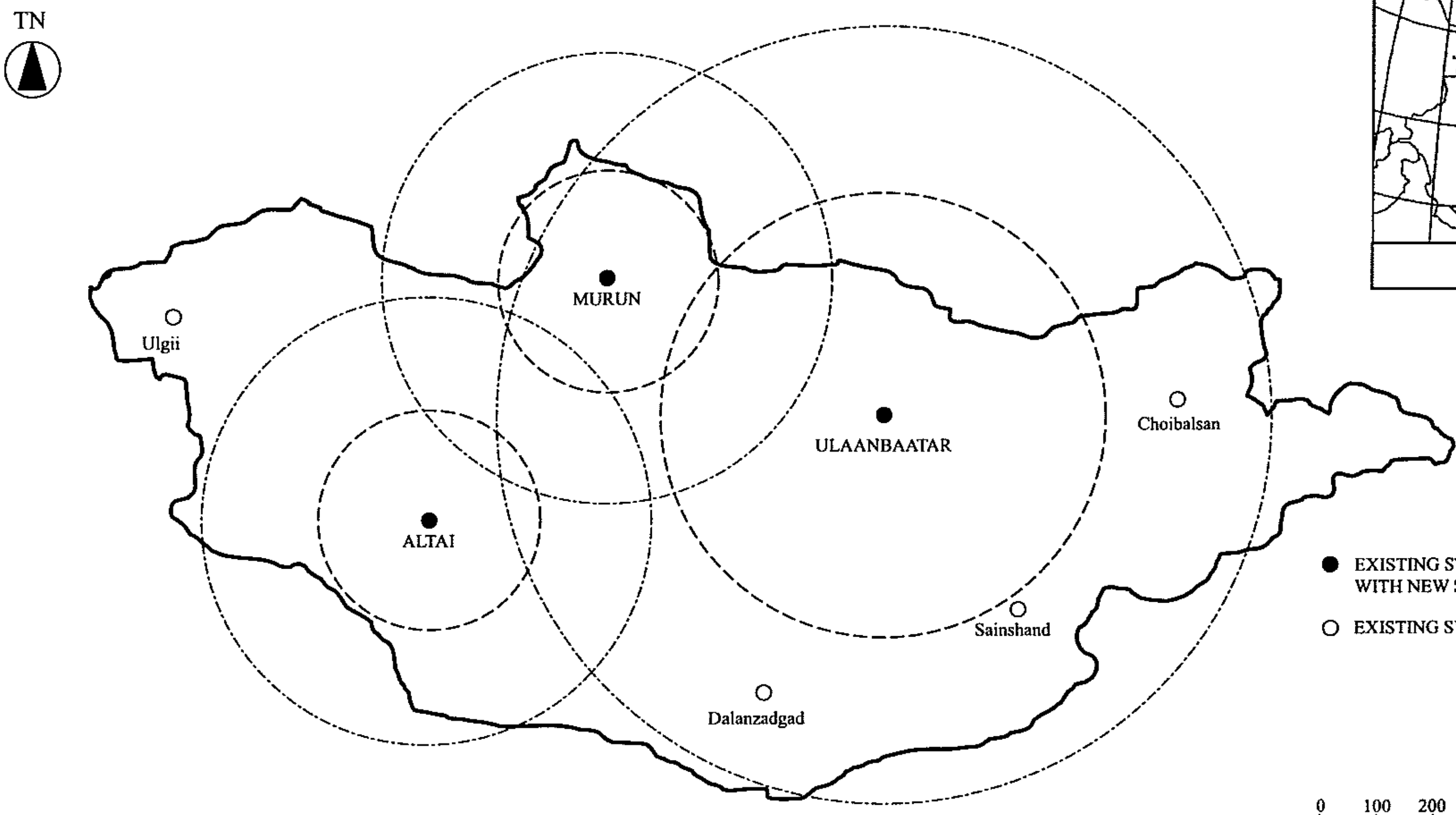
M-31 10KW SW TRANSMITTER OVERVIEW
M-32 COOLING EQUIPMENT OVERVIEW

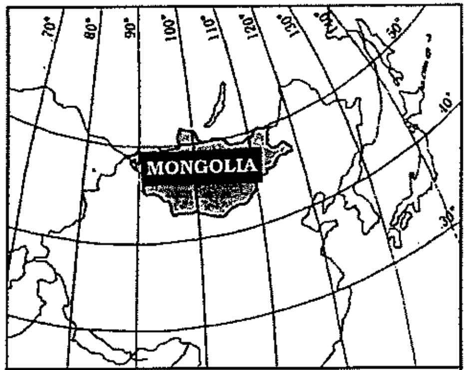
M-41 POWER SUPPLY SINGLE LINE DIAGRAM

M-51 GROUNDING SYSTEM

M-61 10kW SW ANTENNA SYSTEM ARRANGEMENT
M-62 10kW SW ANTENNA OVERVIEW

ALL THE DRAWINGS CONTAINED IN THIS REPORT ARE FOR REFERENCE ONLY. DIMENSIONS AND LOCATIONS OF THE EQUIPMENT ARE APPROXIMATE AND ARE SUBJECT TO CHANGE.





LOCATION OF MONGOLIA

● EXISTING STATIONS TO BE PROVIDED WITH NEW SW TRANSMITTING SYSTEMS

○ EXISTING SW/MW/LW STATIONS

0 100 200 300 400 500 600 700km

SCALE

USUAL SERVICE AREA WITH SSN=100 AND CHANGE-OVER OF FREQUENCIES

MINIMUM SERVICE AREA IN THE CASE OF THE WORST SW PROPAGATION

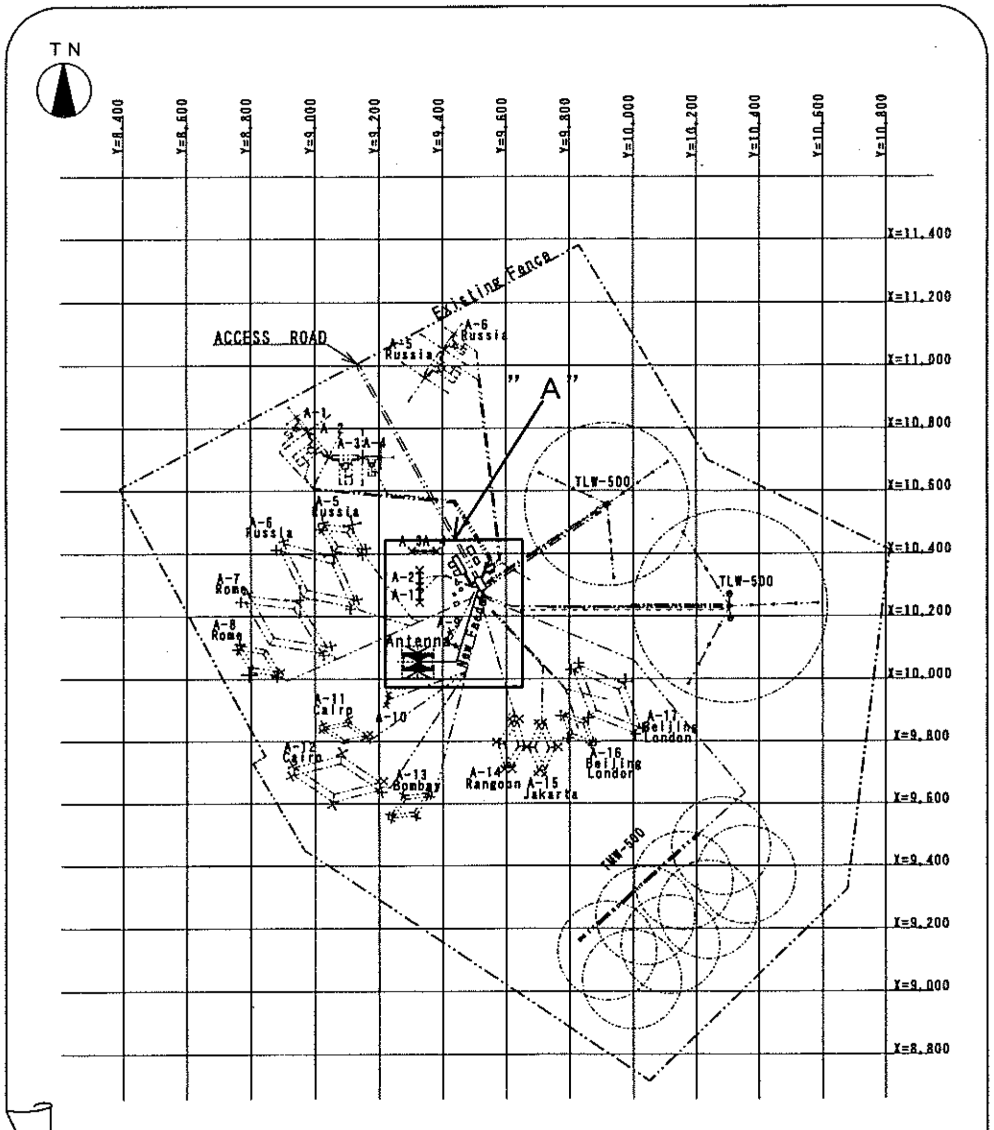
NOTE: SW RADIO RECEPTION OUTSIDE THE SERVICE AREA IS POSSIBLE, ALTHOUGH AUDIBLE LEVEL IS DECREASED.

NEW SW STATION & OPERATION PLAN

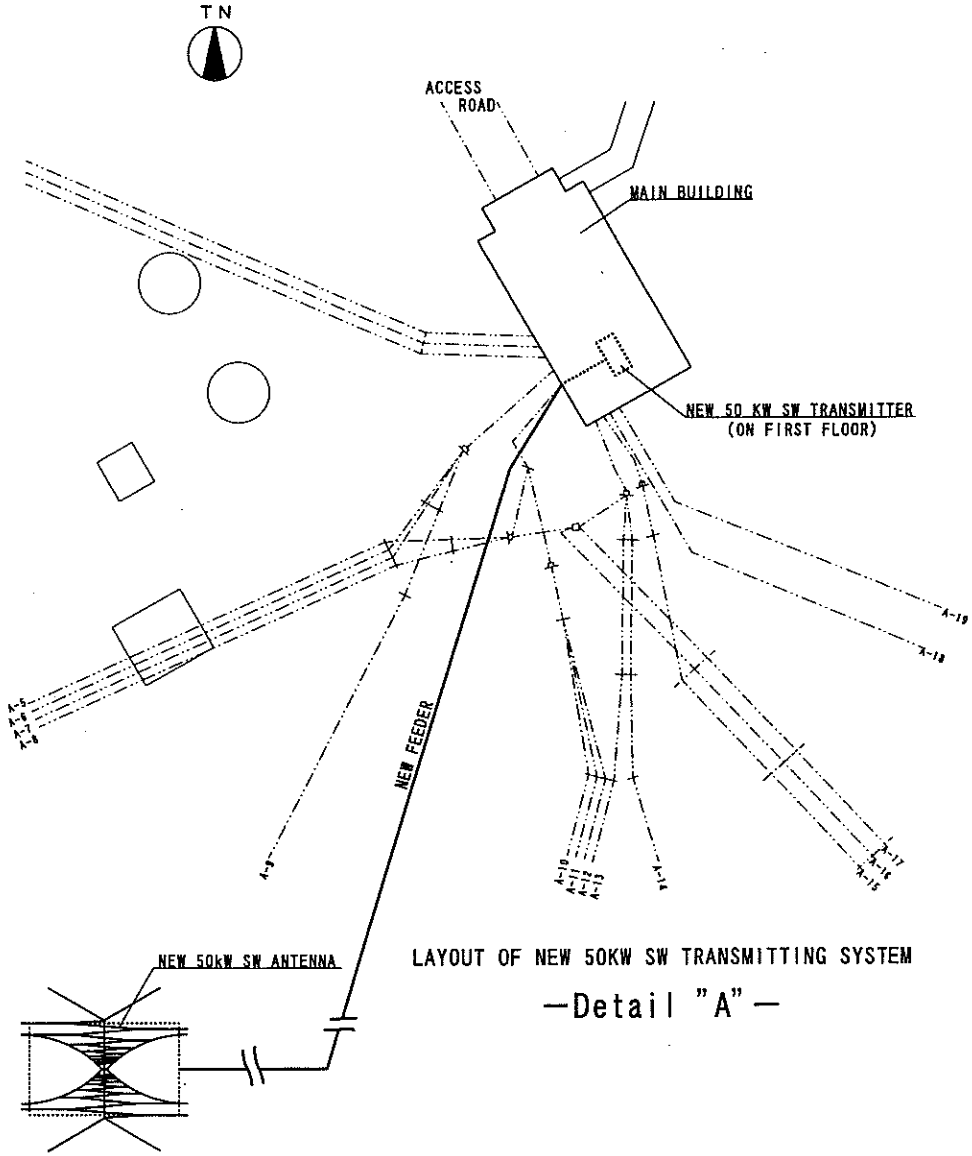
STATION	POWER (kW)	No. of UNIT(S)	OPERATION		ALLOCATED FREQUENCIES (kHz)			SERVICE AREA * IN RADIUS (km)
			MAIN	STAND-BY				
ULAANBAATAR	50	1	X	(EXISTING TSW-100)	4,850	7,260	9,305	700
ALTAI	10	2	X	X	4,830	5,950	9,430	400
MURUN	10	2	X	X	4,895	6,100	9,560	400

* THE SERVICE AREA IS WHERE SIGNAL LEVEL OF APPROX. 50dB AND MORE CAN BE ACHIEVED.

C-11	SW TRANSMISSION SERVICE AREA PLAN



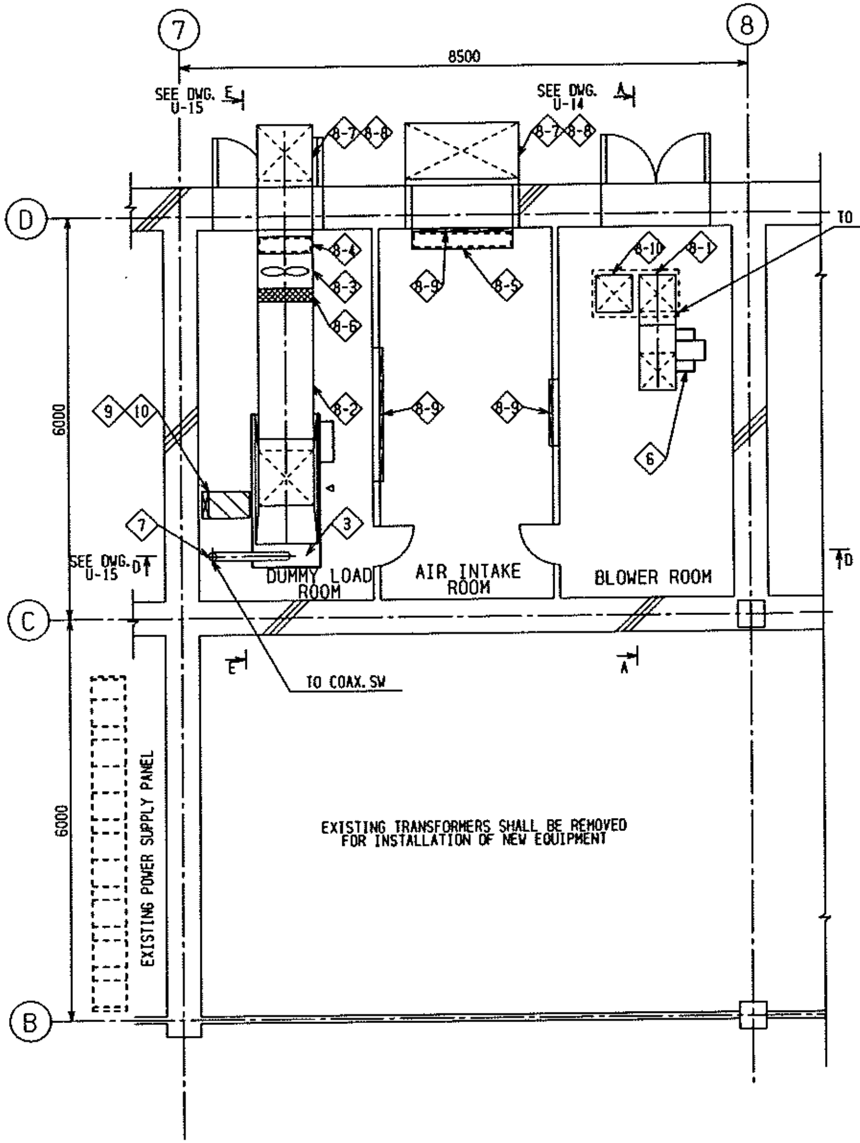
NOTE:1. LAYOUT OF EXISTING TRANSMITTING SYSTEMS IS INDICATED FOR REFERENCE ONLY.



LAYOUT OF NEW 50KW SW TRANSMITTING SYSTEM

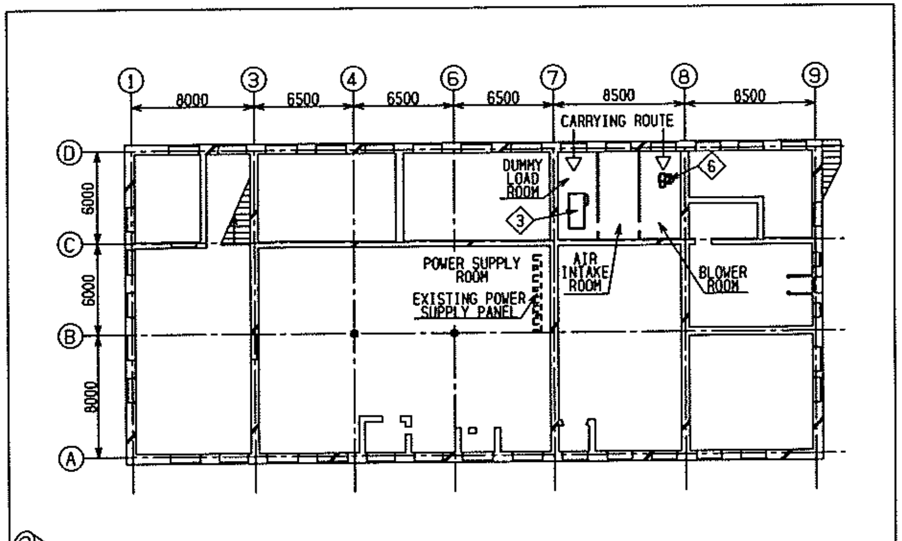
—Detail "A"—

U-11	ULAANBAATAR STATION GENERAL LAYOUT



GROUND FLOOR

SCALE : 1/80



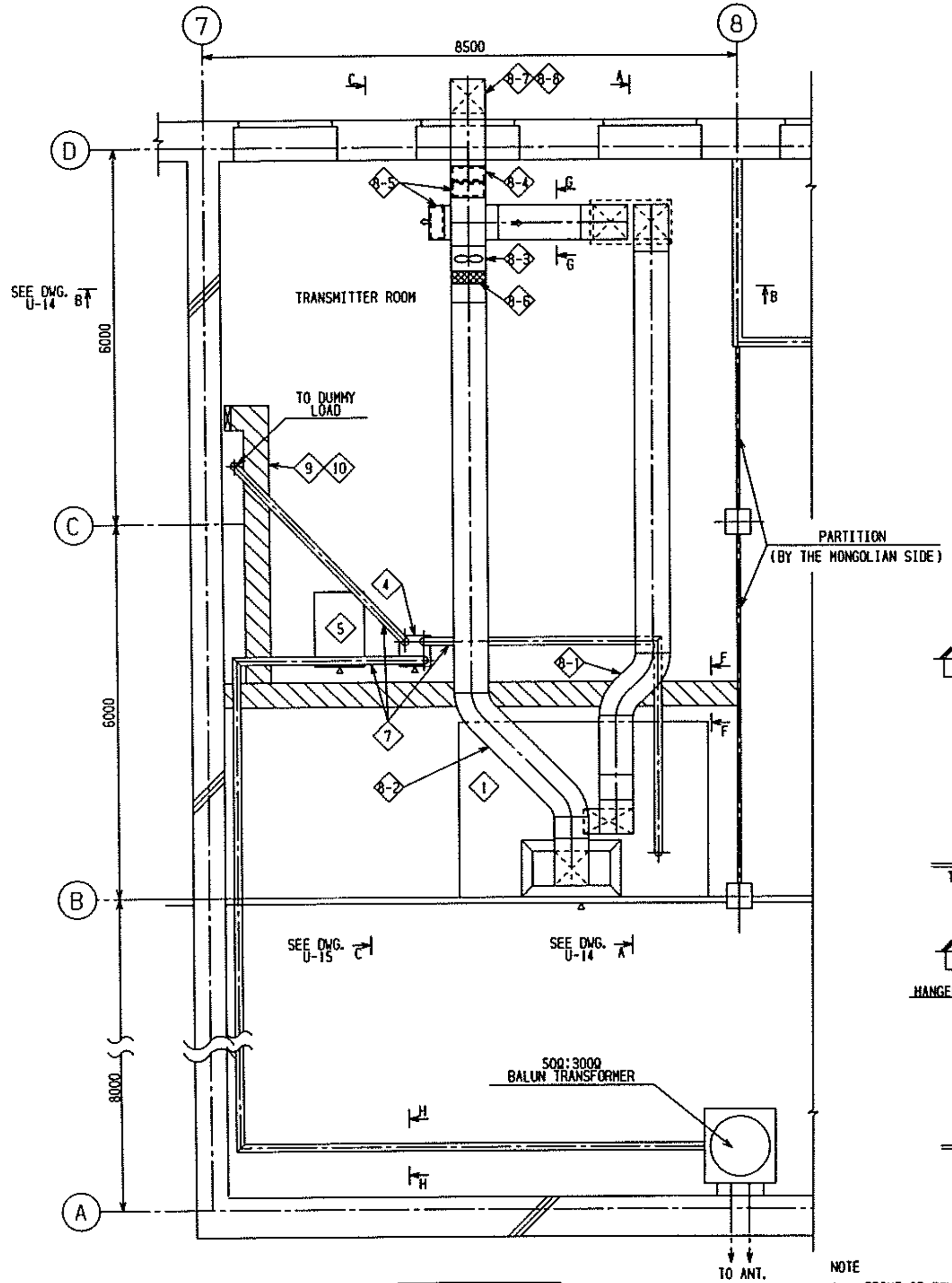
KEY PLAN
GROUND FLOOR

EQUIPMENT LIST

No		EQUIPMENT
1		50kW TX
2	A	PIE
	B	MEASURING RACK
3		DUMMY LOAD
4		COAXIAL SW
5		AVR/ PDB
6		BLOWER
7		INDOOR COAXAL FEEDER
8		COOLING SYSTEM
	1	INTAKE AIR DUCT
	2	EXHAUST AIR DUCT
	3	DUCT FAN
	4	CHECK DAMPER
	5	VOLUME DAMPER
	6	CANVAS DUCT
	7	AIR HOOD
	8	INSECT NET
	9	AIR FILTER & FILTER FRAME
	10	RETURN AIR DUCT
9		CABLE LADDER
10		COPPER PLATE FOR GROUNDING

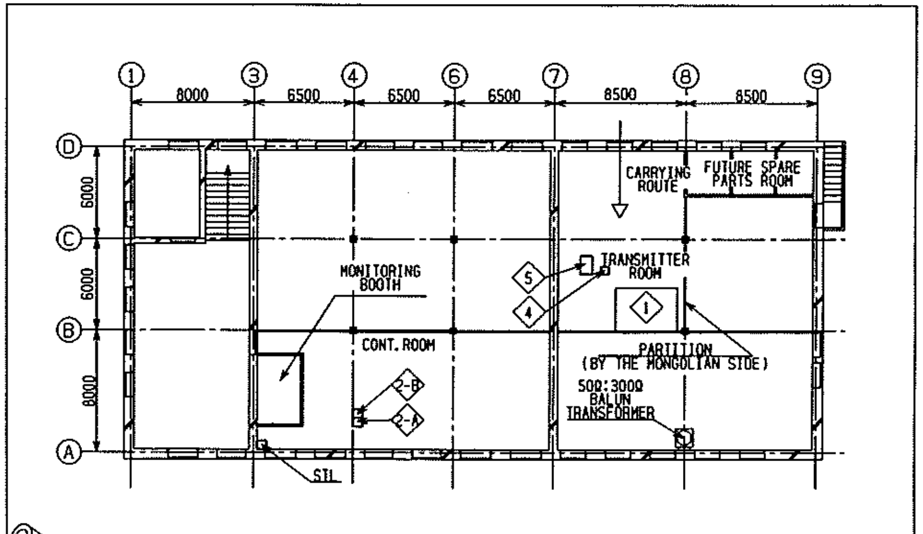
NOTE
1. △: FRONT OF EQUIPMENT
2. DIMENSIONS INDICATED IN THIS DRAWING AND ANY RELATED DRAWINGS ARE APPROXIMATE ONLY.

U-12	ULAANBAATAR STATION GENERAL EQUIPMENT ARRANGEMENT GROUND FLOOR



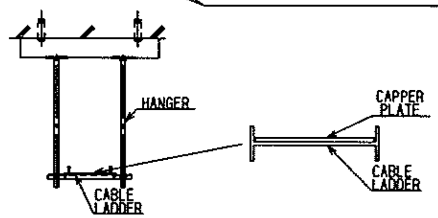
FIRST FLOOR

SCALE : 1/80



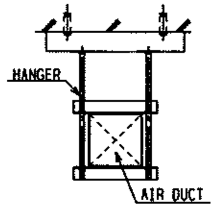
KEY PLAN

FIRST FLOOR



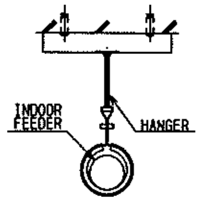
SECTION F-F

TYPICAL SUPPORTING OF CABLE LADDER



SECTION G-G

TYPICAL SUPPORTING OF AIR DUCT



SECTION H-H

TYPICAL SUPPORTING OF INDOOR FEEDER

EQUIPMENT LIST

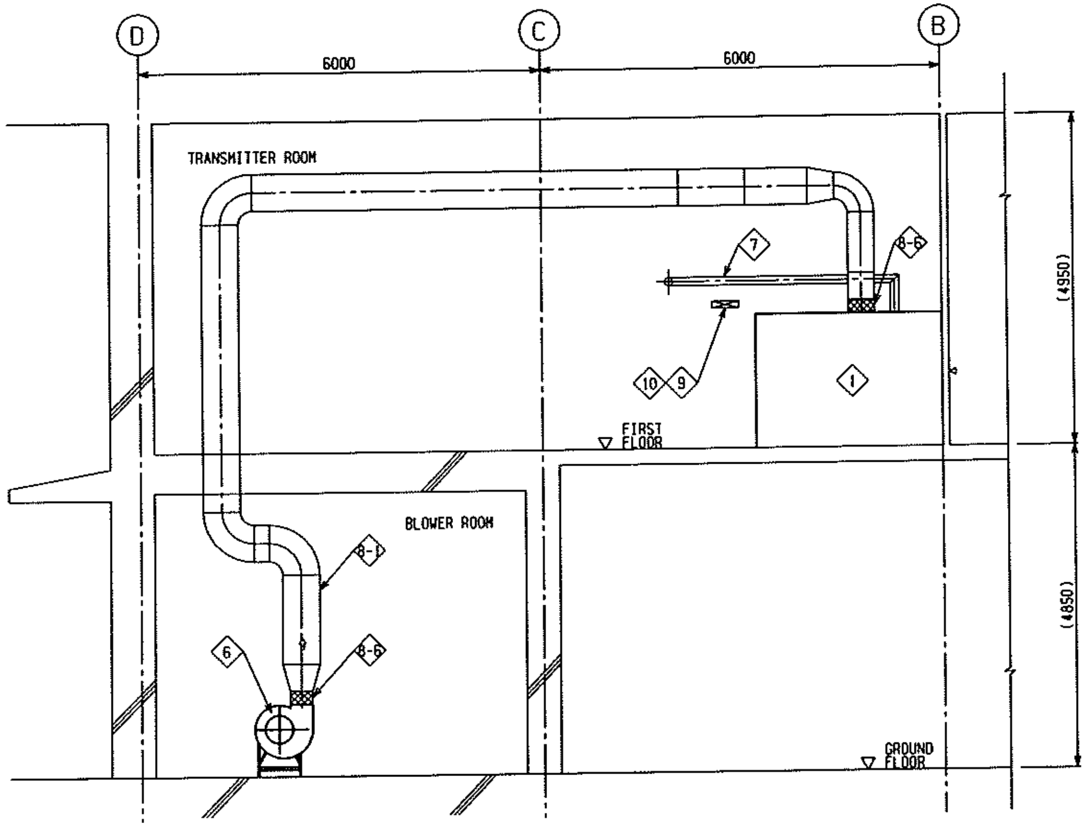
No		EQUIPMENT
1		50kW TX
2	A	PIE
	B	MEASURING RACK
3		DUMMY LOAD
4		COAXIAL SW
5		AVR/ PDB
6		BLOWER
7		INDOOR COAXAL FEEDER
8		COOLING SYSTEM
	1	INTAKE AIR DUCT
	2	EXHAUST AIR DUCT
	3	DUCT FAN
	4	CHECK DAMPER
	5	VOLUME DAMPER
	6	CANVAS DUCT
	7	AIR HOOD
	8	INSECT NET
	9	AIR FILTER & FILTER FRAME
	10	RETURN AIR DUCT
9		CABLE LADDER
10		COPPER PLATE FOR GROUNDING

NOTE

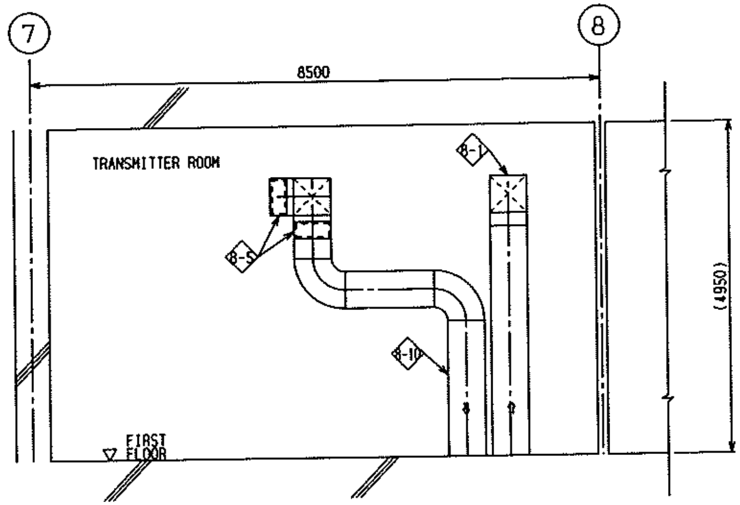
1. △ : FRONT OF EQUIPMENT
2. DIMENSIONS INDICATED IN THIS DRAWING AND ANY RELATED DRAWINGS ARE APPROXIMATE ONLY.

U-13

ULAANBAATAR STATION
GENERAL EQUIPMENT ARRANGEMENT
FIRST FLOOR



SECTION A-A
SEE DWG.U-12 & 13
SCALE : 1/80



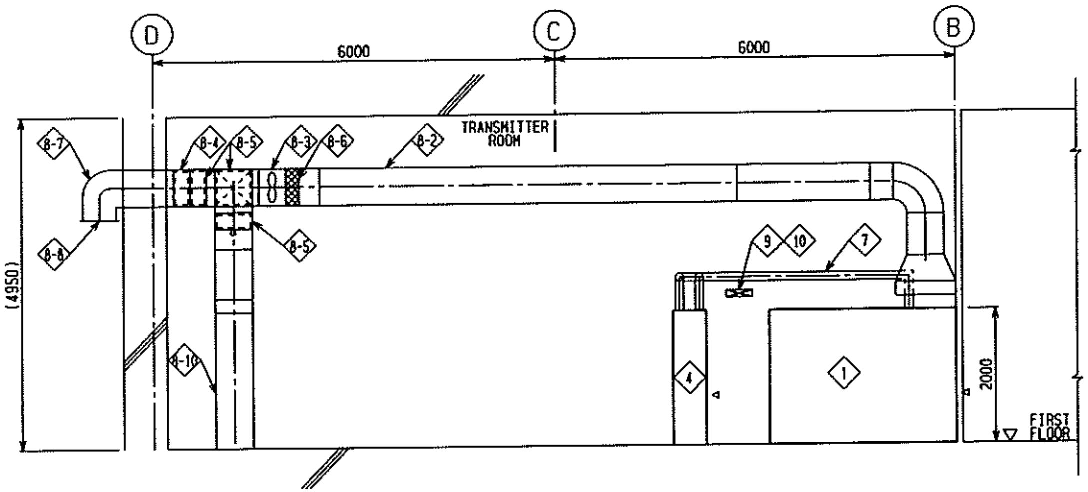
SECTION B-B
SEE DWG.U-13
SCALE : 1/80

EQUIPMENT LIST

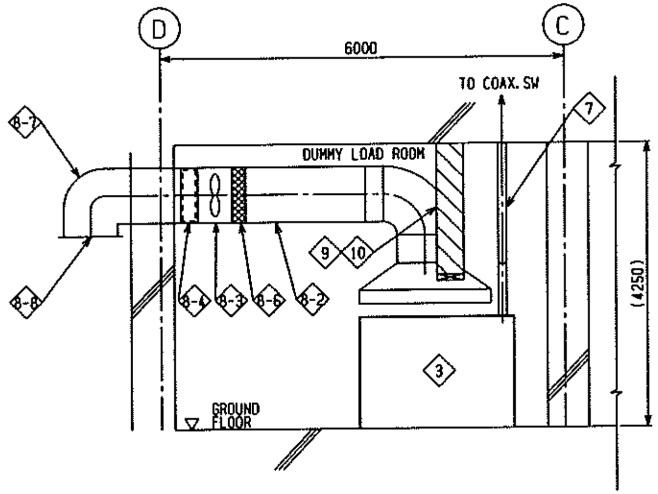
No		EQUIPMENT
1		50kW TX
2	A	PIE
	B	MEASURING RACK
3		DUMMY LOAD
4		COAXIAL SW
5		AVR/ PDB
6		BLOWER
7		INDOOR COAXAL FEEDER
8		COOLING SYSTEM
	1	INTAKE AIR DUCT
	2	EXHAUST AIR DUCT
	3	DUCT FAN
	4	CHECK DAMPER
	5	VOLUME DAMPER
	6	CANVAS DUCT
	7	AIR HOOD
	8	INSECT NET
	9	AIR FILTER & FILTER FRAME
	10	RETURN AIR DUCT
9		CABLE LADDER
10		COPPER PLATE FOR GROUNDING

NOTE
1. △ : FRONT OF EQUIPMENT
2. DIMENSIONS INDICATED IN THIS DRAWING AND ANY RELATED DRAWINGS ARE APPROXIMATE ONLY.

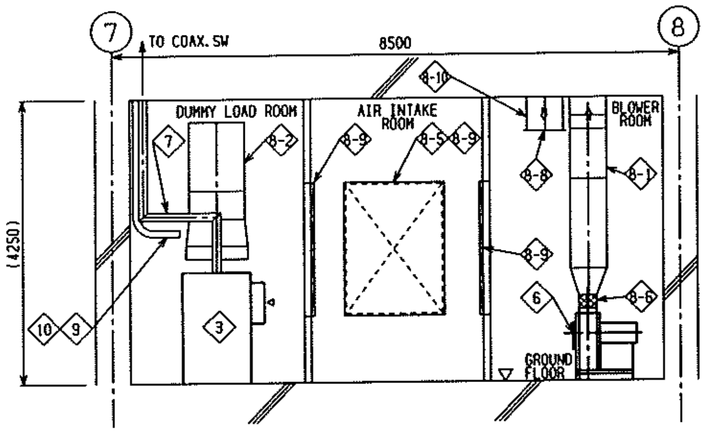
U-14	ULAANBAATAR STATION GENERAL EQUIPMENT ARRANGEMENT SECTION 1/2



SECTION C-C
SEE DWG. U-13
SCALE : 1/80



SECTION E-E
SEE DWG. U-12
SCALE : 1/80



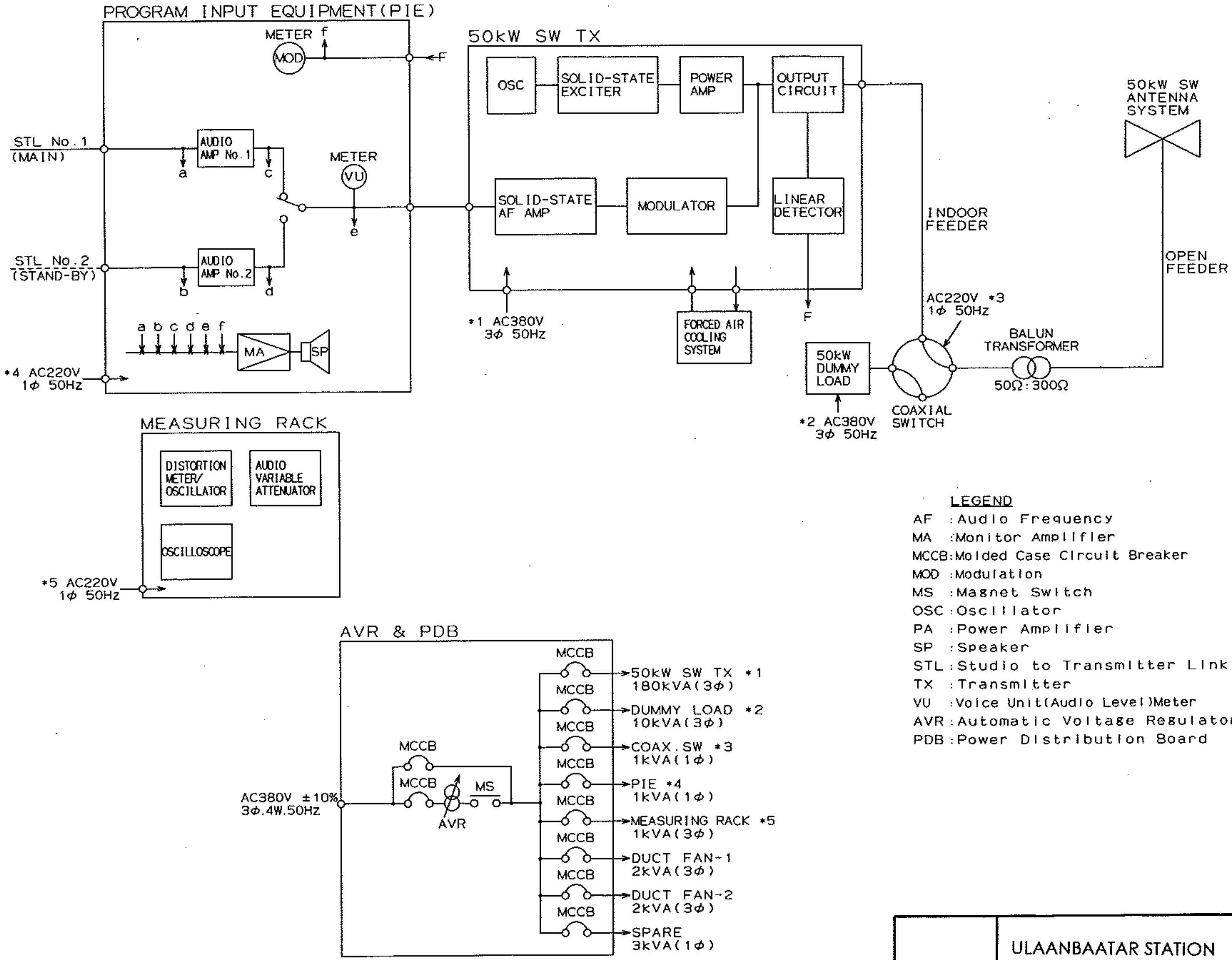
SECTION D-D
SEE DWG. U-12
SCALE : 1/80

EQUIPMENT LIST

No		EQUIPMENT
1		50kW TX
2	A	PIE
	B	MEASURING RACK
3		DUMMY LOAD
4		COAXIAL SW
5		AVR/ PDB
6		BLOWER
7		INDOOR COAXAL FEEDER
8		COOLING SYSTEM
	1	INTAKE AIR DUCT
	2	EXHAUST AIR DUCT
	3	DUCT FAN
	4	CHECK DAMPER
	5	VOLUME DAMPER
	6	CANVAS DUCT
	7	AIR HOOD
	8	INSECT NET
	9	AIR FILTER & FILTER FRAME
	10	RETURN AIR DUCT
9		CABLE LADDER
10		COPPER PLATE FOR GROUNDING

NOTE
1. △: FRONT OF EQUIPMENT
2. DIMENSIONS INDICATED IN THIS DRAWING AND ANY RELATED DRAWINGS ARE APPROXIMATE ONLY.

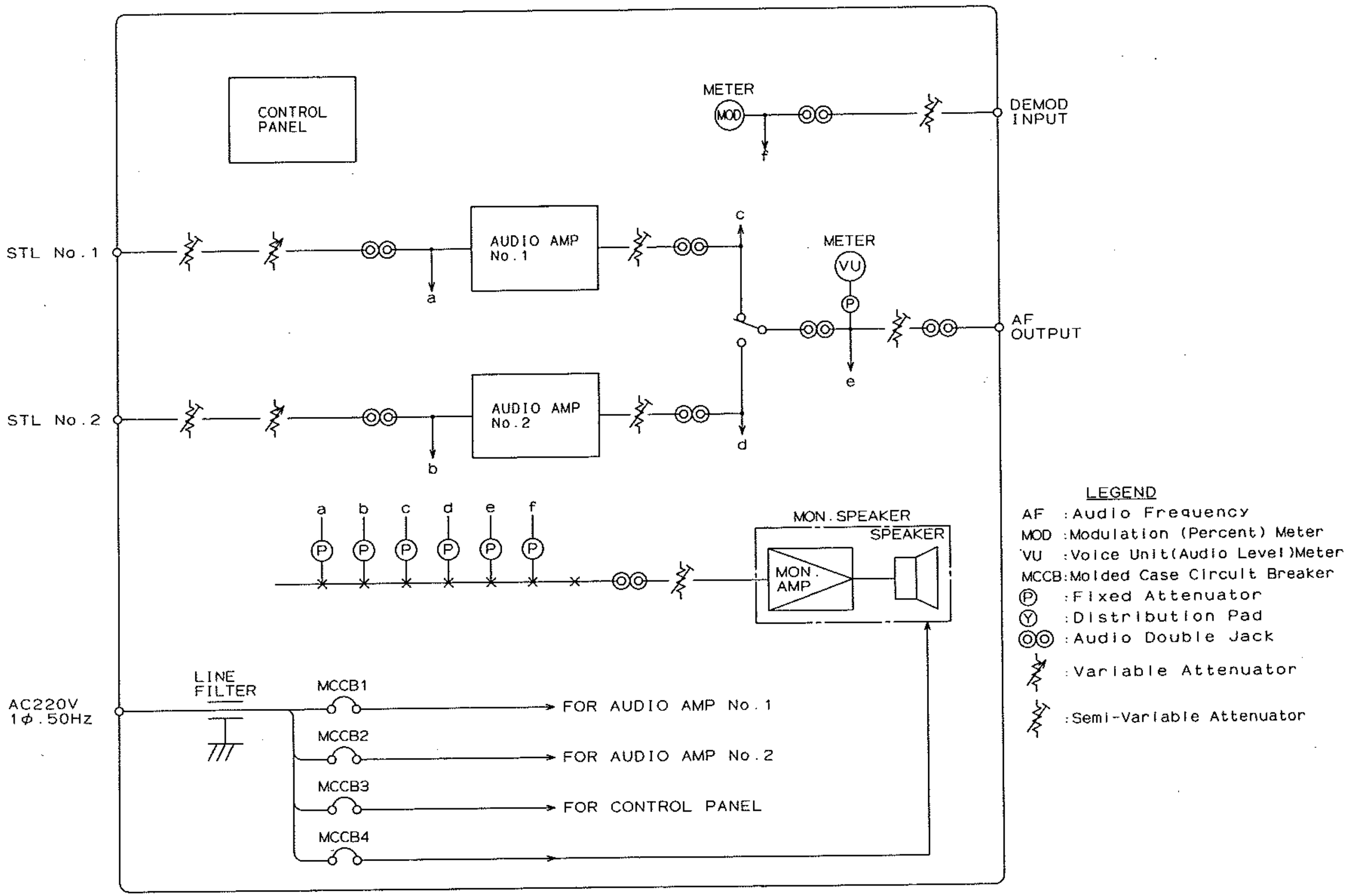
U-15	ULAANBAATAR STATION GENERAL EQUIPMENT ARRANGEMENT SECTION 2/2



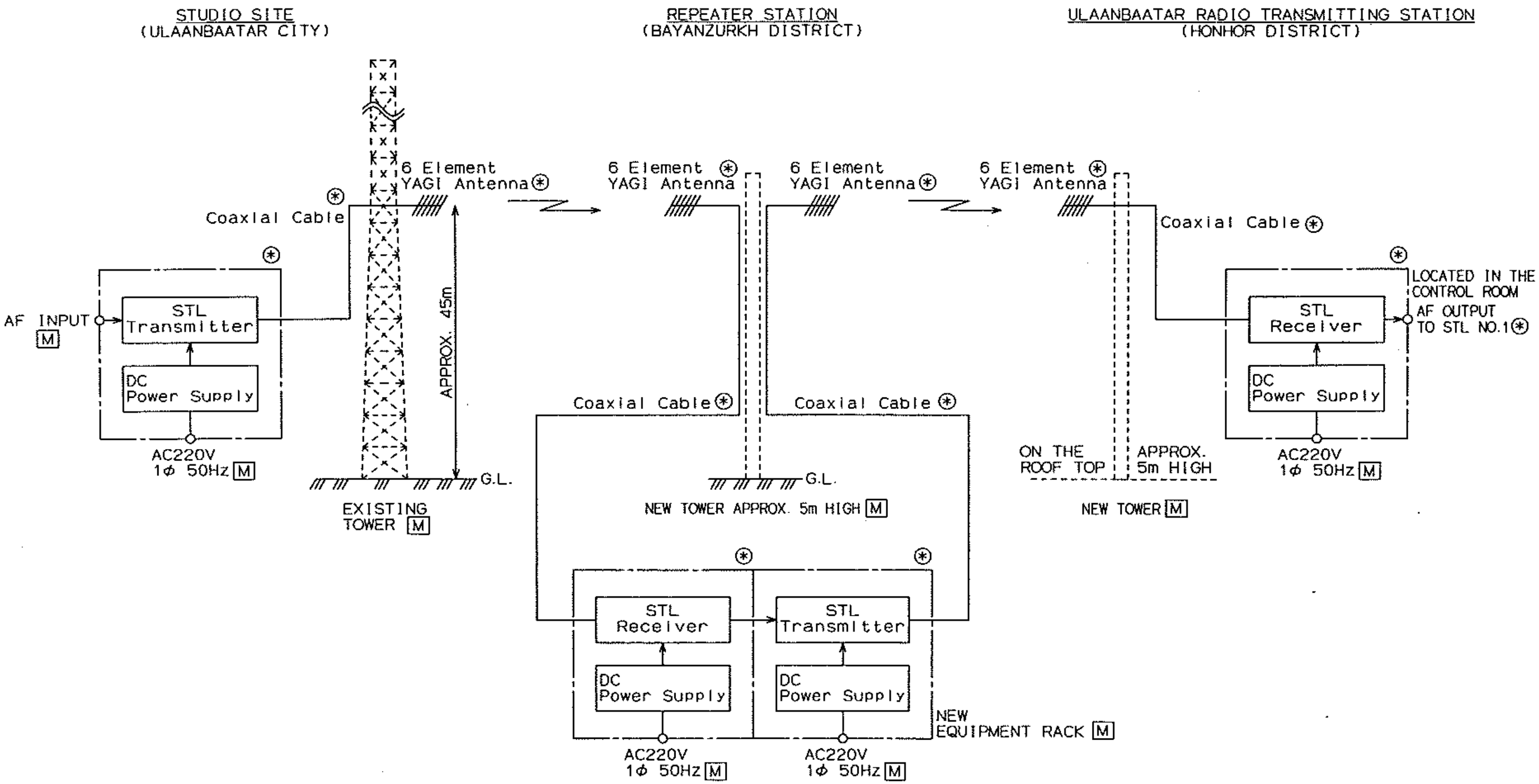
LEGEND

AF :Audio Frequency
MA :Monitor Amplifier
MCCB:Molded Case Circuit Breaker
MOD :Modulation
MS :Magnet Switch
OSC :Oscillator
PA :Power Amplifier
SP :Speaker
STL :Studio to Transmitter Link
TX :Transmitter
VU :Voice Unit(Audio Level)Meter
AVR :Automatic Voltage Regulator
PDB :Power Distribution Board

U-21	ULAANBAATAR STATION TRANSMITTING SYSTEM BLOCK DIAGRAM



U-22	ULAANBAATAR STATION PROGRAM INPUT EQUIPMENT BLOCK DIAGRAM

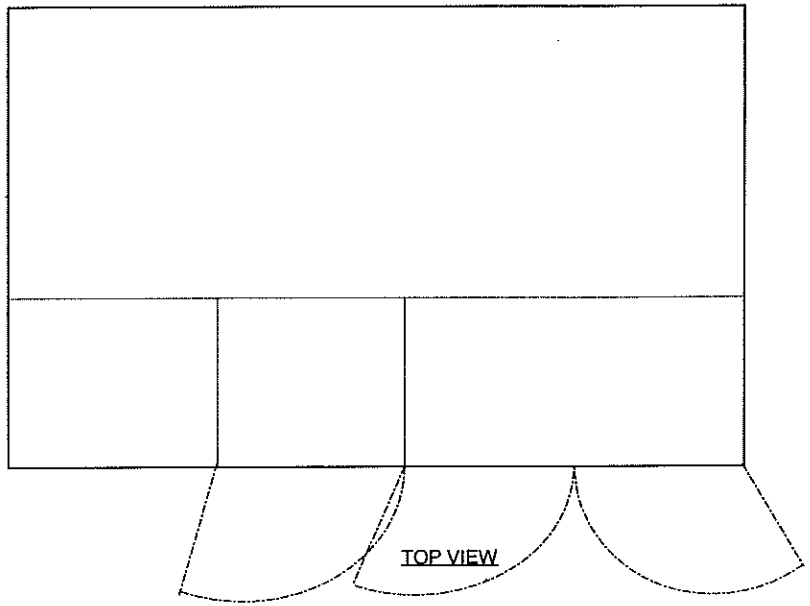


NOTE:
1. EQUIPMENT TO BE SUPPLIED UNDER THIS PROJECT IS MARKED WITH ⊛. ALL OTHER EQUIPMENT AND MATERIALS SHALL BE SUPPLIED BY THE MONGOLIAN SIDE AS MARKED WITH [M].
2. INSTALLATION AND ERECTION OF ALL EQUIPMENT AND MATERIALS SHALL BE SCOPE OF THE MONGOLIAN SIDE.
3. STL FREQUENCY TO BE SELECTED BY THE MONGOLIAN SIDE AMONG 162MHz-170MHz BAND.

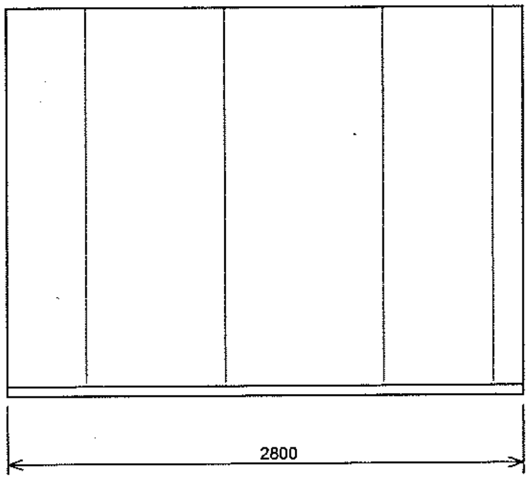
U-23	ULAANBAATAR STATION STL BLOCK DIAGRAM

NOTE:

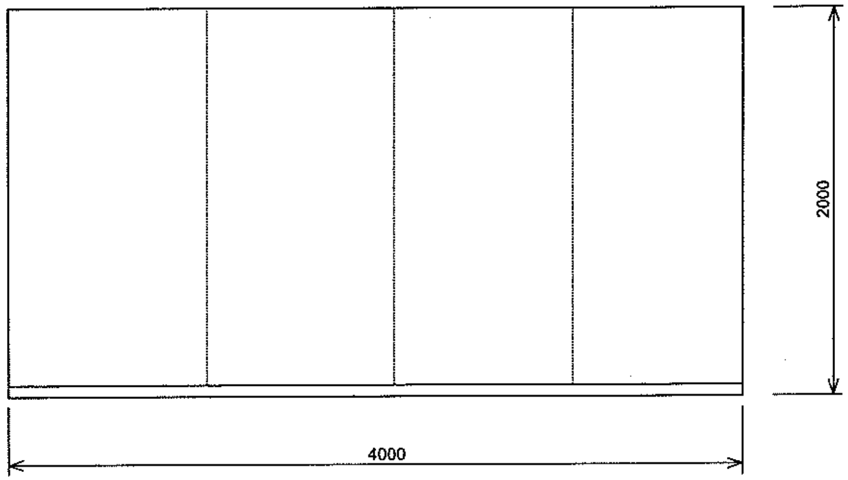
1. ALL THE DIMENSIONS IN THIS DRAWING ARE APPROXIMATE ONLY.



TOP VIEW

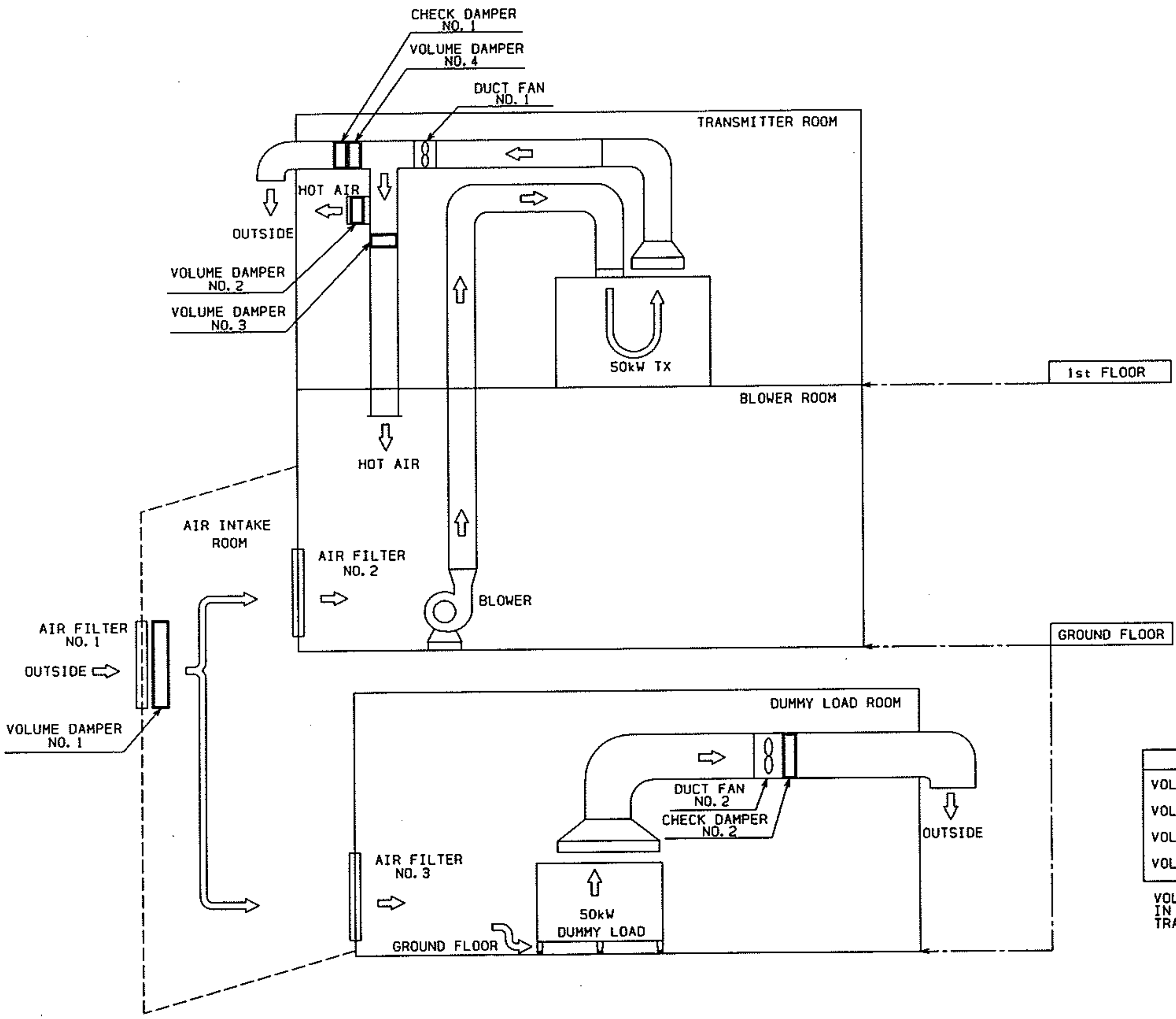


SIDE VIEW



FRONT VIEW

U-31	ULAANBAATAR STATION 50KW SW TRANSMITTER OVERVIEW



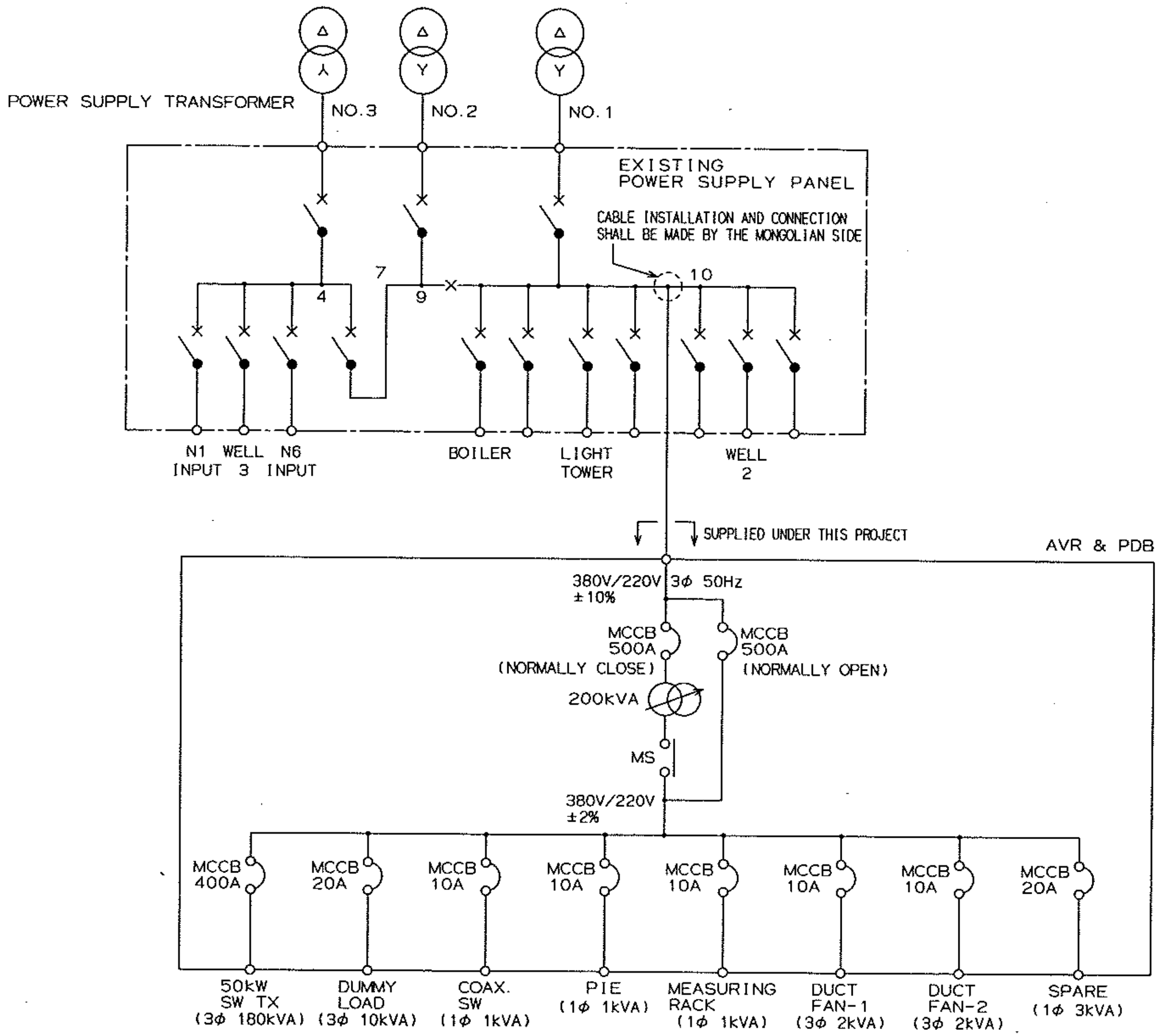
VOLUME DAMPER OPERATION

	SUMMER	WINTER
VOLUME DAMPER NO. 1	FULL OPEN	SEMI CLOSE
VOLUME DAMPER NO. 2	FULL CLOSE	SEMI OPEN
VOLUME DAMPER NO. 3	FULL CLOSE	SEMI OPEN
VOLUME DAMPER NO. 4	FULL OPEN	SEMI CLOSE

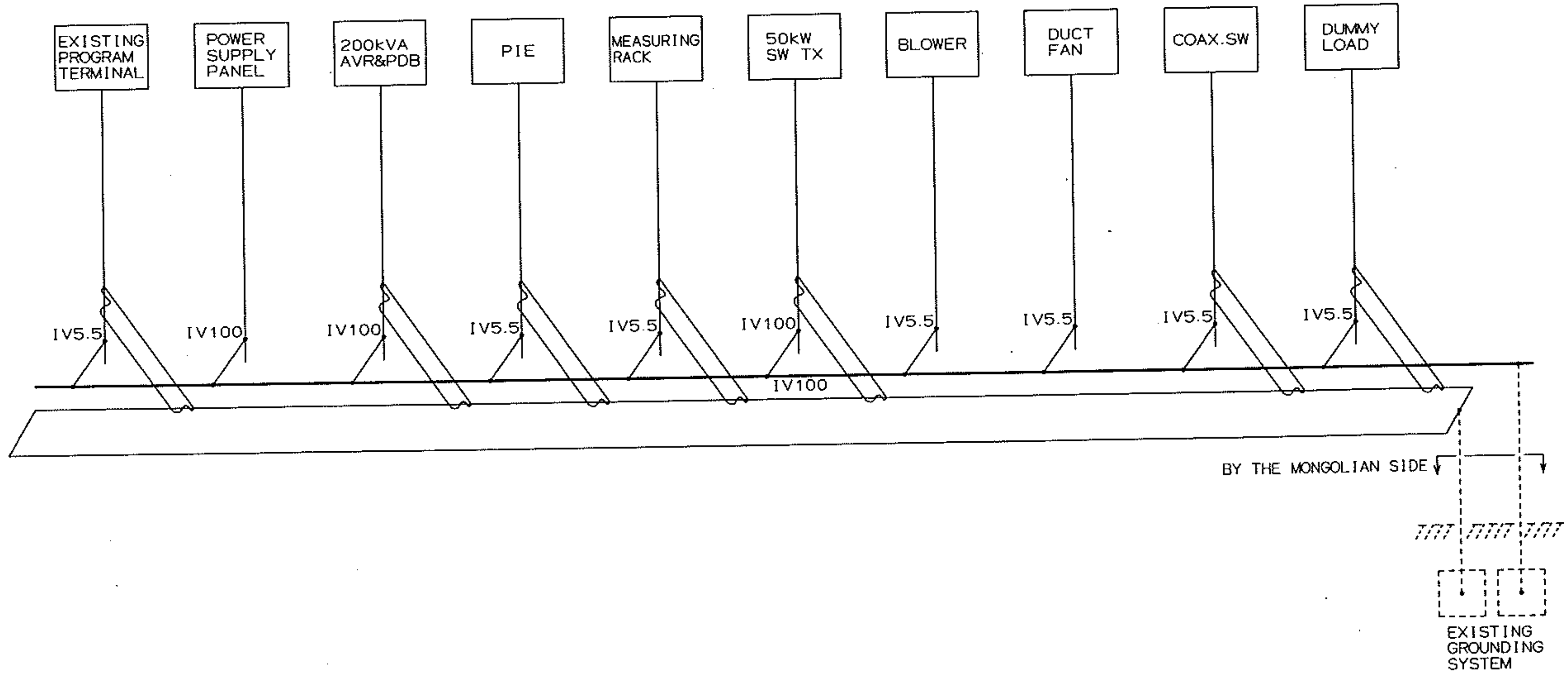
VOLUME DAMPER SHALL BE MANUALLY OPERATED IN ORDER TO ASSURE STABLE FUNCTIONALITY OF TRANSMITTER AND COMFORTABLE ROOM TEMPERATURES

U-32

ULAANBAATAR STATION
COOLING EQUIPMENT OVERVIEW



U-41	ULAANBAATAR STATION POWER SUPPLY SINGLE LINE DIAGRAM



LEGEND

: PVC SHEATHED COPPER WIRE (MAIN)

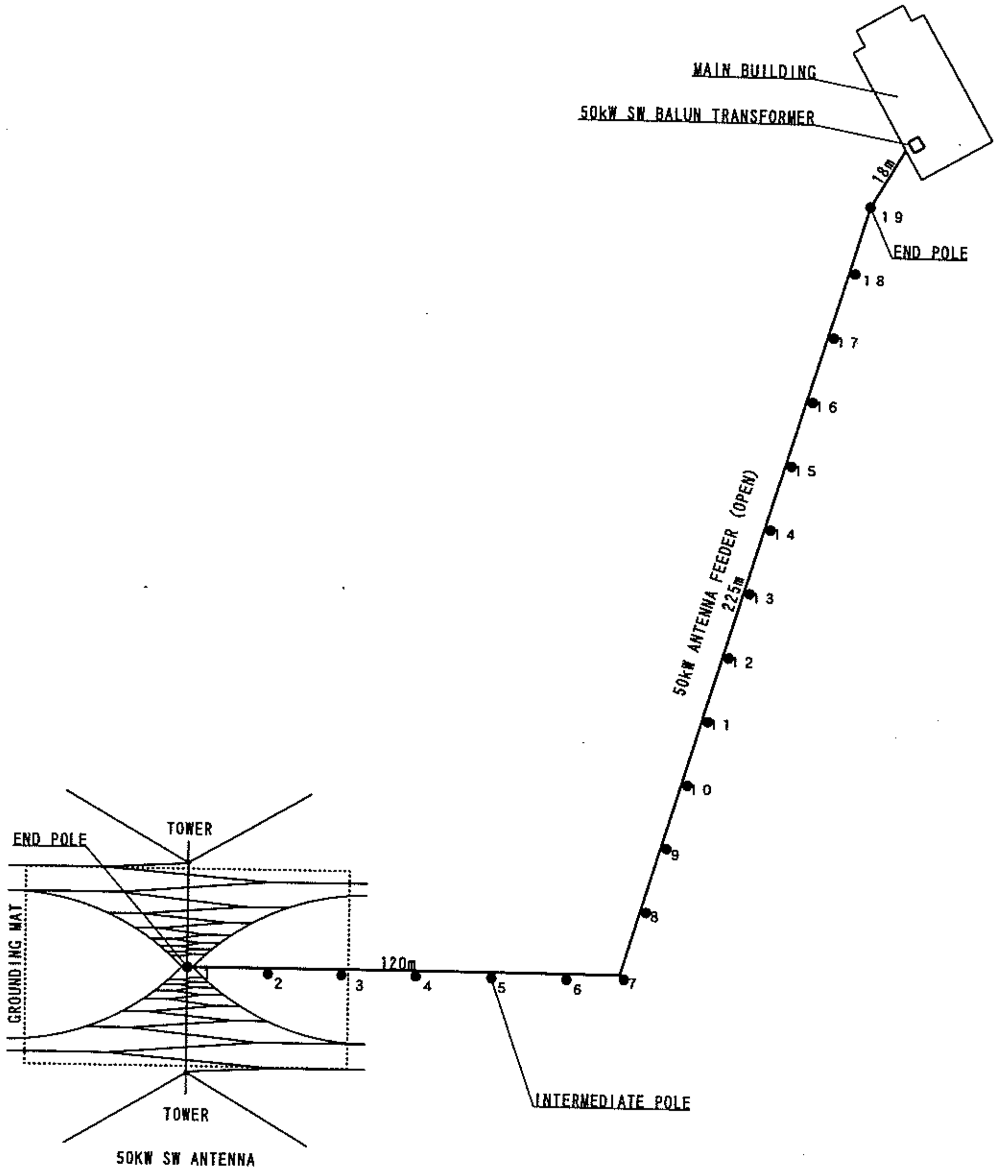
: PVC SHEATHED COPPER WIRE (BRANCH)

: COPPER PLATE (t=0.3mm.w=300mm) (MAIN)

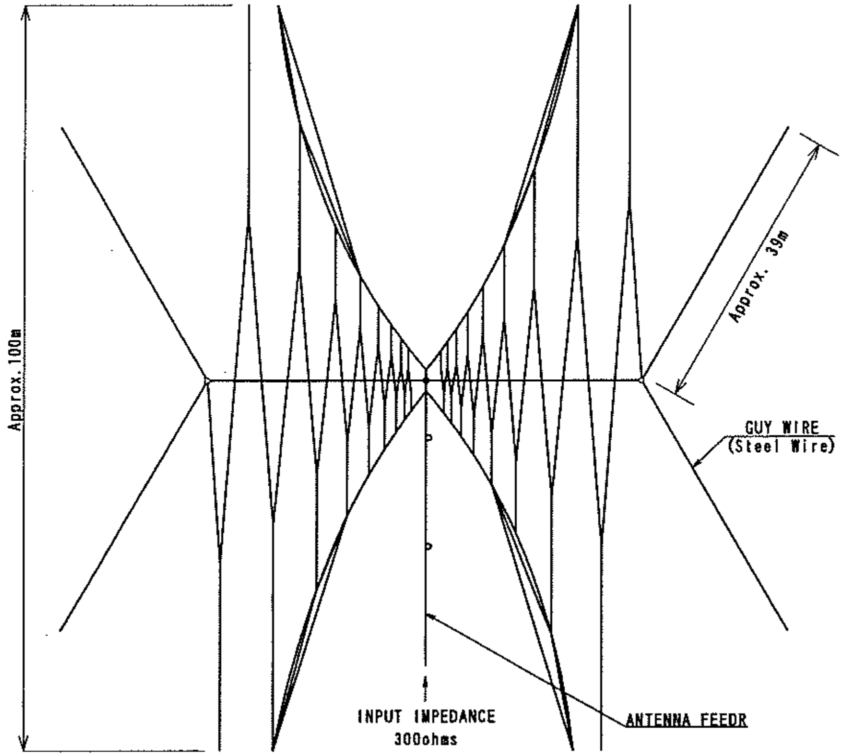
: COPPER PLATE (t=0.3mm.w=300mm) (BRANCH)

IV☐ : PVC SHEATHED COPPER WIRE WITH NOMINAL AREA ☐ IN MM².

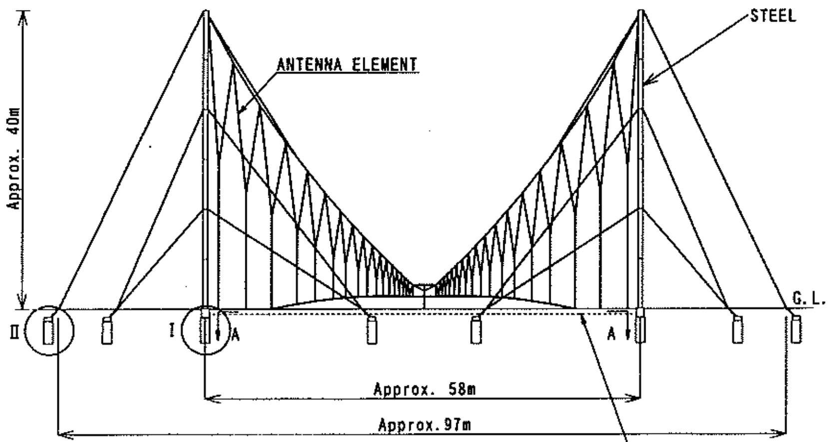
U-51	ULAANBAATAR STATION GROUNDING SYSTEM



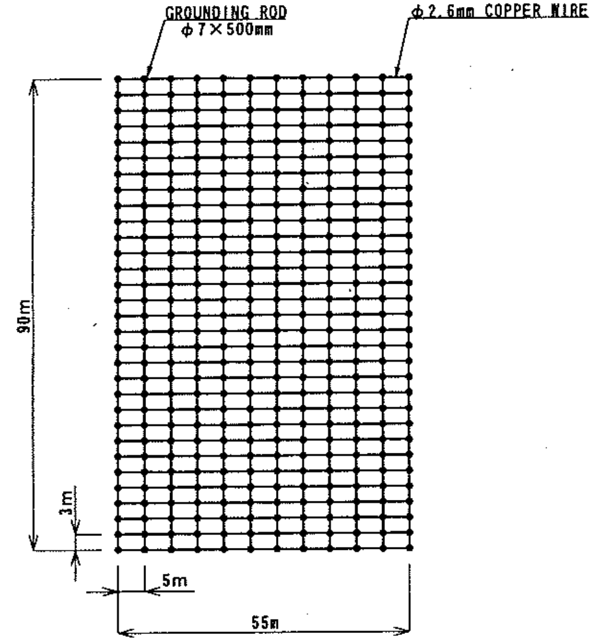
U-61	ULAANBAATAR STATION 50KW SW ANTENNA SYSTEM ARRANGEMENT



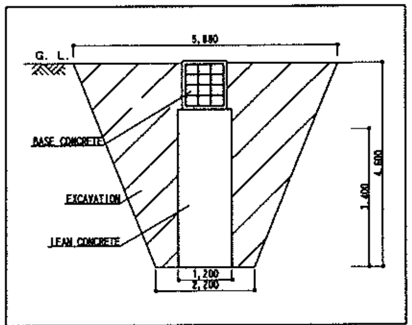
PLAN



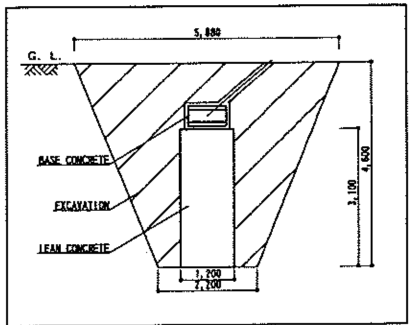
ELEVATION



A-A

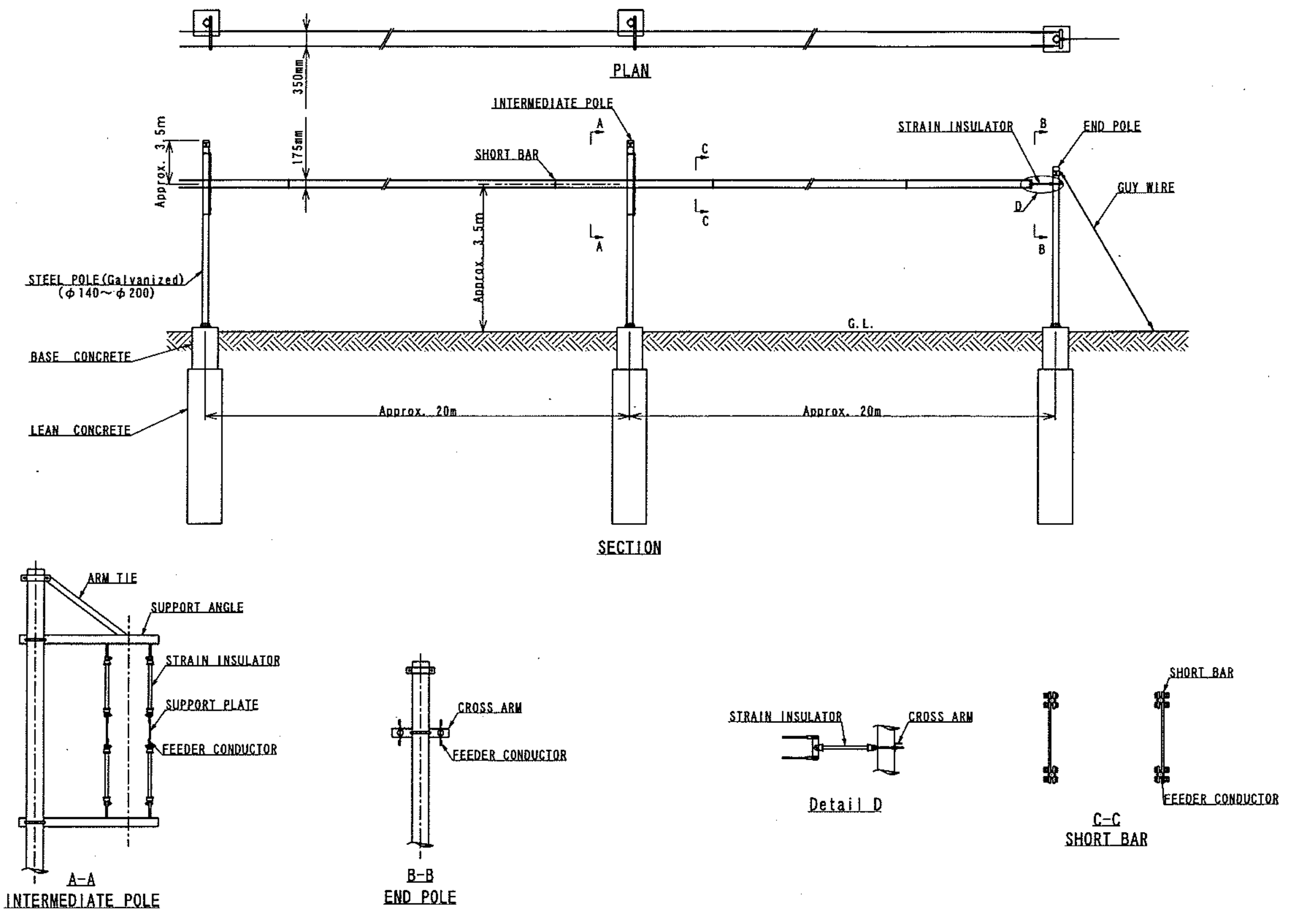


-Detail I-

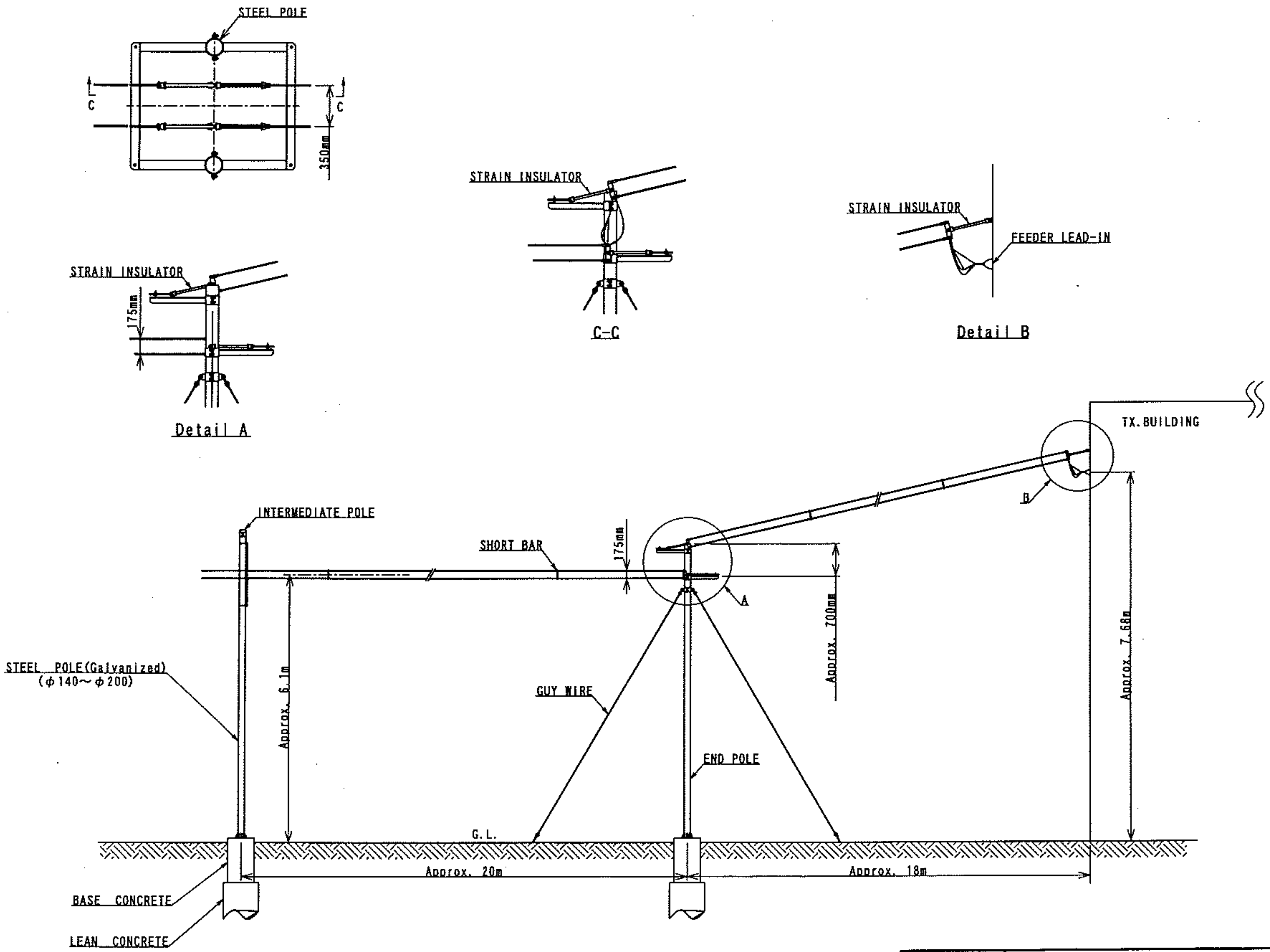


-Detail II-

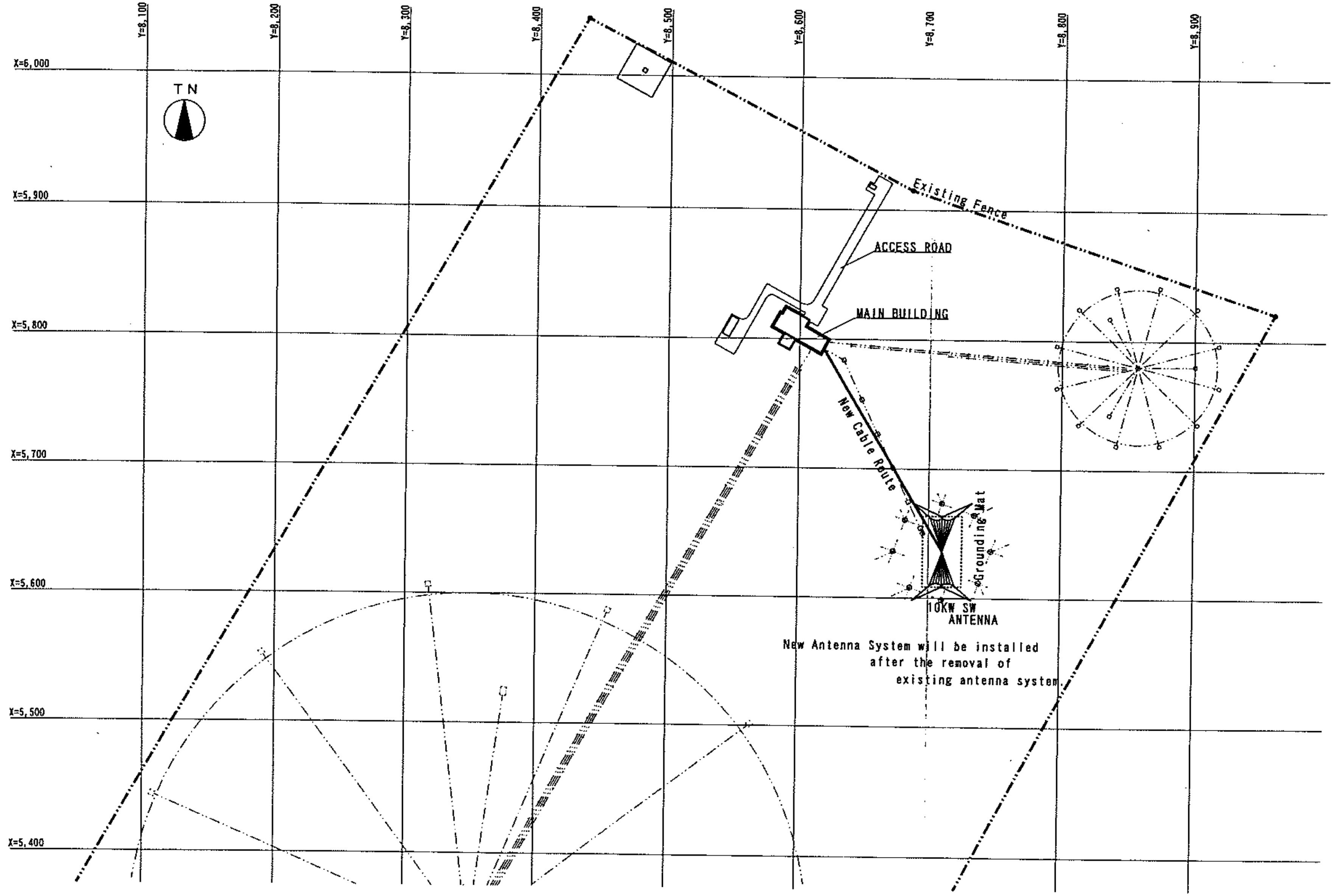
U-62	ULAANBAATAR STATION 50KW SW ANTENNA OVERVIEW



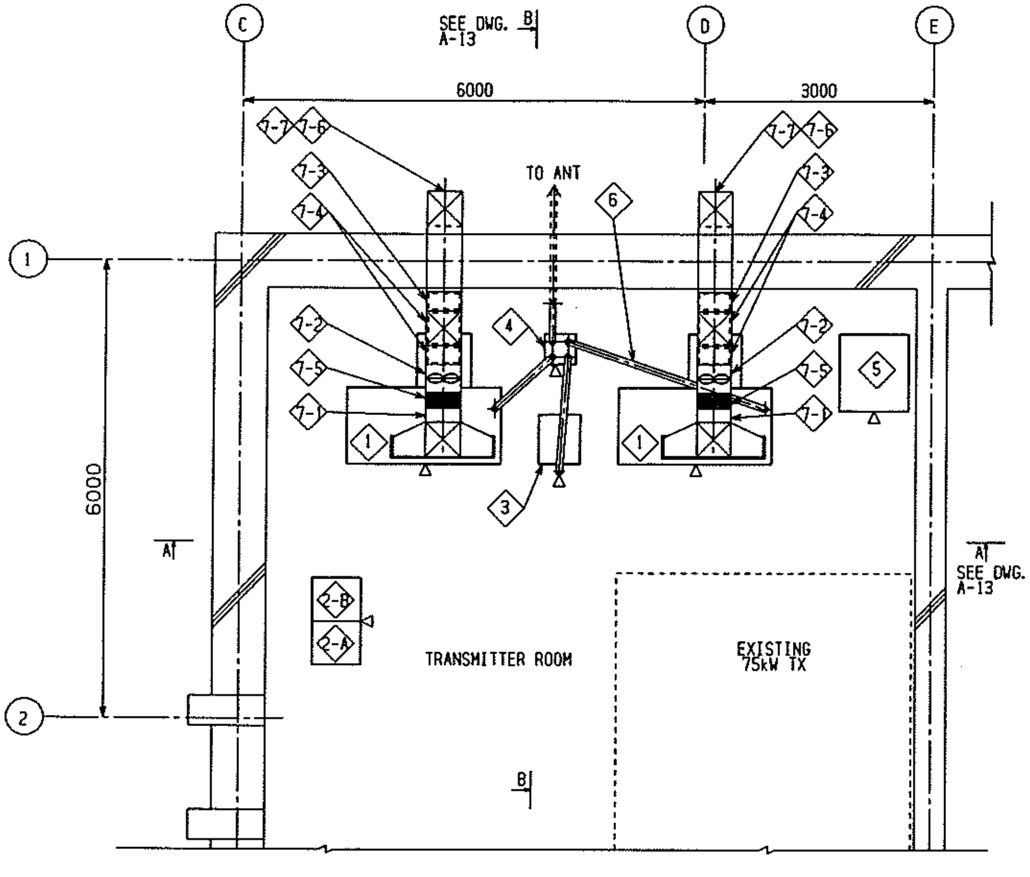
U-63	ULAANBAATAR STATION 50KW SW ANTENNA FEEDER TYPICAL SECTION



U-64	ULAANBAATAR STATION 50KW SW ANTENNA FEEDER ARRANGEMENT AT TX BUILDING END

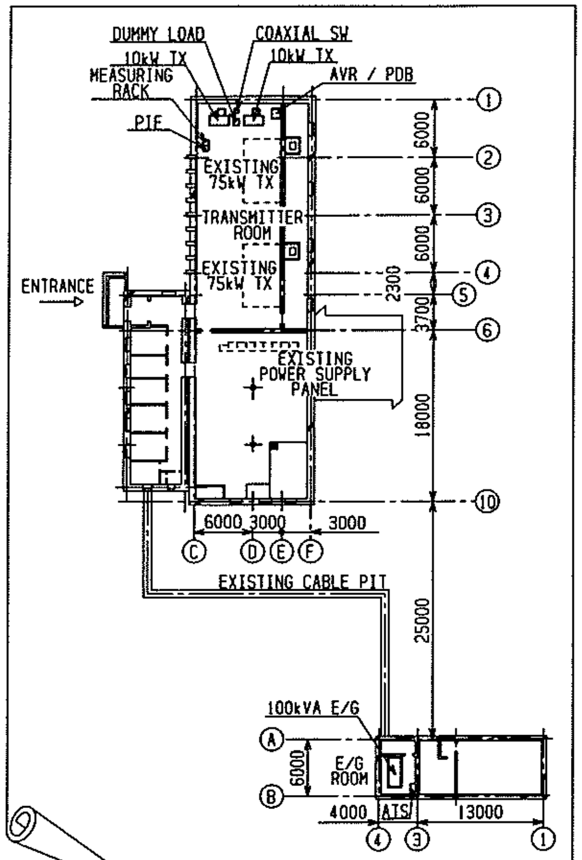


A-11	ALTAI STATION GENERAL LAYOUT



PLAN

SCALE : 1/70



KEY PLAN

EQUIPMENT LIST

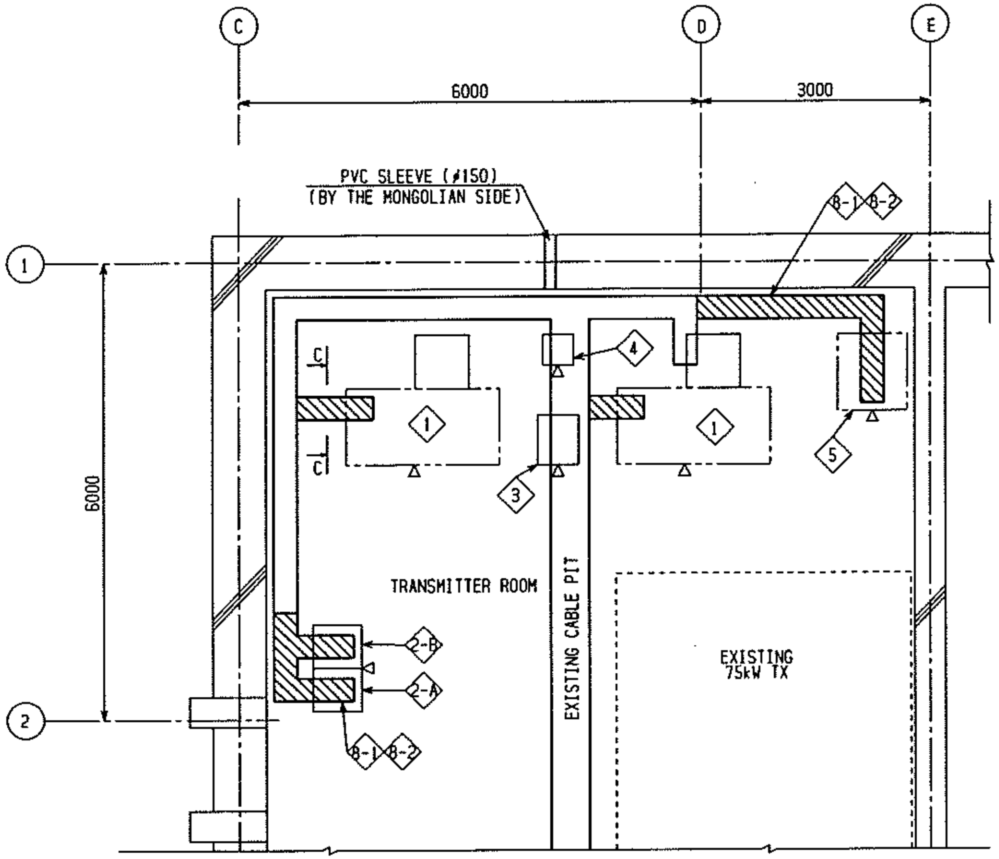
No.		DESCRIPTION
1		10kw TX
2	A	PIE
	B	MEASURING RACK
3		DUMMY LOAD
4		COAXIAL SW
5		AVR / PDB
6		INDOOR COAXAL FEEDER
7		COOLING SYSTEM
	1	EXHAUST AIR DUCT
	2	DUCT FAN
	3	CHECK DAMPER
	4	VOLUME DAMPER
	5	CANVAS DUCT
	6	AIR HOOD
	7	INSECT NET
8	1	COPPER PLATE FOR GROUNDING
	2	CABLE PIT

NOTE

1 Δ:FRONT OF EQUIPMENT

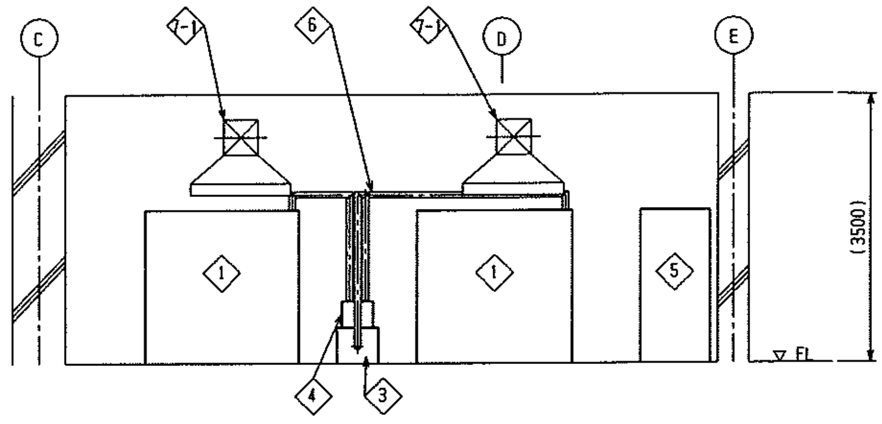
2 DIMENSIONS INDICATED IN THIS DRAWING AND ANY RELATED DRAWINGS ARE APPROXIMATE ONLY.

A-12	ALTAI STATION GENERAL EQUIPMENT ARRANGEMENT 1/2



CABLE PIT ARRANGEMENT

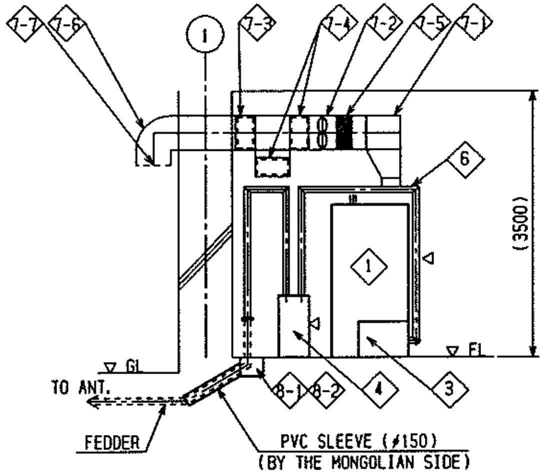
SCALE : 1/70



SECTION A-A

SEE DWG. A-12

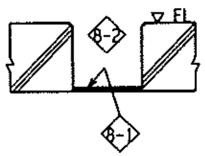
SCALE : 1/70



SECTION B-B

SEE DWG. A-12

SCALE : 1/70



SECTION C-C

EQUIPMENT LIST

No.		DESCRIPTION
1		10kw TX
2	A	PIE
	B	MEASURING RACK
3		DUMMY LOAD
4		COAXIAL SW
5		AVR / PDB
6		INDOOR COAXAL FEEDER
7		COOLING SYSTEM
	1	EXHAUST AIR DUCT
	2	DUCT FAN
	3	CHECK DAMPER
	4	VOLUME DAMPER
	5	CANVAS DUCT
	6	AIR HOOD
	7	INSECT NET
8	1	COPPER PLATE FOR GROUNDING
	2	CABLE PIT

NOTE

1 Δ :FRONT OF EQUIPMENT

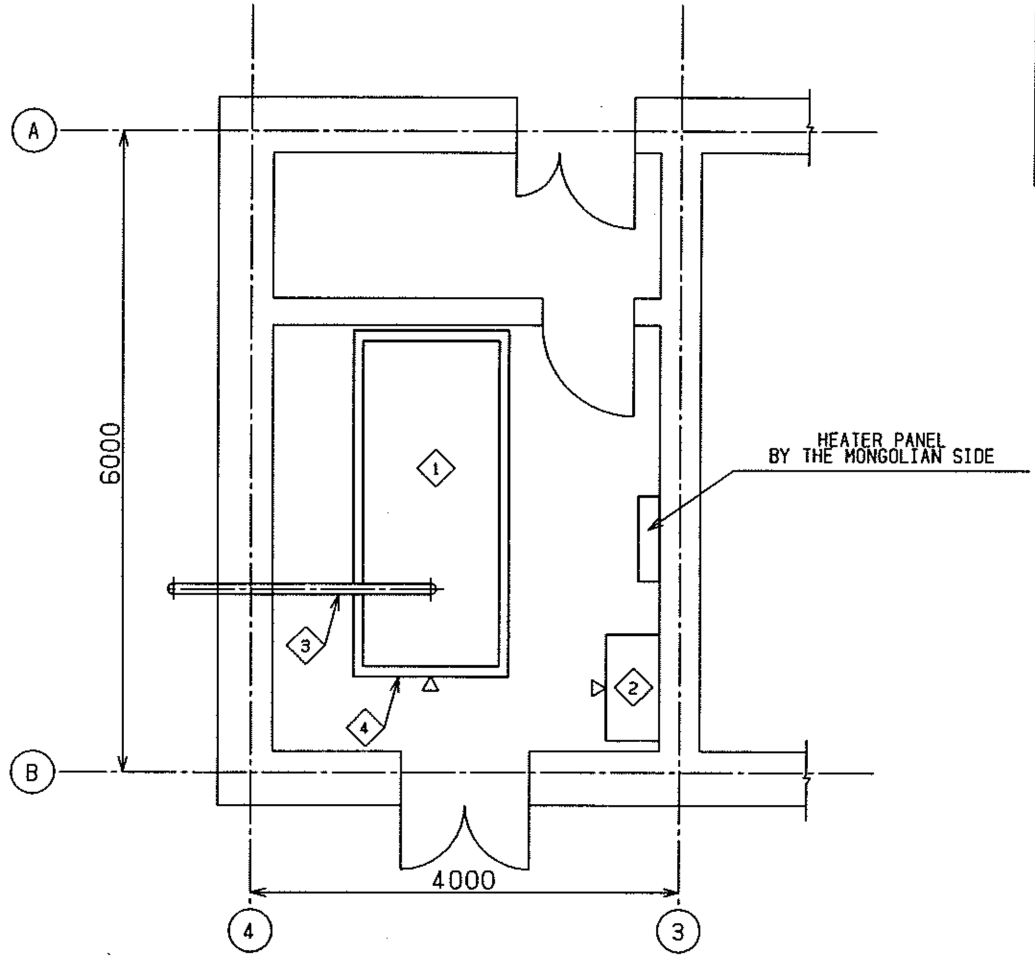
2 DIMENSIONS INDICATED IN THIS DRAWING AND ANY RELATED DRAWINGS ARE APPROXIMATE ONLY.

3 ▨:NEW CABLE PIT (BY THE MONGOLIAN SIDE)

A-13	ALTAI STATION GENERAL EQUIPMENT ARRANGEMENT 2/2

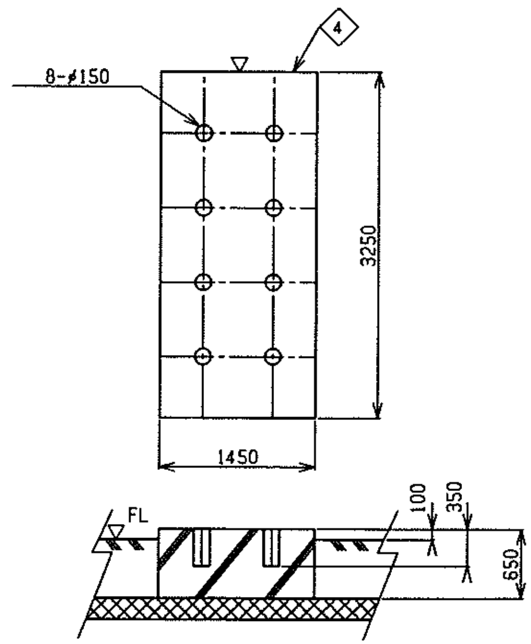
EQUIPMENT LIST

No		DESCRIPTION
1		100KVA EMERGENCY GENERATOR (E/G)
2		AUTOMATIC TRANSFER SWITCH (ATS)
3		EXHAUST PIPE
4		E/G BED



PLAN

SCALE : 1/50



E/G BED

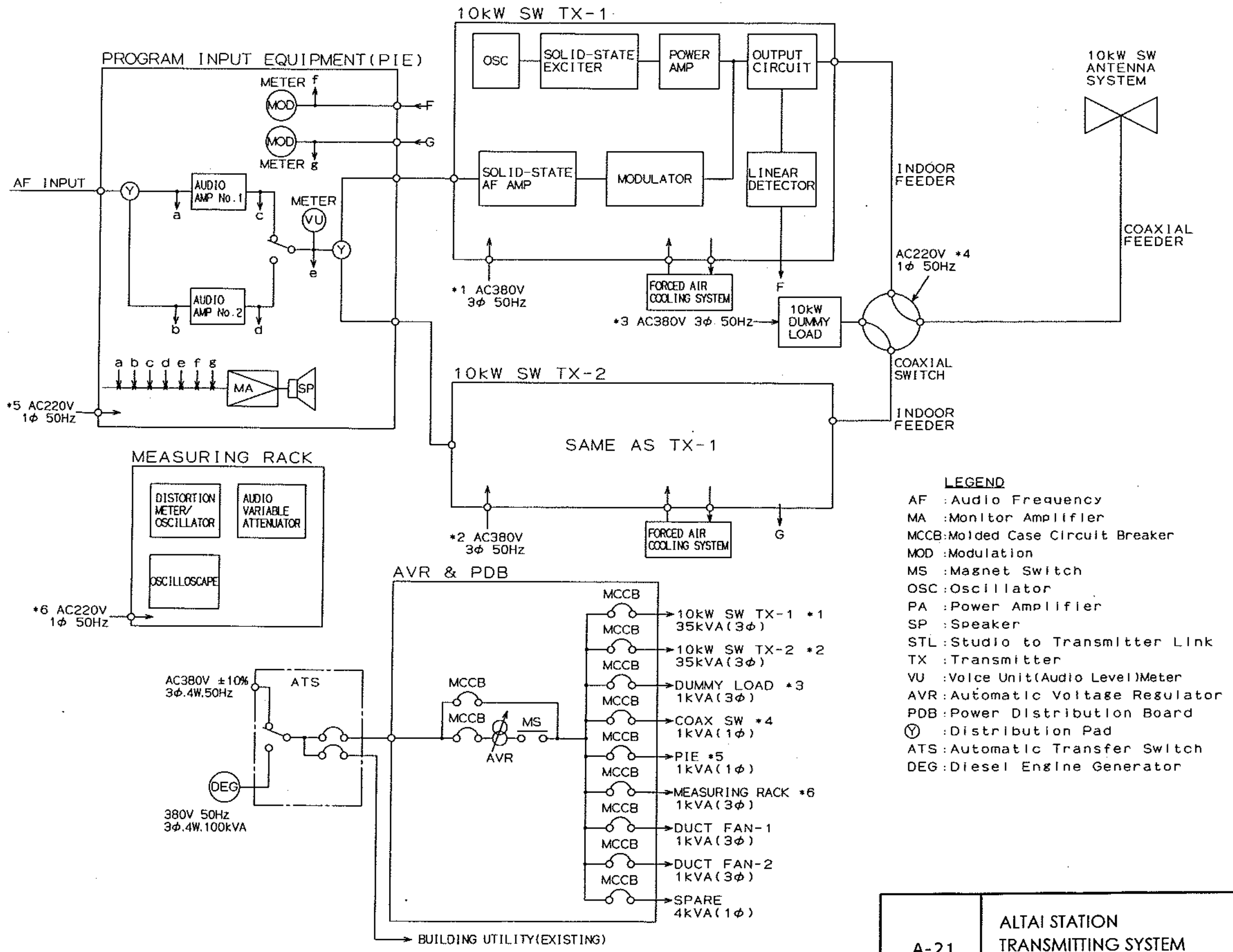
NOTE

1 Δ:FRONT OF EQUIPMENT

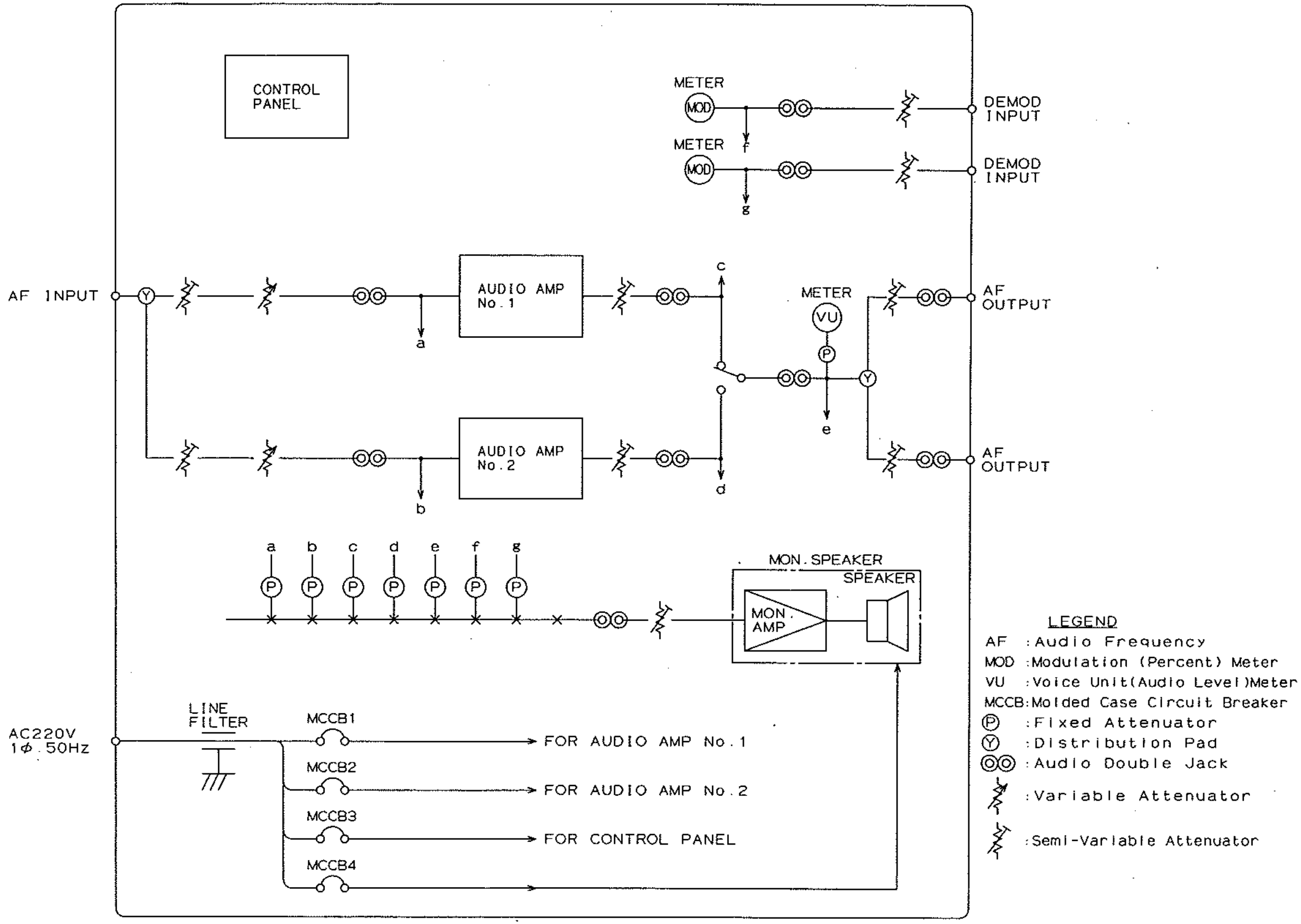
2 DIMENSIONS INDICATED IN THIS DRAWING AND ANY RELATED DRAWINGS ARE APPROXIMATE ONLY.

3 THE NEW E/G IS INSTALED AFTER EXISTING E/G REMOVAL.

A－14	ALTAI STATION GENERAL EQUIPMENT ARRANGEMENT EMERGENCY GENERATOR



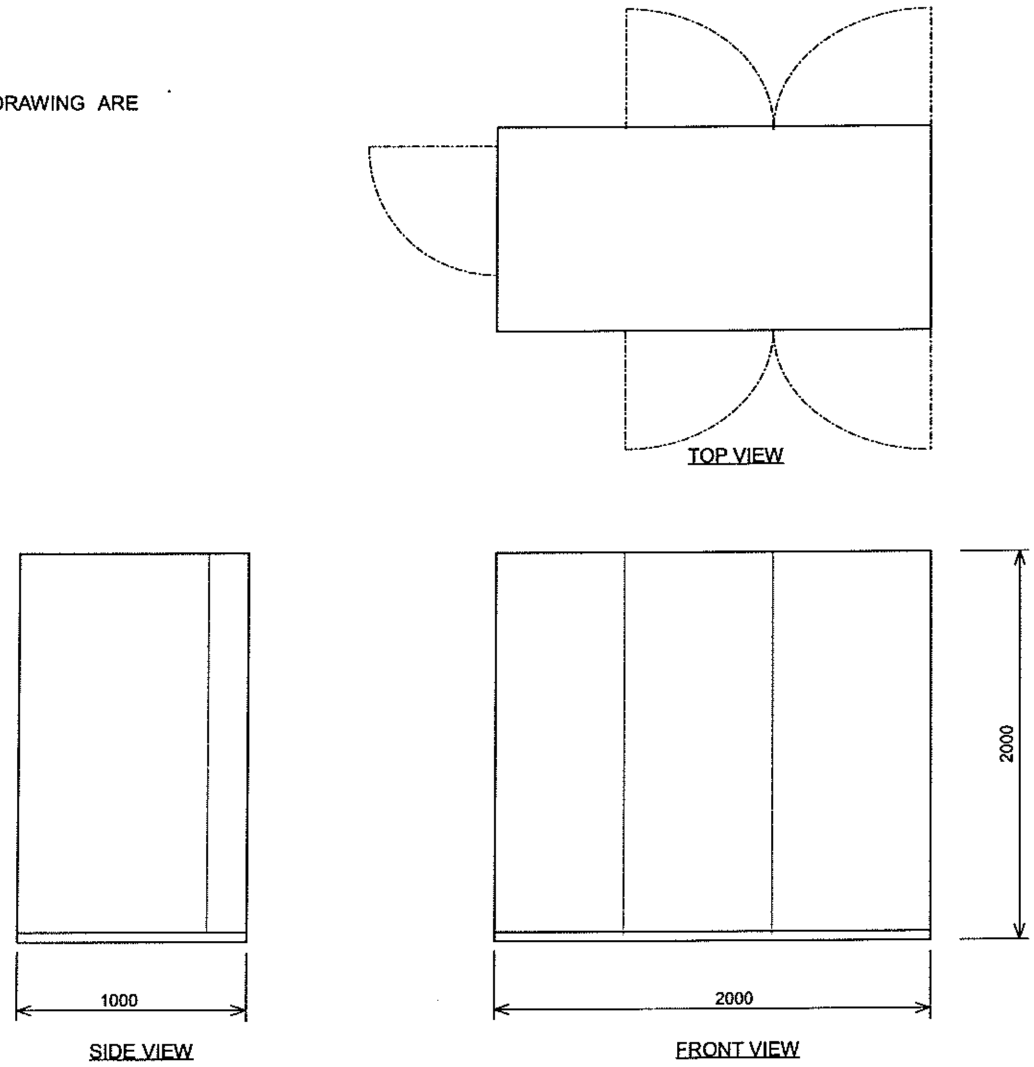
A-21	ALTAI STATION TRANSMITTING SYSTEM BLOCK DIAGRAM



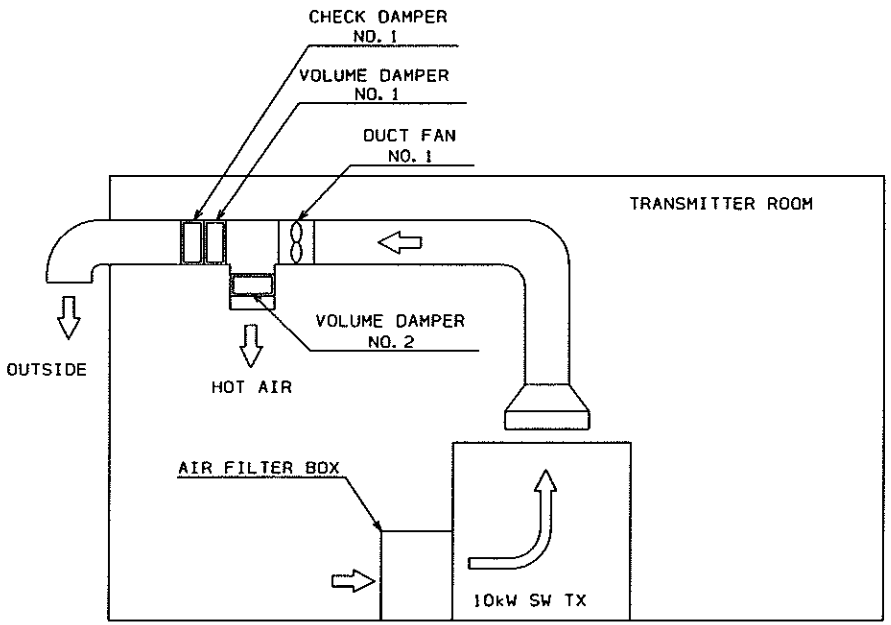
A-22	ALTAI STATION PROGRAM INPUT EQUIPMENT BLOCK DIAGRAM

NOTE:

1. ALL THE DIMENSIONS IN THIS DRAWING ARE APPROXIMATE ONLY.



A-31	ALTAI STATION 10KW SW TRANSMITTER OVERVIEW



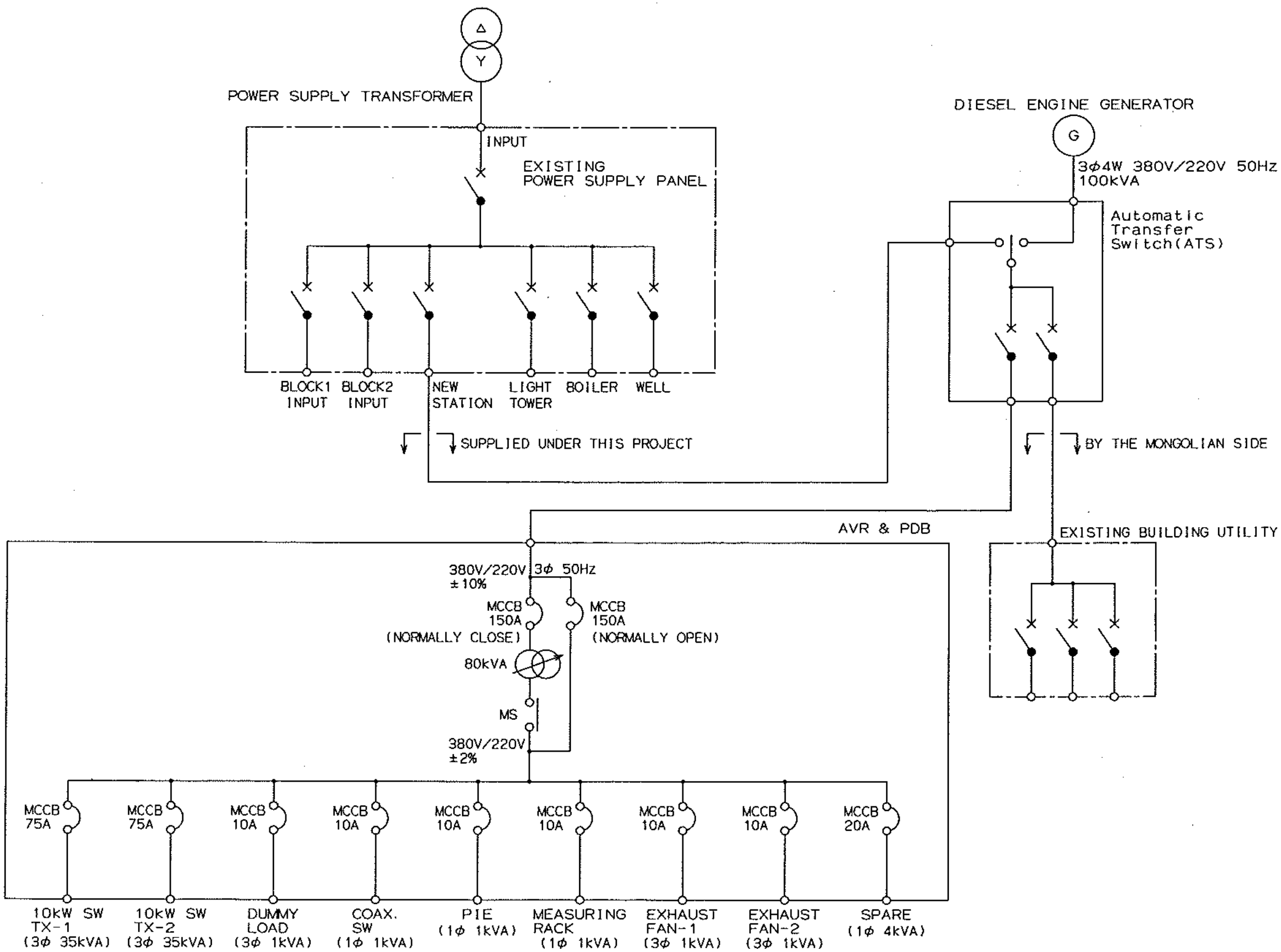
VOLUME DAMPER OPERATION

	SUMMER	WINTER
VOLUME DAMPER NO. 1	FULL OPEN	SEMI CLOSE
VOLUME DAMPER NO. 2	FULL CLOSE	SEMI OPEN

VOLUME DAMPER SHALL BE MANUALLY OPERATED IN ORDER TO ASSURE STABLE FUNCTIONALITY OF TRANSMITTER AND COMFORTABLE ROOM TEMPERATURES

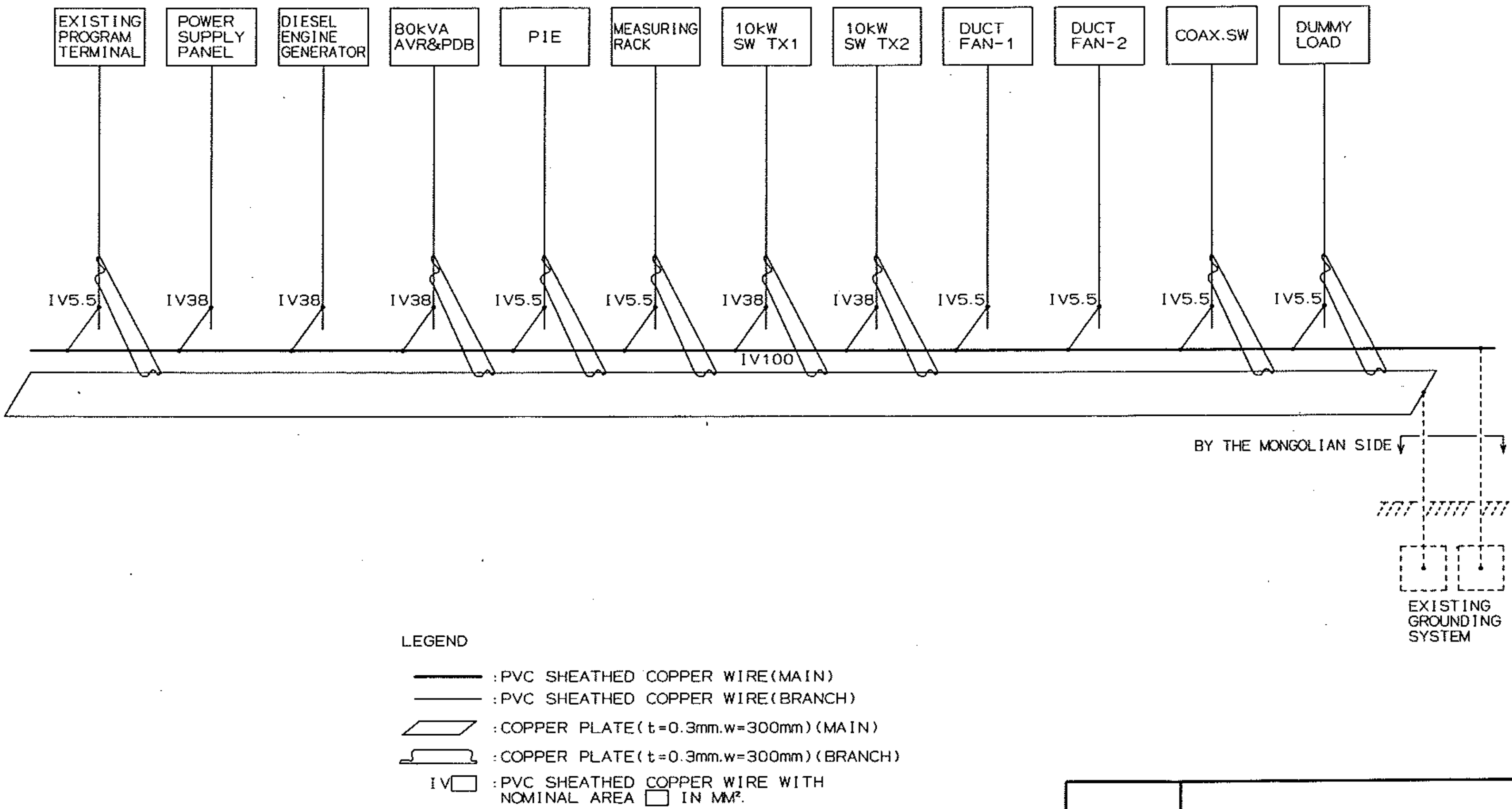
A-32

ALTAI STATION
COOLING EQUIPMENT OVERVIEW

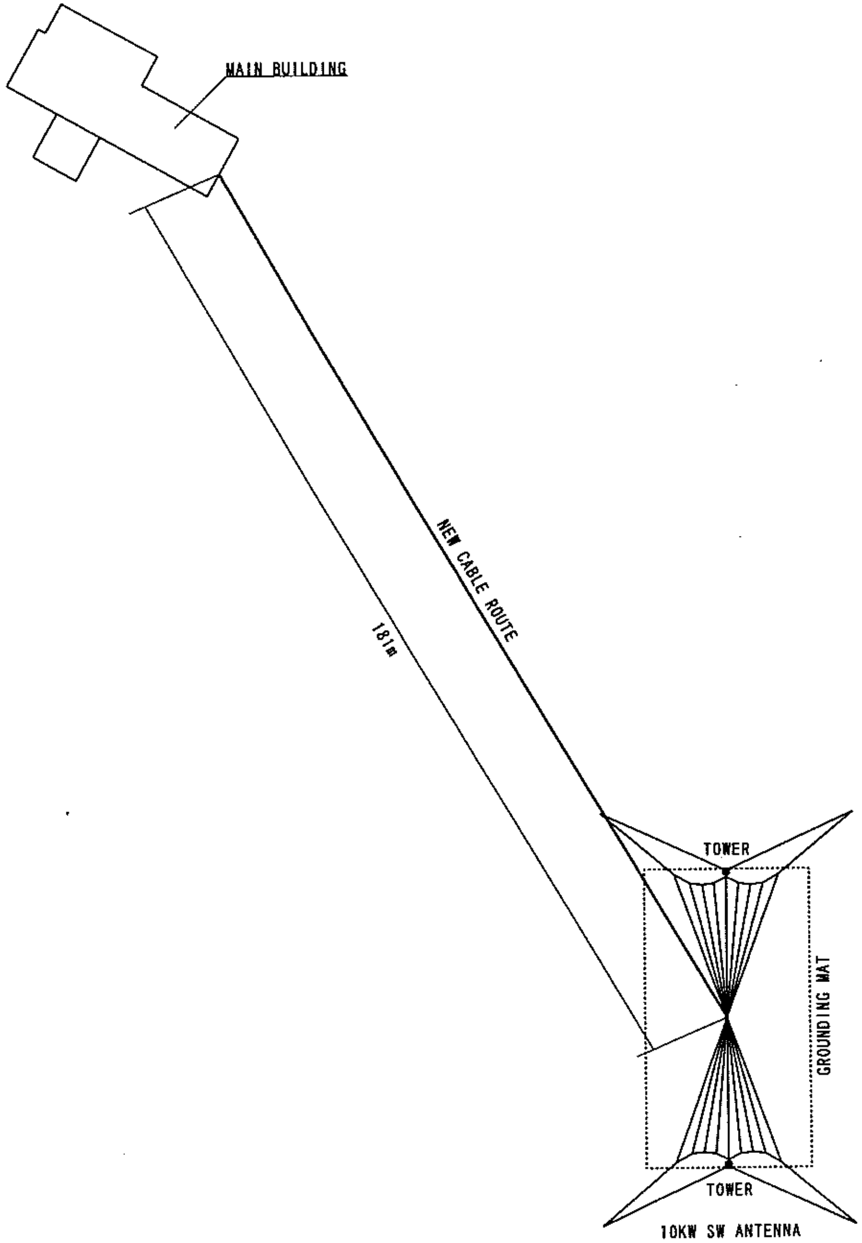


A-41

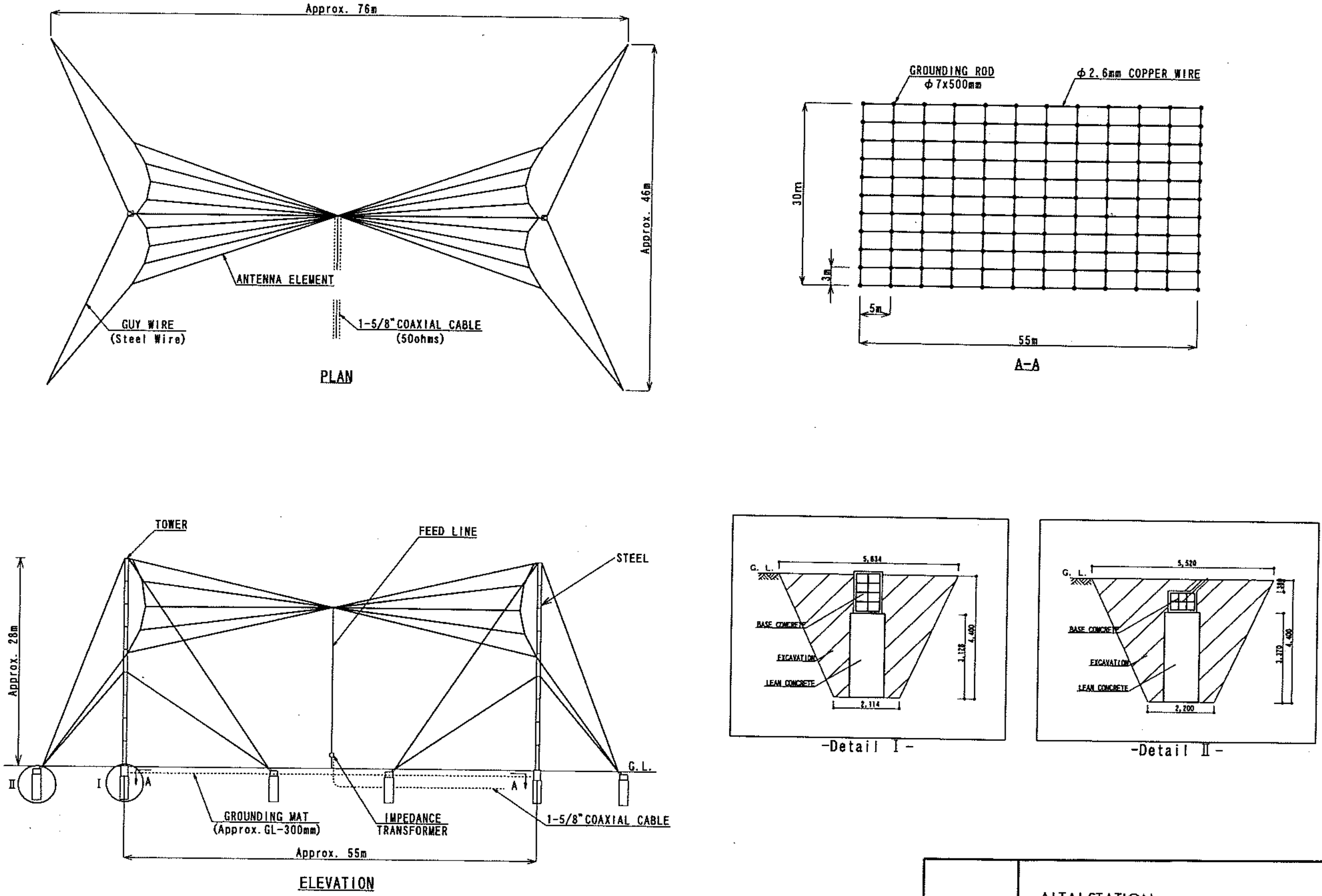
ALTAI STATION
POWER SUPPLY
SINGLE LINE DIAGRAM



A-51	ALTAI STATION GROUNDING SYSTEM

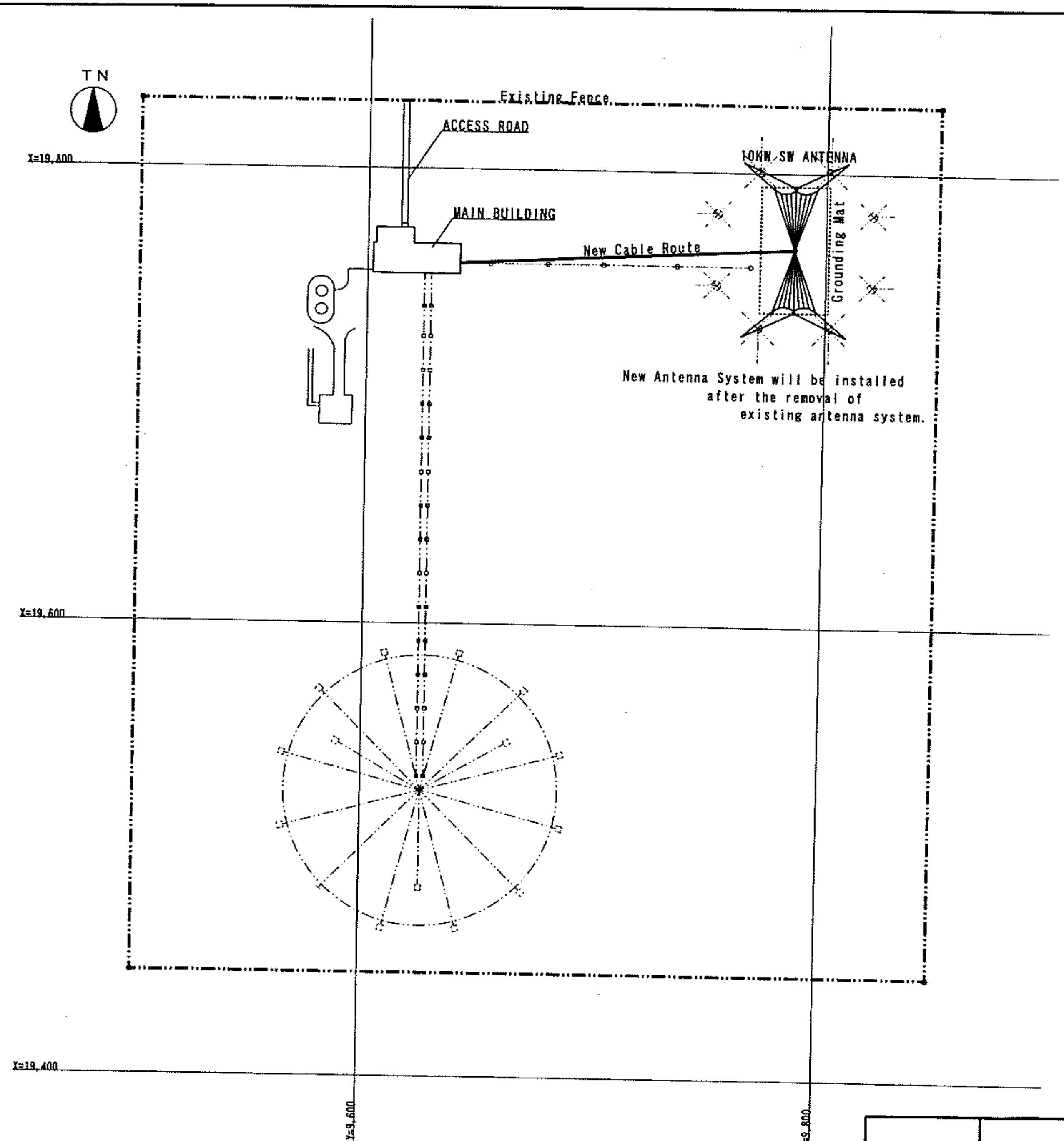


A-61	ALTAI STATION 10KW SW ANTENNA SYSTEM ARRANGEMENT

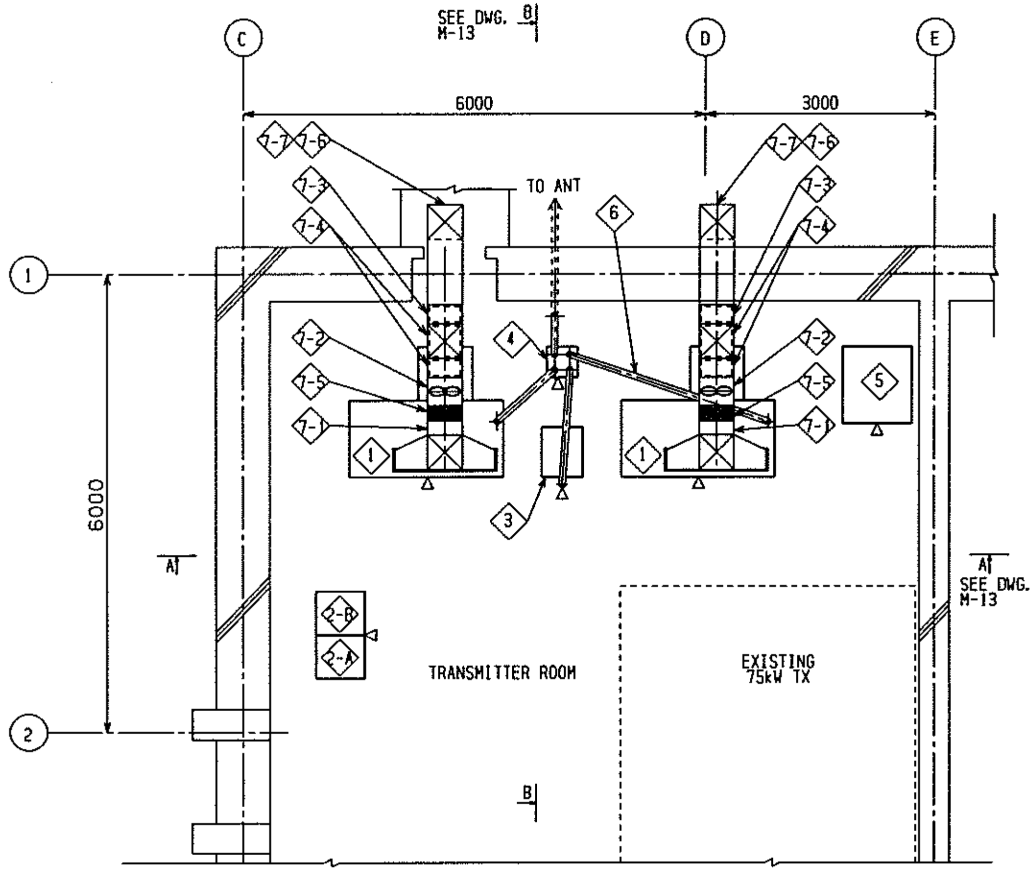


A-62

ALTAI STATION
10KW SW ANTENNA OVERVIEW

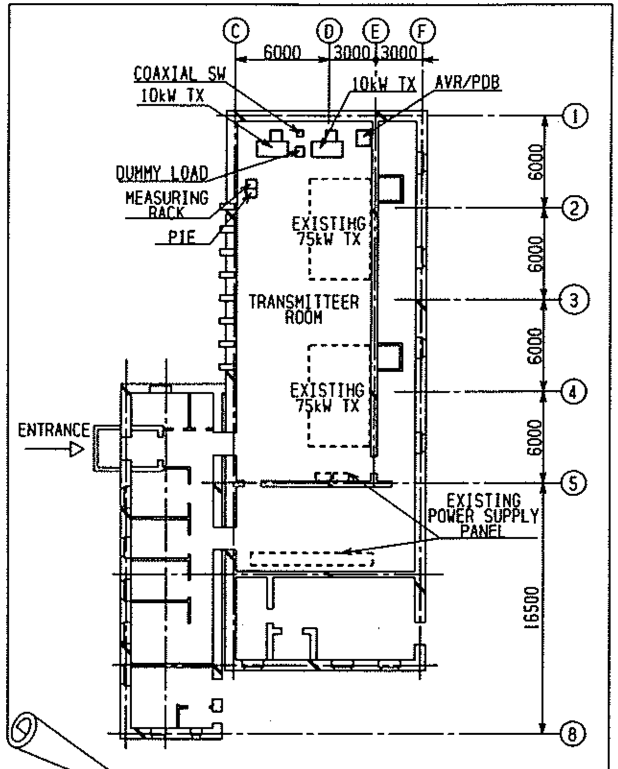


M-11	MURUN STATION GENERAL LAYOUT



PLAN

SCALE : 1/70



KEY PLAN

EQUIPMENT LIST

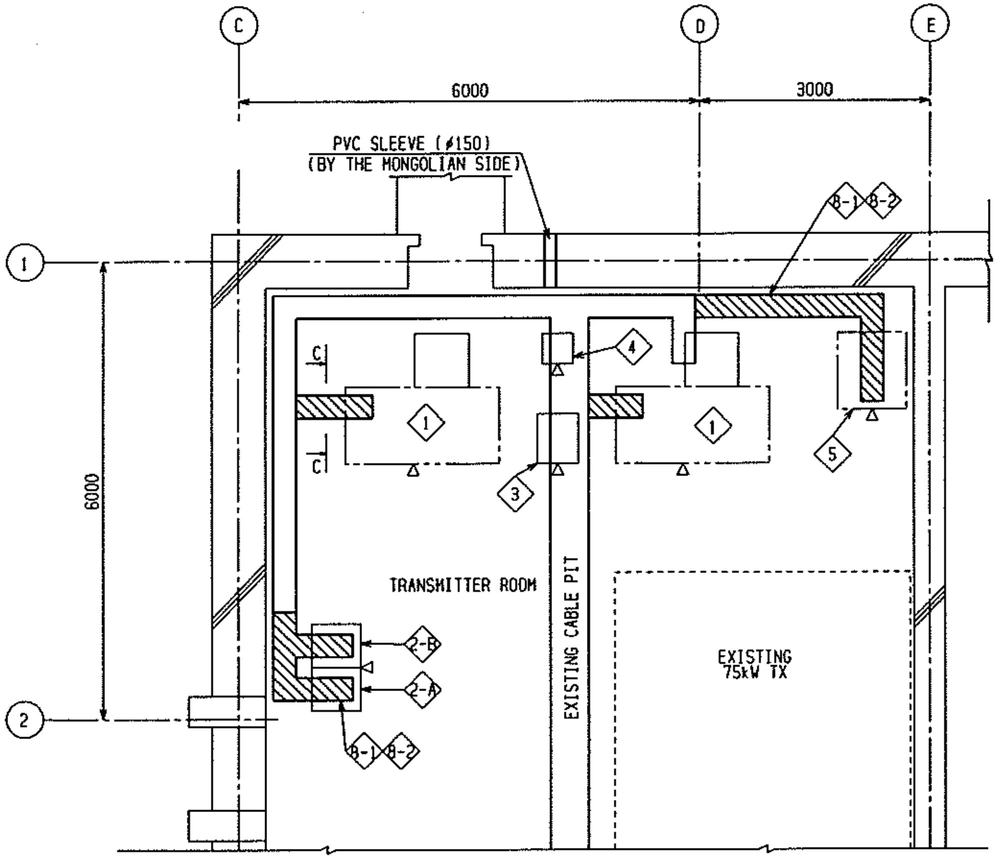
No.		DESCRIPTION
1		10kw TX
2	A	PIE
	B	MEASURING RACK
3		DUMMY LOAD
4		COAXIAL SW
5		AVR / PDB
6		INDOOR COAXAL FEEDER
7		COOLING SYSTEM
	1	EXHAUST AIR DUCT
	2	DUCT FAN
	3	CHECK DAMPER
	4	VOLUME DAMPER
	5	CANVAS DUCT
	6	AIR HOOD
	7	INSECT NET
8	1	COPPER PLATE FOR GROUNDING
	2	CABLE PIT

NOTE

1 △:FRONT OF EQUIPMENT

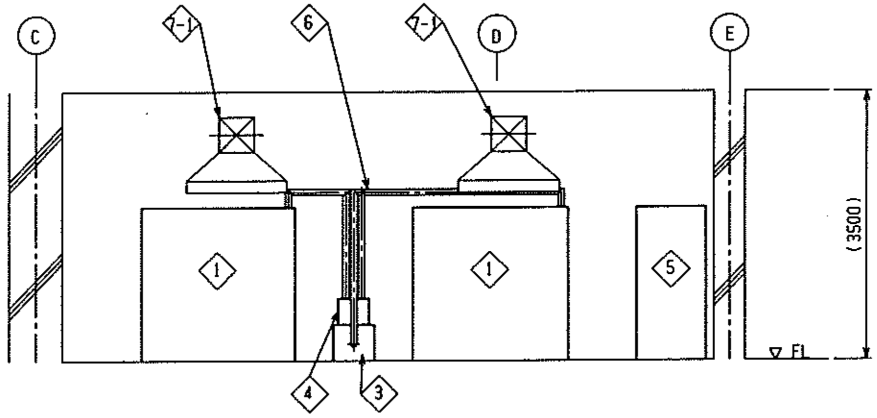
2 DIMENSIONS INDICATED IN THIS DRAWING AND ANY RELATED DRAWINGS ARE APPROXIMATE ONLY.

M-12	MURUN STATION GENERAL EQUIPMENT ARRANGEMENT 1/2



CABLE PIT ARRANGEMENT

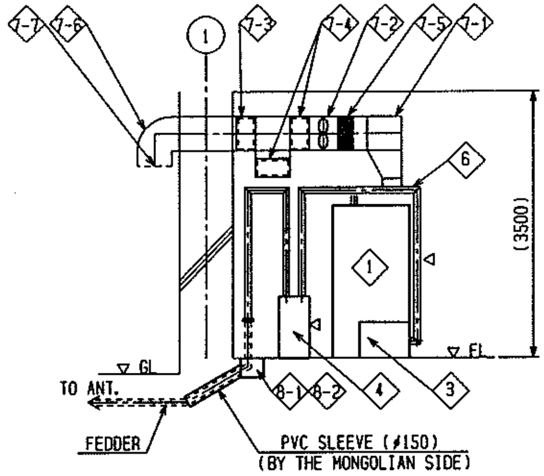
SCALE : 1/70



SECTION A-A

SEE DWG.M-12

SCALE : 1/70



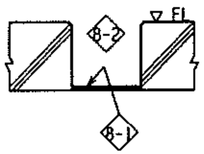
SECTION B-B

SEE DWG.M-12

SCALE : 1/70

EQUIPMENT LIST

No.		DESCRIPTION
1		10kw TX
2	A	PIE
	B	MEASURING RACK
3		DUMMY LOAD
4		COAXIAL SW
5		AVR / PDB
6		INDOOR COAXAL FEEDER
7		COOLING SYSTEM
	1	EXHAUST AIR DUCT
	2	DUCT FAN
	3	CHECK DAMPER
	4	VOLUME DAMPER
	5	CANVAS DUCT
	6	AIR HOOD
	7	INSECT NET
8	1	COPPER PLATE FOR GROUNDING
	2	CABLE PIT



SECTION C-C

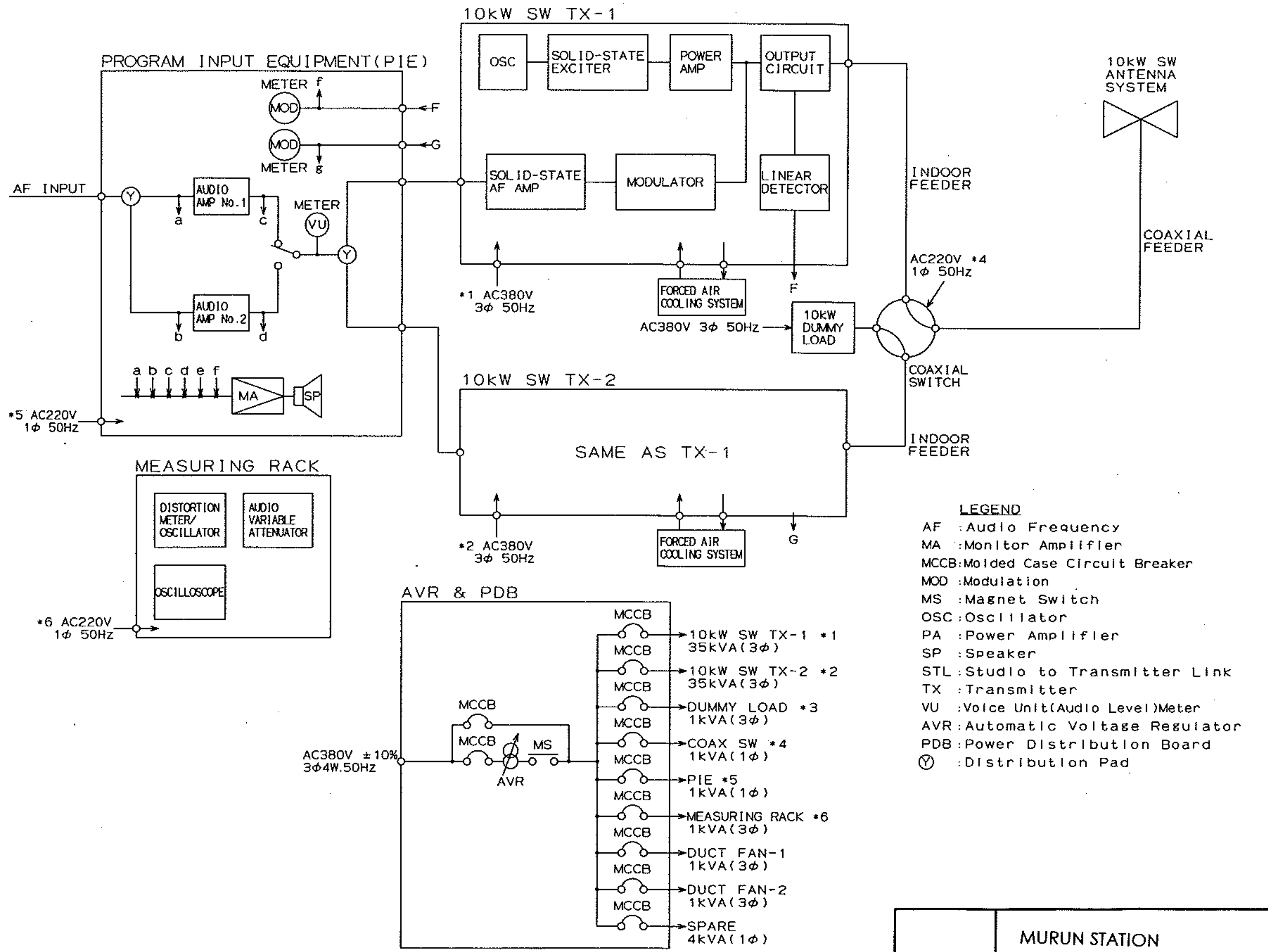
NOTE

1 Δ :FRONT OF EQUIPMENT

2 DIMENSIONS INDICATED IN THIS DRAWING AND ANY RELATED DRAWINGS ARE APPROXIMATE ONLY.

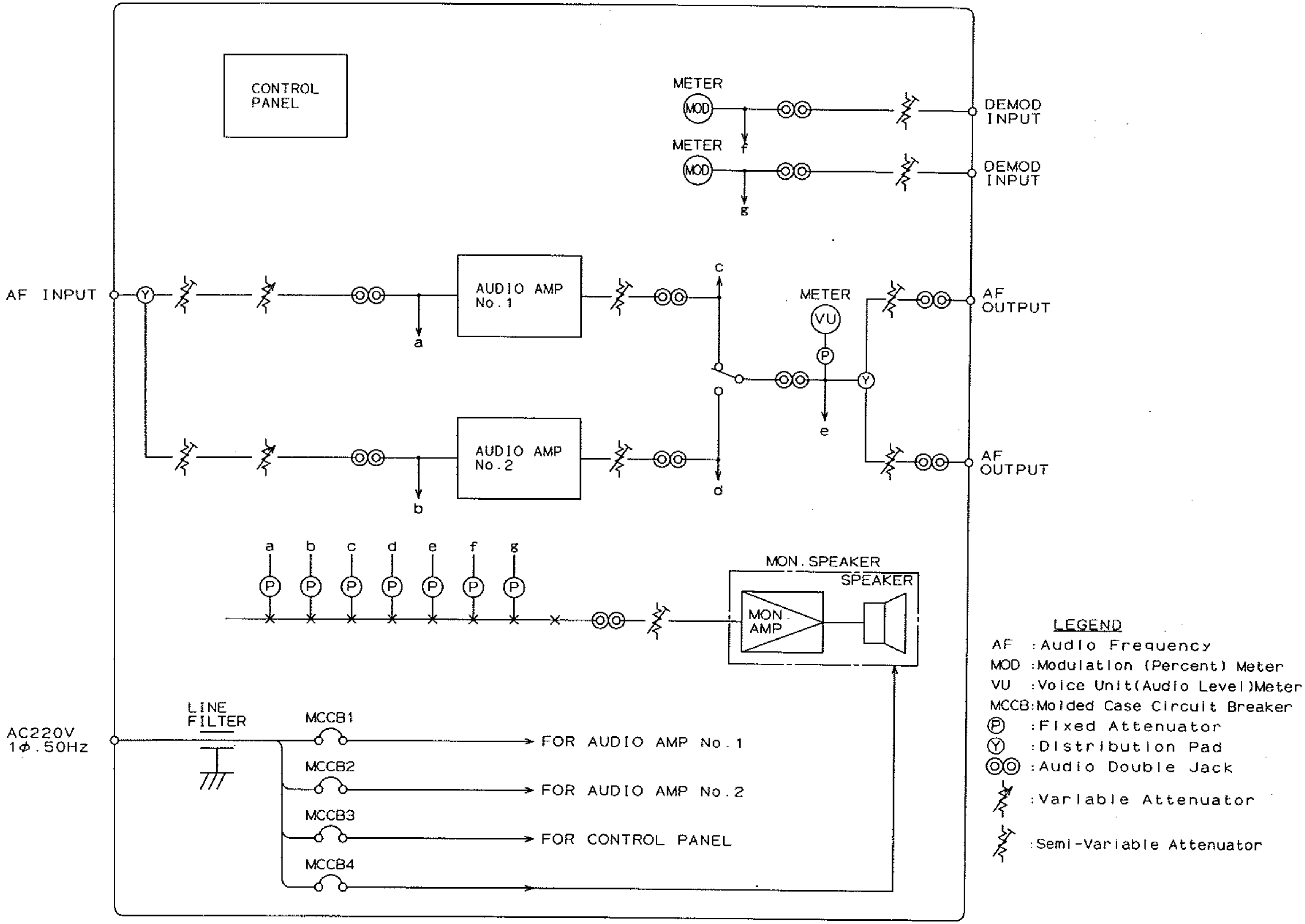
3 ▨:NEW CABLE PIT (BY THE MONGOLIAN SIDE)

M-13	MURUN STATION GENERAL EQUIPMENT ARRANGEMENT 2/2



M-21

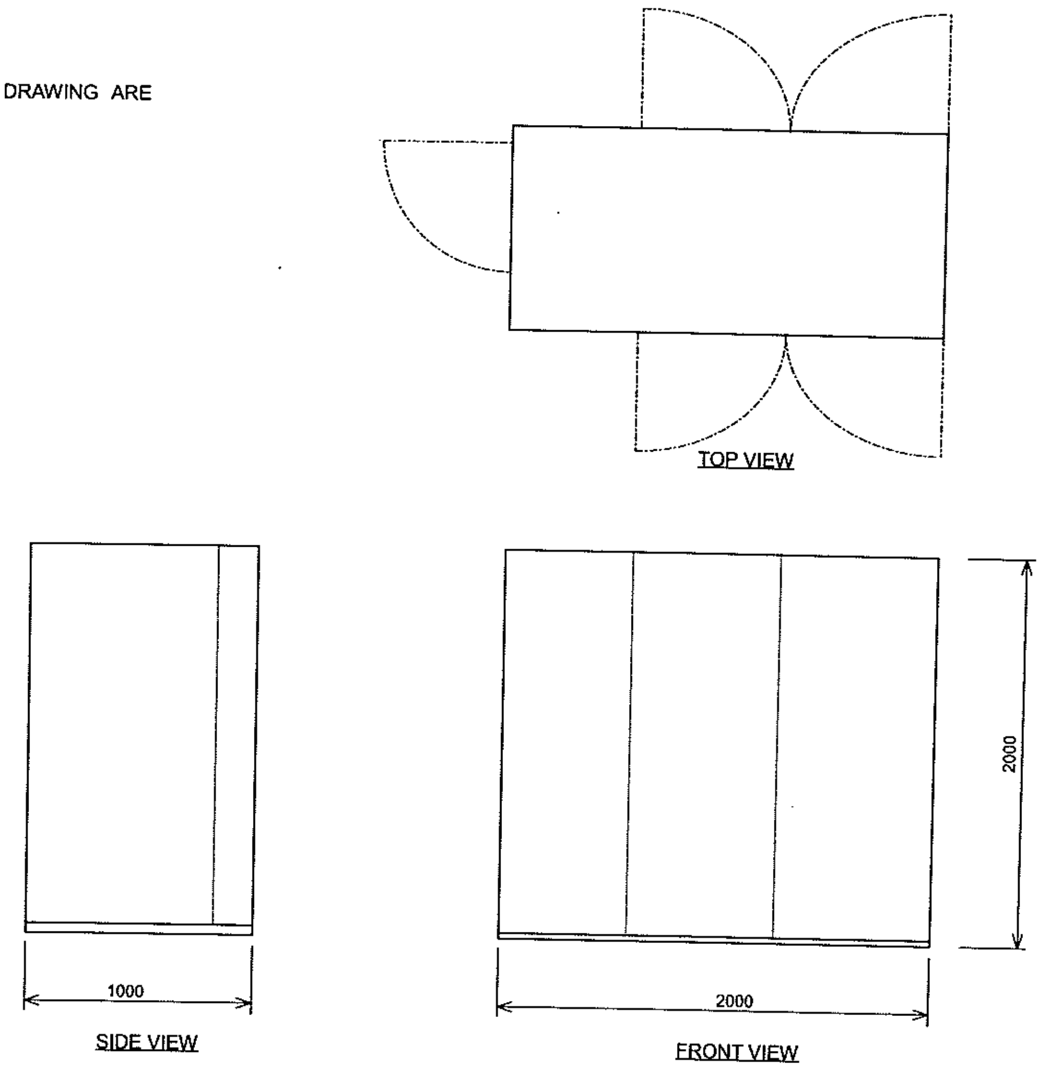
MURUN STATION
TRANSMITTING SYSTEM
BLOCK DIAGRAM



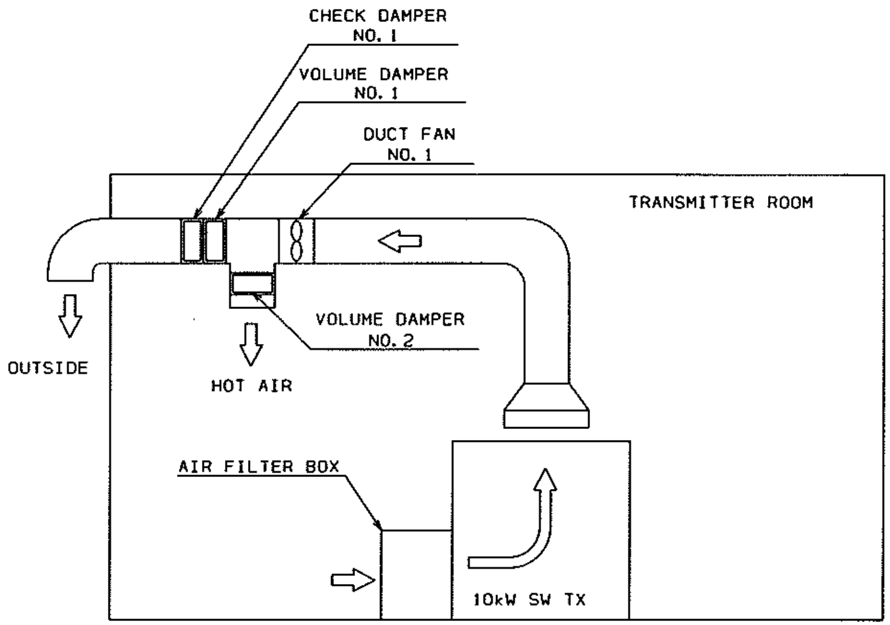
M-22	MURUN STATION PROGRAM INPUT EQUIPMENT BLOCK DIAGRAM

NOTE:

1. ALL THE DIMENSIONS IN THIS DRAWING ARE APPROXIMATE ONLY.



M-31	MURUN STATION 10KW SW TRANSMITTER OVERVIEW

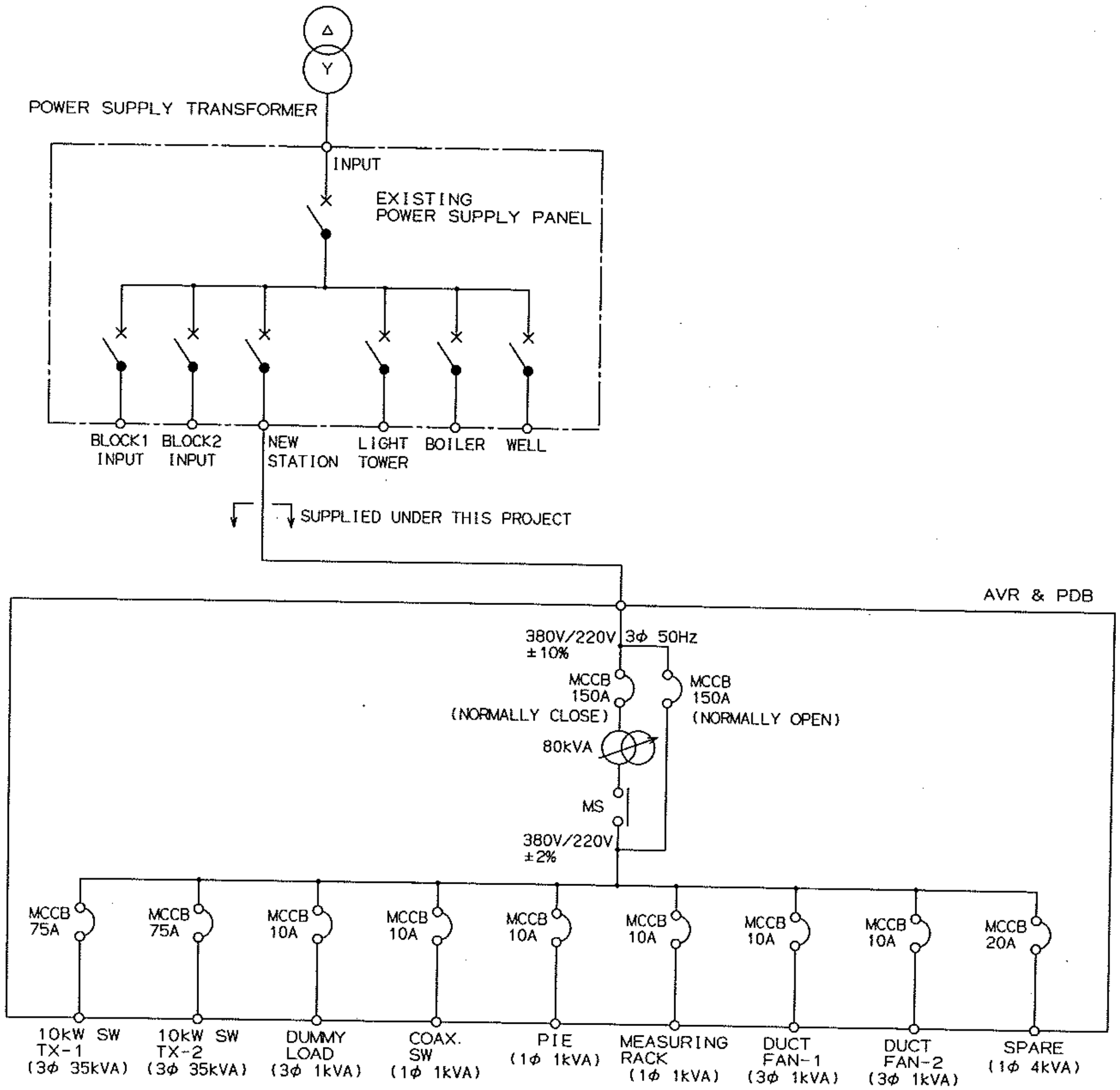


VOLUME DAMPER OPERATION

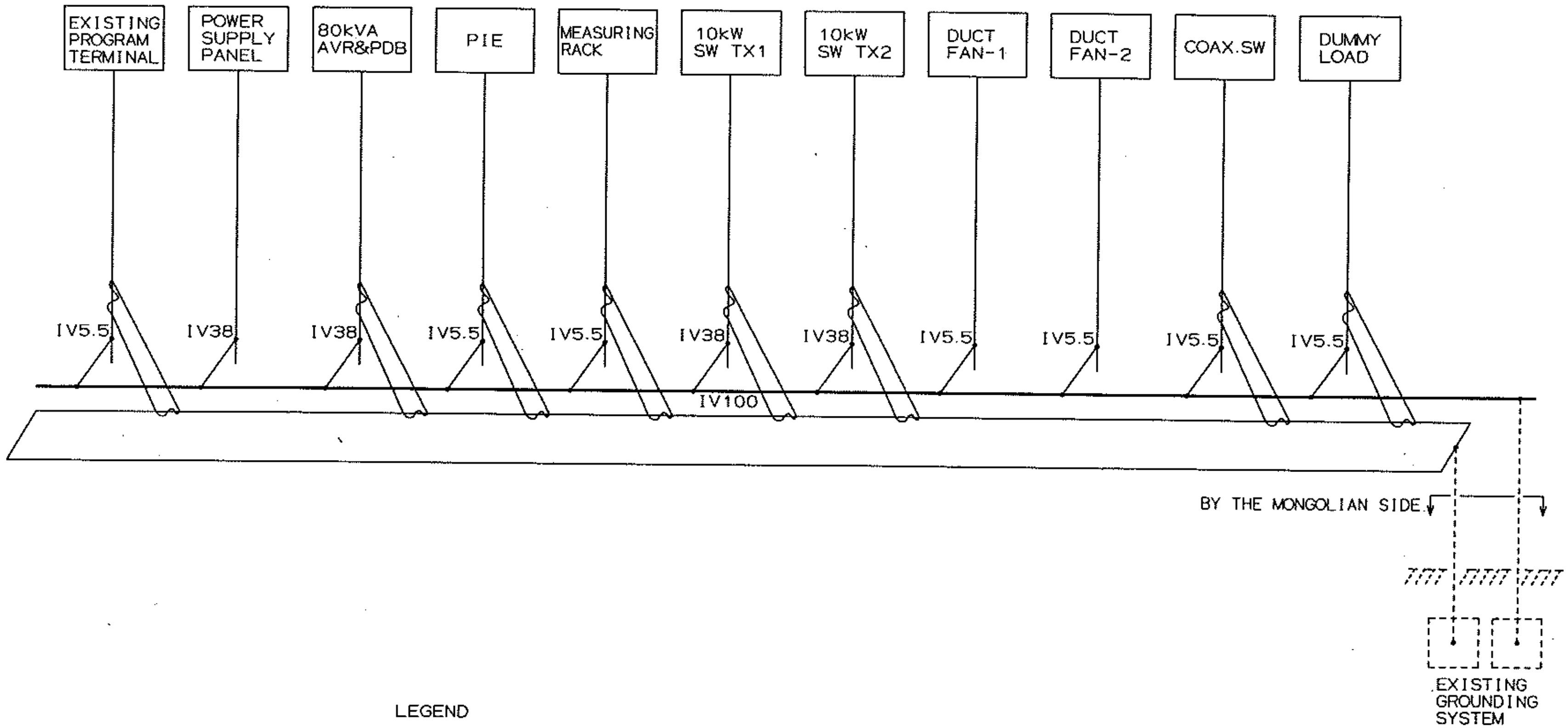
	SUMMER	WINTER
VOLUME DAMPER NO. 1	FULL OPEN	SEMI CLOSE
VOLUME DAMPER NO. 2	FULL CLOSE	SEMI OPEN

VOLUME DAMPER SHALL BE MANUALLY OPERATED IN ORDER TO ASSURE STABLE FUNCTIONALITY OF TRANSMITTER AND COMFORTABLE ROOM TEMPERATURES

M-32	MURUN STATION COOLING EQUIPMENT OVERVIEW



M-41	MURUN STATION POWER SUPPLY SINGLE LINE DIAGRAM



LEGEND

: PVC SHEATHED COPPER WIRE(MAIN)

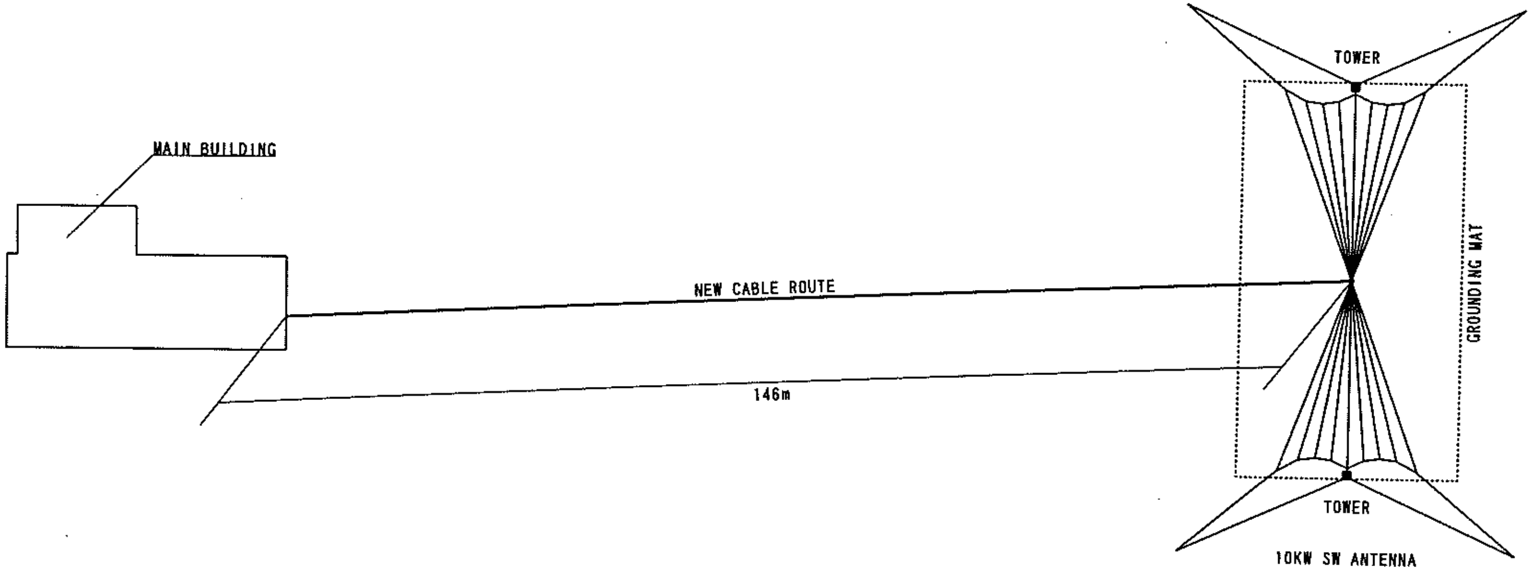
: PVC SHEATHED COPPER WIRE(BRANCH)

: COPPER PLATE(t=0.3mm.w=300mm)(MAIN)

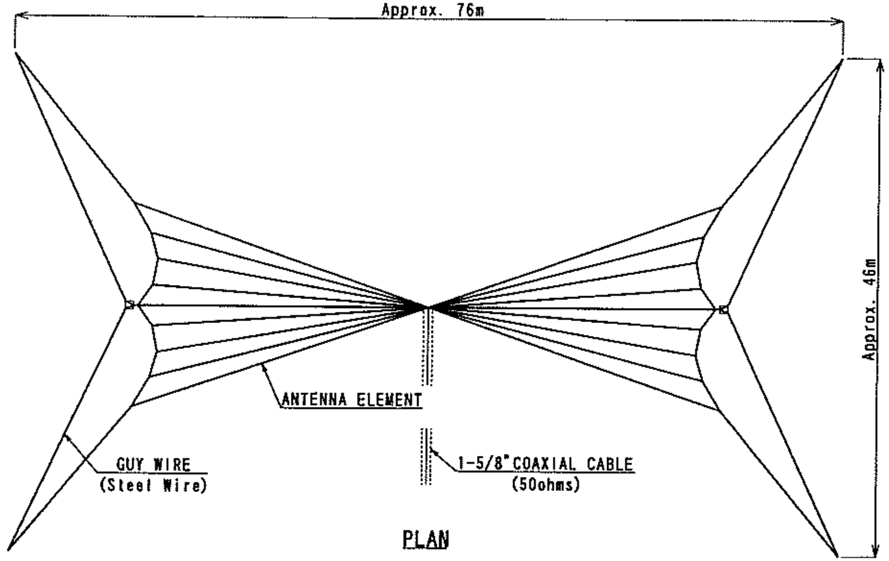
: COPPER PLATE(t=0.3mm.w=300mm)(BRANCH)

IV☐ : PVC SHEATHED COPPER WIRE WITH NOMINAL AREA ☐ IN MM².

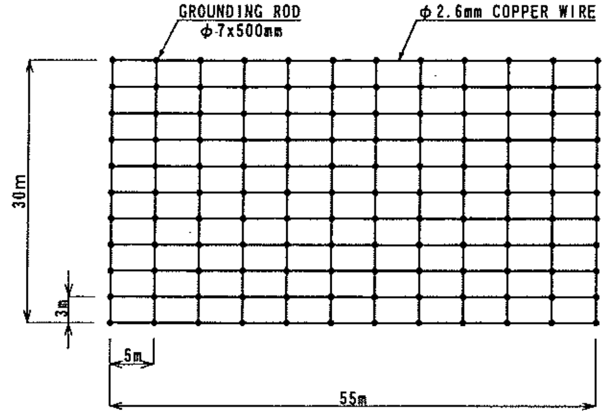
M-51	MURUN STATION GROUNDING SYSTEM



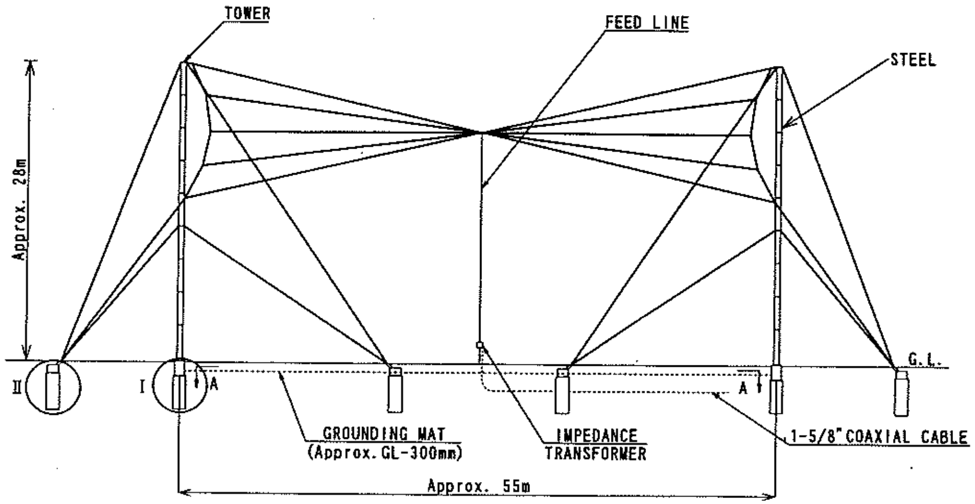
M-61	MURUN STATION 10KW SW ANTENNA SYSTEM ARRANGEMENT



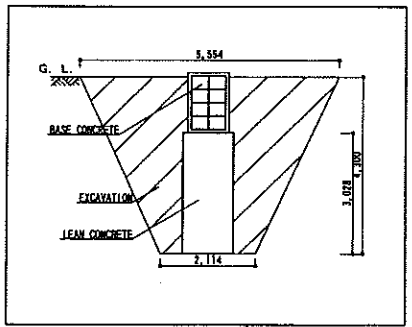
PLAN



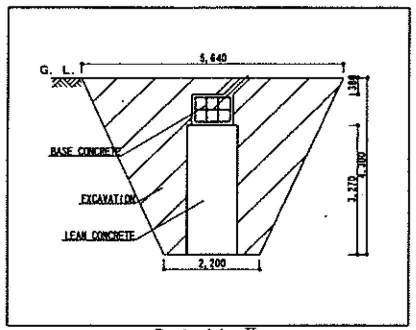
A-A



ELEVATION



-Detail I-



-Detail II-

M-62	MURUN STATION 10KW SW ANTENNA OVERVIEW