BASIC DESIGN STUDY REPORT ON THE REHABILITATION PROJECT FOR IMPROVEMENT OF 4TH THERMAL POWER STATION IN MONGOLIA

MARCH 1992

JAPAN INTERNATIONAL COOPERATION AGENCY

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ON
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OF
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IN
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PREFACE

In response to a request from the Government of Mongolia, the Government of Japan decided to conduct a basic design study on the Rehabilitation project for Improvement of the 4th Thermal Power Station in Mongolia, and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Mongolia a study team headed by Mr. Shoji Simbo, Managing Director, Grant Aid Study and Design Department of JICA from October 11 to November 8, 1991.

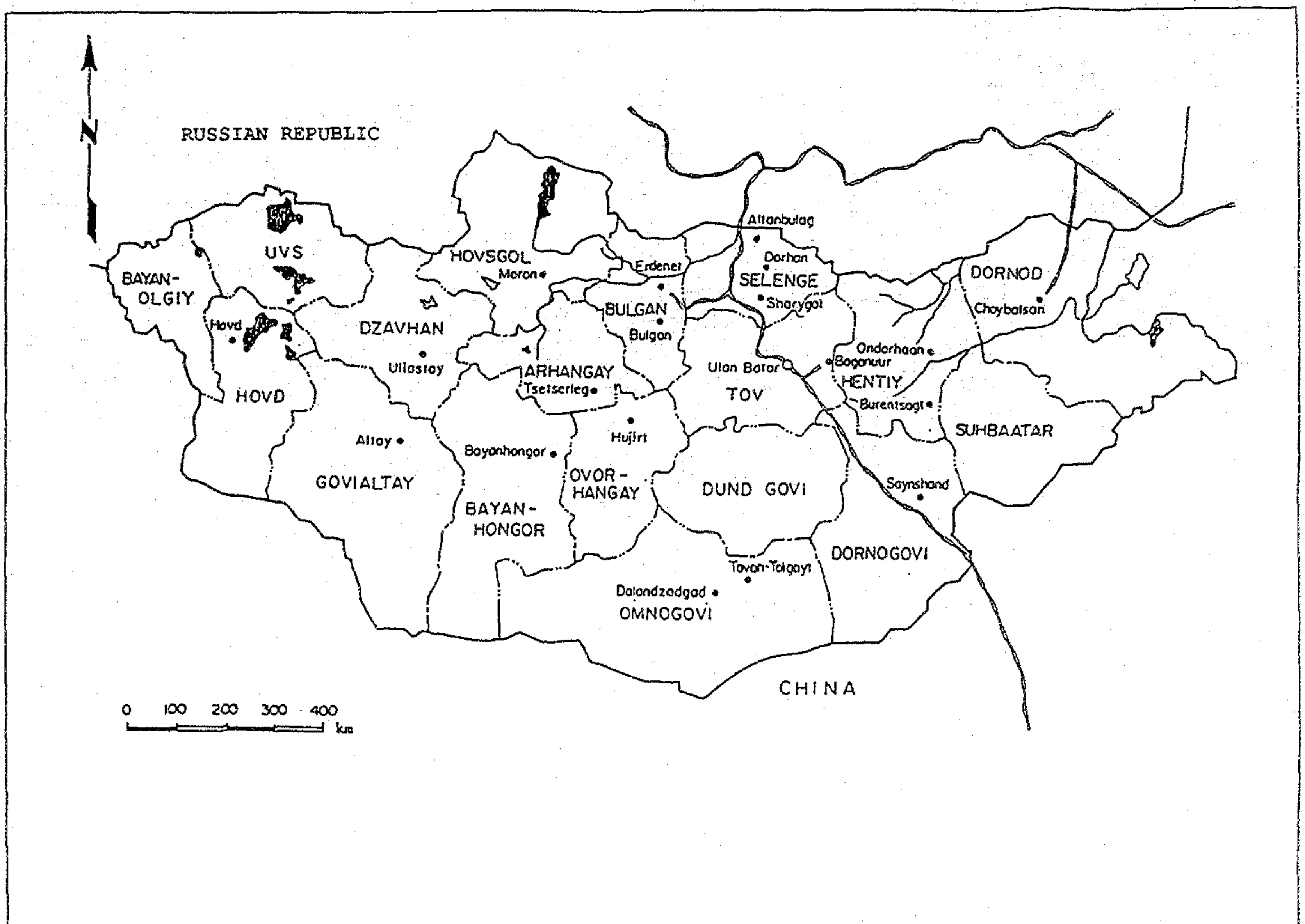
The team held discussions with the officials concerned of the Government of Mongolia, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Mongolia in order to discuss a draft report and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government to Mongolia for their close cooperation extended to the teams.

March 1992

Kensuke Yanagiya
President
Japan International Cooperation Agency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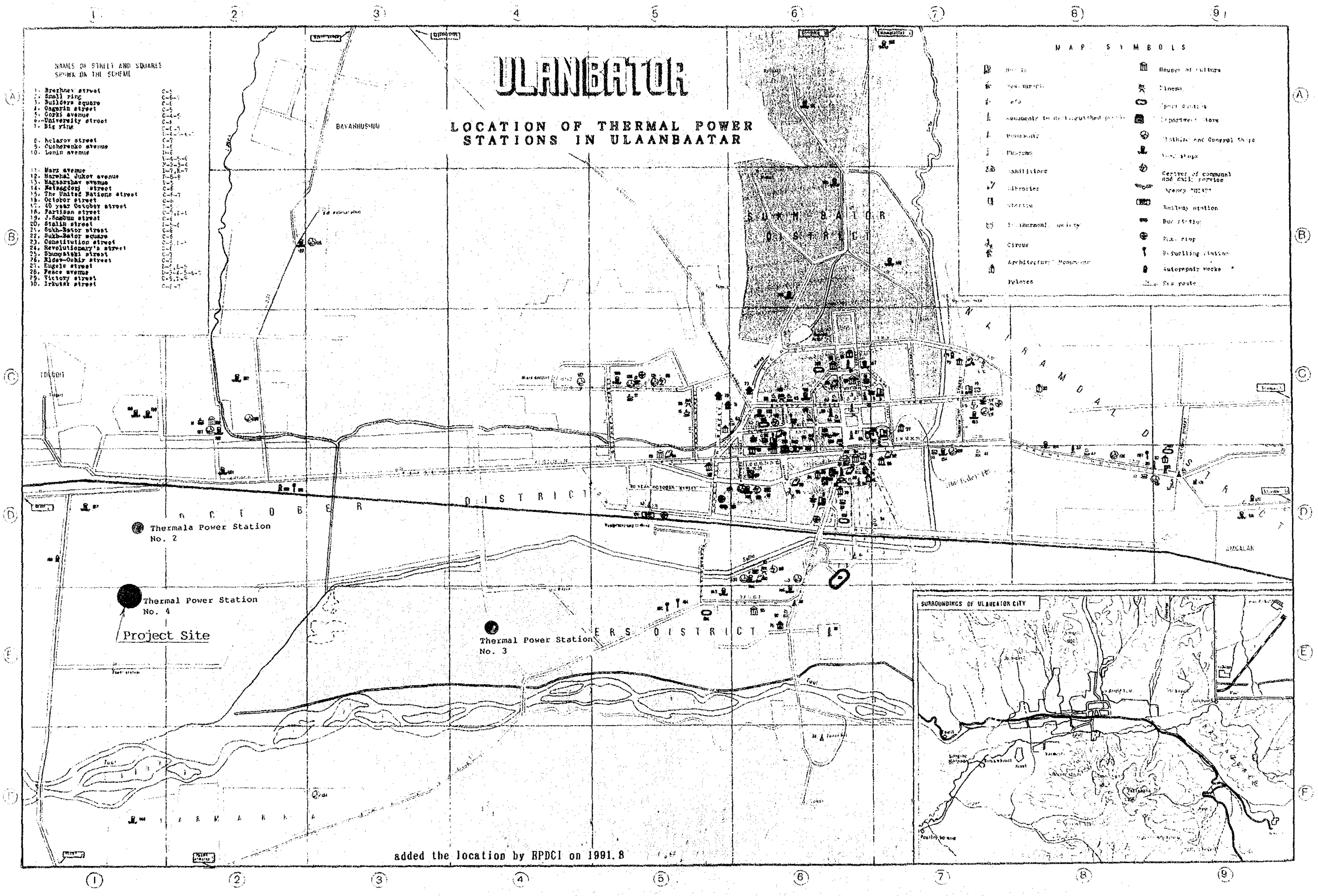
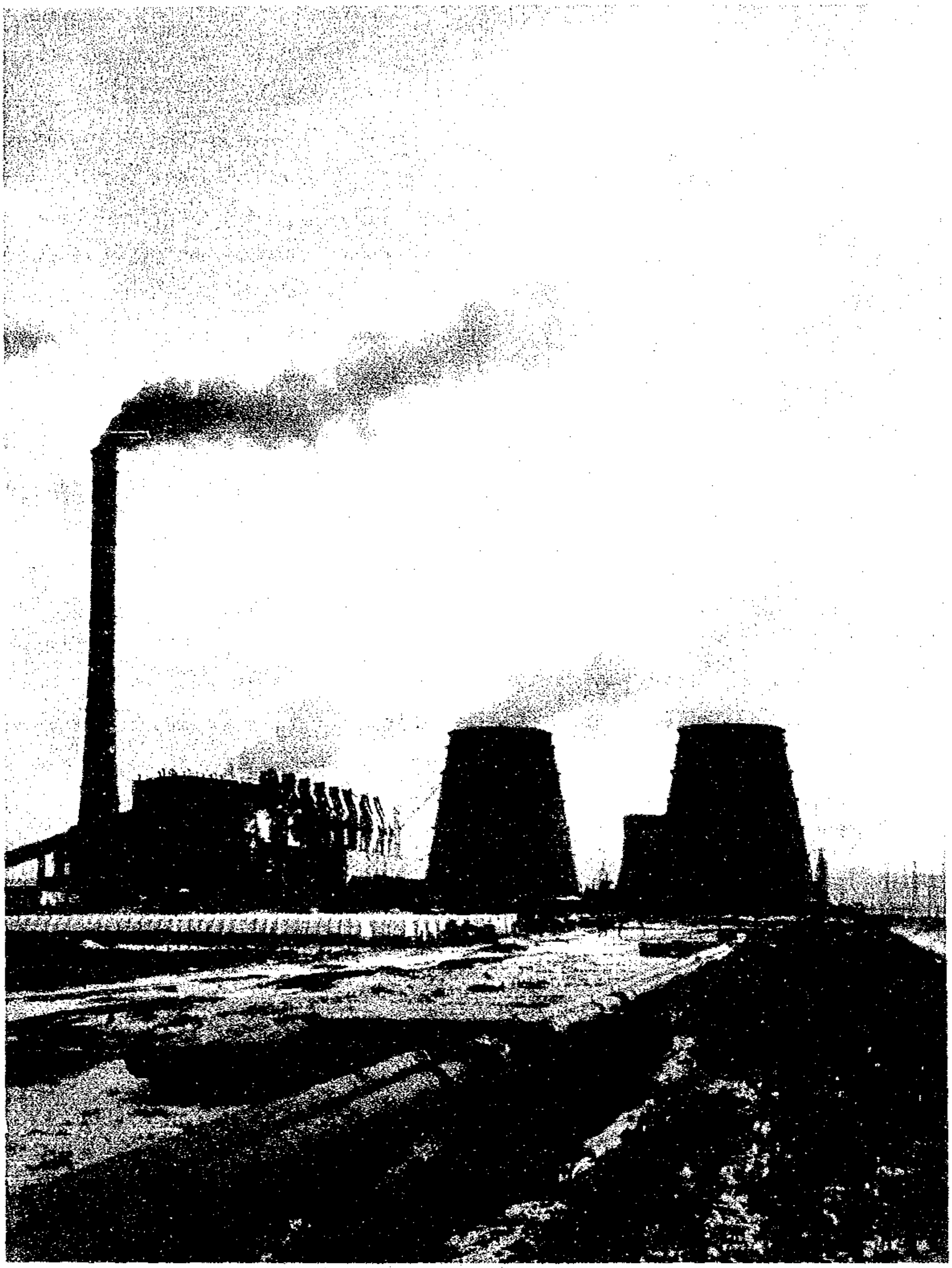


ULANBATOR
LOCATION OF THERMAL POWER STATIONS IN ULAANBAATAR
NAMES OF STREET AND SQUARES SHOWN ON THE SCHEME
1. Brezhnev street
2. Small ring
3. Builders square
4. Gagarin street
5. Gorki avenue
6. University street
7. Big ring
8. Kclarov street
9. Cucherenko avenue
10. Lenin avenue
11. Marx avenue
12. Marshal Jukov avenue
13. Magsarzhav avenue
14. Natsagdorj street
15. The United Nations street
16. October street
17. 40 year October street
18. Partisan street
19. J.Sambuu street
20. Stalin street
21. Sukh-Bator street
22. Sukh-Bator square
23. Constitution street
24. Revolutionary's street
25. Shongatski street
26. Ider-Ochir street
27. Engels street
28. Peace avenue
29. Victory street
30. Irkutsk street
MAP SYMBOLS
BAYANHUSHUU
SUKH BATOR DISTRICT
OCTOBER DISTRICT
NAIRAMDAL DISTRICT
AMGALAN
Thermala Power Station No. 2
Thermal Power Station No. 4
Project Site
Thermal Power Station No. 3
SURROUNDINGS OF ULANBATOR CITY
added the location by EPDCI on 1991.8



THE 4TH THERMAL POWER STATION

SUMMARY

Since its independence in 1921, economic development has continued in Mongolia under the assistance of the ex-Soviet Union for 70 years. However, the new political regime born from a free election in 1990 for the first time since its independence has reformed the conventional system dependent on the ex-Soviet Union and Eastern Europe, and has begun to follow its own democratic reformation line called "Urukelulut cinechirel", and has been striving to expand its relationships with Western nations, aiming at "Development harmonizing market economy with planned economy".

In Ulaanbaatar City, the capital with a population of 570,000 (as of the end of 1990), where approximately 27% of the total population concentrates, the population has still continued to increase along with the policy for switching to a market economy and industrialization. Improvement in the urban economic infrastructures of the six central provinces surrounding the city is making very slow progress due to financial difficulties. The supply of energy (electricity, hot water and steam), among others, is incapable of meeting with the rapid growth in demand in recent years. The electric power having been transmitted from the ex-Soviet Union tends to stop due to coal mine strikes and power shortages in the ex-Soviet Union. The supply of maintenance materials and machinery from the ex-Soviet Union has become unstable, so that difficulty is keenly felt especially in the winter season when the demand for energy reaches its peak.

The energy for the six central provinces including Ulaanbaatar city has been supplied mainly from the 3rd and the 4th thermal power stations. (the 1st was closed down, and the 2nd is for emergency use). A great role is played, in particular, by the 4th thermal power station, newest and largest energy generating station having 540 MW capacity (8 boilers, 6 turbine-generators).

However, the boiler, availability factor of the 4th thermal power station has been extremely low, it was only at the 50% level. Since the atomospheric temperature goes down possibly to less than -40°C in severe winter and the priority has to be given to the supply of hot water for heating for the living of the general public, power generation has been suppressed, which causes frequent power outages.

Furthermore, brownish smoke is eventually emitted from the stack of the power station since the electrostatic precipitator (ESP) is not fully put into service even if the boiler is operated. In the winter season, in particular, an air inversion layer is often formed in the atmosphere in addition to a high load on the boiler. It would be feared, therefore, that some undesirable health effects may be caused to the citizens of Ulaanbaatar city, depending on the direction of the wind.

In July, 1991, under such conditions, the Mongolian government requested the Japanese government for technical cooperation and grant aid for the rehabilitation of the 4th thermal power station in Ulaanbaatar city.

Responding to the request, the Japanese government, through its Japan International Cooperation Agency (JICA), provided technical cooperation to dispatch experts on Nov. 1991, in which they superivsed the repair work on the heavily worn-out portions such as primary fan blades and so on, as urgent provisional measures to tide over the peak power demand in the winter of 1991. In addition, it was decided for JICA to conduct a basic design study on rehabilitation to execute measures of grant aid and then to send a basic design study team from October 10 to November 9, 1991. During the study period, consulting with the agencies concerned in the Mongolian government including the Ministry of Fuel and Energy and the Ministry of Industry and Trade, the study team held discussions with the personnel responsible for operation and maintenance of the 4th thermal power station and lots of data were collected and field studies were conducted.

After returning to Japan, the team examined the costs and benefits, worked out a master plan, an execution plan and a management plan, and computed the project cost based on the results of the study, all of which are summarized to finish a draft of the Final Report on the supply for rehabilitation. The team was again dispatched to Mongolia from the 20 of February, 1992 to the 29 of the same month to explain to and discuss with the personnel concerned of the Mongolian government and of the power station on the draft of the Final Report. This is the Final Report further reviewed and summarized, in which the comments from the Mongolian side at that time have also been taken into consideration.

Described hereunder is an outline of the Report.

The 4th thermal power station was manufactured and constructed mostly in the 1980s with the technology of the ex-Soviet Union. Despite that not yet even a decade has elapsed since the commencement of operation, the boiler availability factor still remains at the 50% level. It is understood that the unachieved power supply (actual value in 1990: 221,300 MWh), the difference between the request to the 4th thermal power station and its actual generation value eventually becomes just a power shortage in the central energy system, which should be covered in the result by the purchase of power from the ex-Soviet Union or causes the power failure. The availability factor of the turbine generator is as high as about 70%, and its operation records show no particular problem at present.

The results of the studies are outlined as follows, concerning the current status of major equipment in the power station as well as the necessity and urgency of the rehabilitation:

(1) Power Station in General

The inside of the plant house where the boiler and turbine are installed is dark and lots of pulverized coal and fly ash accumulates everywhere. In addition, since they are washed away with water at times, troubles are induced in the electric systems. The environment of operation as well as of maintenance is kept in poor conditions. In the light of current Japanese status, in spite of its comparatively new and powerful station, it appears an outworn station having been in service for 20 to 30 years, which the poor environment is additionally giving birth to new problems. The necessity and urgency for rehabilitation are high.

(2) Boiler Pressure Part and Large Capacity Pump

The operation of the boiler has been suspended at times due to furnace explosion and its associated various causes or their combination. Including this, the boiler trouble on boiler pressure parts accounted for 29%, which however, was not caused by any fundamental problems in boiler itself. Also less trouble occurred for large capacity pump.

As the boiler and large capacity pump themselves seem to be designed with ample allowances, and are all less than eight years old since the commencement of their operation, no urgent problem on them has occurred.

(3) Mill and Pulverized Coal Feed System

Most trouble have occurred in this system, accounting for approximately 57% of boiler trouble.

These problems are mainly caused by wear. The major cause of the low availability factor of the boiler lies in the trouble with this system. The first step to be taken to reduce boiler trouble is to reduce trouble in the pulverized coal feed system. It can also be expected to see a reduction in trouble related to the boiler pressure part through improvement of the feed system and its associated maintenance.

(4) Steam Turbine and Generator

As these equipment, similar to the boiler, under the category of station major machinery, were manufactured with ex-Soviet Union technology, no procurement will be possible in Japan, even for their partial rehabilitation. However, there appears happily no particular problem for them. With the availability factor as high as about 70%, the operation records (vibration, bearing oil temperature, etc.) show no sign of any problem at present.

(5) Coal Handling System

The coal measuring equipment in the power station has been damaged and no reliable measurement is being taken on the amount of coal consumed, presenting a problem for station management. Furthermore, the receiving coal contains lots of foreign materials (stones, metal pieces), which would be responsible for problems such as broken belts, and in addition, for wear in the pulverized coal feed system. The measure is therefore in need of prompt installation.

(6) Electrostatic Precipitator (ESP)

The electrostatic precipitator is often not operating or not in full charge, even when the boiler is in operation. As to the cause of such status, there exists no particular problem in the ESP itself. What are most responsible for the non-operation is the rapping system of the ESP, the troubles of which are electric motor burnt-down, too short reducer life of approx. one (1) month due to low quality material and manufacturing and bend-down or cut-off of the rapping rod. The fly ash discharging portion also has problems of choke, wear and leak of fly ash in canvas for air slider and of malfunction of hopper ash level sensor and shortage of air supply for hopper. The hopper is located in a separate building, which inside is also dark and its maintenance environment is also poor mainly due to the leakage of fly ash. In the ash treatment system, problems of wear and scaling (pluggage of pipe) occurs at its ash slurry transport and water feed portion, resulting in low availability of the precipitator. For the same reasons, as the electrostatic precipitator cannot be electrically charged fully, that is, with approx. 40% of its capacity at times, even when the electrostatic precipitator itself is in operation, efficiency of dust collecting is quite low. Taking the above current status into consideration, to suppress the dust emission from the stack, it is necessary to always put the ESP in 100% charge whenever the boiler is in operation. The urgency is great.

(7) Measurement Instruments

Measuring instruments are of too old type as used over 30 years ago, all of which are of electric type. In addition, it seems that no calibration test for them has been conducted because of lack of tools or materials. It can accordingly hardly be said that the instruments in the central control room as well as those on the field possess a kind of reliability, presenting a wicked problem for operation and management. Since their functions are directly related with functions of all the equipment, their malfunctions are inducing the troubles of each equipment. Therefore, it is necessary for Mongolian personnel to be able to do the calibration test of existing instruments at first to make the risk raised by the troubles as small as possible.

(8) Electrical Equipment

There are still lots of problems such as cable fires, power leakages and shorts, which are all caused by the accumulation of pulverized coal, washing with water and incomplete daily inspection, and a remarkable improvement can be expected through betterment of the environment.

On the other hand, international organizations and many countries have offered assistance programs to Mongolia. The United States of America decided to give an emergency grant aid amounting to $10 million for the purchase of materials and machinery from the ex-Soviet Union, and concerning the thermal power stations approximately $2.8 million has been allocated to cover the shortage of some of the materials and machinery. It has been confirmed that the assistance program from Japan this time will not duplicate with this USA grant aid program.

Based on the status as described above, the following four items were finally decided as the basic measures for the rehabilitation project:

(1) Measures against Pluggage in Ash Treatment System

In order to raise the availability factor of the ESP and to reduce air pollution by dust exhausted from the stack, to recover the fly ash discharging function of the ESP and then to decrease troubles in the ash treatment system by means of replacement of the canvas for air slider, replacement of the motor-driven reducer for rapping system of the ESP and supply of the mobile vacuum cleaning equipment and so on.

(2) Measures against Wear in the Pulverized Coal Feed System

In order to prevent boiler trouble which mainly occurred in the pulverized coal feed system and to raise the availability factor of the boiler, to improve their wear resistance and then to decrease boiler troubles, by means of adhesions of ceramics tile onto the pulverized coal pipe, classifier, cyclone separator and primary fan, and additional mounting magnetic separator for improved iron chip removal.

(3) Atmospheric Pollution Measurement

In order to get the functional data of the electrostatic precipitator and to grasp actual fly ash emission status, to check the dust collection efficiency and to measure the amount of exhausted fly ash from stack by means of supply of the instruments for measurement of dust concentration in the flue gas at ESP inlet and outlet.

(4) Supplementary Measure for Plant Maintenance

In order to improve the maintenance of the station and to realize the efficient work of rehabilitation to supply the necessary materials and machinery, as supplement of above (1) & (2) measures.

Shown in the following table are the details of items as the results of the basic design study worked out.

Major Materials and Machinery (1)

Section	Items		Contents
1.	Measures against pluggage in Ash treatment system	1.1 Electrostatic precipitator ash hopper discharge equipment	Canvas of Air slider for 13.5m 60 sheets 10.5m 60 〃 6.0m 50 〃 (Replacement)
			Rubber pad of ash level sensors for ash hopper 1m ×2m×5mm 20 sheets (Replacement)
			Air hammers (4 per each hopper in front two lines only) 200 pieces (New Installation)
		1.2 Air supply facility	Packaged air conpressors 3 units Air piping & headers 3 sets High pressure hoses and others 1 set (New Installation)
		1.3 Electrostatic precipitator reducer	Motor-driven reducers for Mechanical rapping system 160 units (Replacement)
		1.4 Slurry pit level control equipment	Level control equipment for No. 1 & No. 2 pit (including pipes, valves & level indicators) 2 sets (New Installation)
		1.5 Slurry valves for ash slurry pump outlet	Sluice valves 18 units (Replacement)
		1.6 Feed water line	Additional feed water line with 350 & 65 mm O.D 1 set (New Installation)
		1.7 Pipe cleaner for ash treatment water supply line	Pipe cleaners for large and middle diameter pipes 1 set each (Supply)
		1.8 Mobile vacuum cleaning equipment	Mobile equipment for fly ash removal from ESP ash hopper and other dust removal (11 ton diesel truck) 2 cars (Supply)
		1.9 Miscellaneous for ash treatment system	Gland packing of ash slurry pump 2 sets Pressure gauges of ash slurry pump 30 sets (Replacement)

Major Materials and Machinery (2)

Section	Items		Contents
		1.10 Piping system for dust cleaning	Piping system to be used with mobile cleaning equipment ・Boiler house 1 set ・ESP hopper room 1 set (New Installation)
2.	Measures against wear of pulverized coal system	2.1 Alumina ceramics tiles (including adhesive and surface condition)	Adhesion of tiles at site for following portions Total 1,000m² ・pulverized coal pipe at mill outlet ・corn portion of classifier ・classifier outlet fuel pipe ・cyclone separator inlet ・bends in pulverized coal pipes (72°～30° bend) (New Installation)
		2.2 Ceramics tile lined 90° bend of pulverized coal pipe	90 ° bends of pulverized coal pipe 56 pieces (Replacement)
		2.3 Ceramics tile lined primary fan outlet flow control damper	Dampers as a test for one boiler 12 units (New Installation)
		2.4 Ceramics tile lined primary fan rotor	Ceramics tile lined primary fan rotor assembly 18 sets (Replacement)
		2.5 Magnetic separator	Additional mounting of one unit per each conveyor (Removable iron chip weight more than 25 kg) 2 units (New Installation)
3.	Atmospheric pollution measurement	3.1 Measurement for environmental pollution	Instruments ・for measurement of water content in flue gas 2 sets ・for measurement of flue gas velocity 2 sets ・for analysis of flue gas components 2 sets ・for dust collection of flue gas 2 sets ・for dust measurement 1 set (Supply)

Major Materials and Machinery (3)

Section	Items		Contents
4.	Supplementary measure for plant maintenance	4.1 Pumps	• Phosphate injection pumps for boiler (Replacement) 14 units • Lubricant oil pumps for mill (〃) 6 units
		4.2 Valves	• Sluice valves for steam line, 25 kgf/cm² Motor driven (〃) 18 units • Sluice valves for water line, 25 kgf/cm² Manually operated (〃) 6 units
		4.3 Level gauges	• Boiler drum level gauges (〃) 8 sets • Low pressure water level gauges (〃) 2 sets
		4.4 Coal scale	• Scales for coal conveyor (〃) 2 sets
		4.5 Measuring instruments	• Portable clamp meters (Supply) 10 units • Ohm-meters (〃) 10 units • Dial calipers (〃) 2 units • Ultrasonic thickness gauges (〃) 2 units • Multi-meter (〃) 56 units • Portable calibrator (〃) 2 units
		4.6 Materials & machinery for rehabilitation site work	• Portable grinders(100mm/180mm dia) (〃) 50 units • Grindstone disks (〃) 12000 pieces • Chain blocks (〃) 3 units • Wire (1/2", 3/4") 500m/rolls (〃) each 2 rolls • Can type surface cleaners (〃) 3 kℓ • Spray type surface cleaners (〃) 2000 bottle • Auxiliary devices for work (〃) 1 set • Plasma cutting machines (〃) 3 units • Alternating current welding machines (〃) 5 units • Anti-dust glasses and masks (〃) each 25 pieces • Paper for vibrometer (〃) 5 packages • Welding electrodes (〃) 5000 kg • Holders for welding electrodes (〃) 20 pieces • Hot air dryer 3kW (〃) 5 units • Drill (〃) 20 units • Transformer 34,380V/220V, 3 phase (〃) 6 units • Motor-driver cutter (〃) 5 units

Major Materials and Machinery (4)

Section	Items		Contents
		4.7 Materials & machinery for general plant maintenance	• Transceivers (〃) 60 units • Insulating tapes (〃) 1 set • Copying machines (including copying paper) (〃) 3 units • Graphite packing (square type) (〃) 200 kg • Sealing putty (〃) 1,300 kg • Portable electric vacuum cleaners (〃) 8 units • Portable flash lights (〃) 100 units • Submerged pump (〃) 5 units • Small size pipe cleaner (〃) 4 units • Fork lift (〃) 2 units
		4.8 Lighting equipment	• Lighting fixtures for mercury lamps incl. lamps (new installation) 214 sets • Mercury lamps (Supply) 428 pieces • Incandescent lamps (〃) 400 pieces

The cost of materials and machinery required of the project will be borne by Japan, but the cost of site work for them will be incurred by Mongolia. Since all the site work itself is to be executed by the maintenance personnel of the power station as a part of the maintenance work, the inclusion of such cost of work is not appropriated in the project cost and then the cost was not included therein.

The executing agency of the project is the Ministry of Fuel and Energy, and the one directly in charge is the maintenance department of the 4th thermal power station, a subordinate organization of the ministry. The rehabilitation project will be executed as an extension of, or addition to the ordinary maintenance work, so that the department will have adequate capacity for the completion of the project. Further, the repair technique of the primary fan repair and of the adhesion work with ceramics tile is one of the key factors in the project, for which urgent guidance was already provided by Japanese experts on November 1991. It is believed that such transferred technique will be used best in the project.

The site work of the project is divided into two stages; the first stage is aimed at completion by the end of December 1993, while the second stage by the end of December 1994. At the first stage, to tide over the peak power demand in winter from December 1992 to February 1993, it is most preferable that at least part of the work will be completed by the end of December 1992. It is necessary for that purpose to complete the D/D (Detailed Design), verification, bid, ordering, etc. after the signing of E/N (Exchange of Notes), in a considerably short period of time. In addition, for the site work to be executed under full responsibility of the Mongolian side, the Consultant shall from time to time in Mongolia advise on the supervision of the work schedule to the Mongolian side so that the rehabilitation project will be able to be completed within the planned period. It was decided in the study that all the required materials and machinery will be purchased in Japan, considering the state of Mongolia and situations in the ex-Soviet Union.

For the maintenance of the power station after the completion of the rehabilitation project, for which the Mongolian side shall be responsible through his operation, repair and regular, periodical or daily inspection under the current maintenance organization of the power station, drawing up a patrol manual, prohibition of water washing, execution of dry cleaning, coal quality control and so on are in particular emphasized in the Report in expectation of improvement by the Mongolian side.

After the completion of the project, the availability factor of the boiler, which has hitherto been a bottleneck in the operation of the power station, will be improved, and an adequate amount of steam necessary for power generation will then be secured, with the result that the shortage of electricity will be fully cancelled and further, even approximately 150,000 MWh of surplus will be expected. Adequate amount of electricity can consequently be supplied to the people who have been compelled to lead an inconvenient life from frequent power failure till now. Furthermore, the surplus electricity will be available to be sent to the industrial cities of both Erdenet and Darkhan. On the other hand, a substantial improvement can be expected in the environment of Ulaanbaatar city mainly through the reduction of pluggage in the ash treatment system around the ESP, in particular a large amount of improvement of the reduction of air pollution in winter seasons under high power station load. The output of the 4th thermal power station covers approximately 70% of the total power demand of the six central provinces and the benefit of the rehabilitation is estimated very great. As described so far, the grant aid of the Japanese government to the project is considered significant and justifiable.

Future proper management of the maintenance is essential in order to assure itself the benefit of the project clearly after completion of the rehabilitation. The proper management, we believe, is to secure supply from the ex-Soviet Union of maintenance parts, indispensable for the daily maintenance of the power station, to secure the budget therefor, to complete and improve the methods of maintenance, to train the personnel and to inform the citizens surely of the current situation. The dispatch of Japanese experts will be recommended for the training of maintenance personnel, for which it is desirable for the Mongolian side to establish a system for it in near future.

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CHAPTER 6

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CHAPTER 1 INTRODUCTION

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Since its independence in 1921, economic development has continued in the Mongolia under the assistance of ex-Soviet Republic for 70 years. However, the new political regime born from a free election in 1990 for the first time since its independence has reformed the conventional system dependent on the ex-Soviet Union and Eastern Europe, has begun to follow its own democratic reformation line called "Urukelulut cinechirel", and has been striving to expand its relationships with Western nations, aiming at "Development harmonizing market economy with planned economy".

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The energy for the six central provinces including Ulaanbaatar City has been supplied mainly from the 3rd and the 4th Thermal Power Stations. (No. 1 was closed down, and No. 2 is for emergency use). A great role is played, in particular, by the 4th Thermal Power Station with 540 MW capacity (8 boilers, 6 turbine-generators).

The boiler availability factor of the 4th Thermal Power Station has been extremely low, it was only 50% level. Since the atmospheric temperature goes down to less than -40°C in severe winter and the priority has to be given to the supply of hot water for heating for the living of general public, the power generation has been suppressed, which causes frequent power outages.

Furthermore, brownish smoke is eventually emitted from the stack of the power station since the electrostatic precipitator (ESP) is not fully put into service even if the boiler is operated. In the winter season, in particular, an air inversion layer is often formed in the atmosphere in addition to a high load on the boiler. It would be feared, therefore, that some undesirable health effects may be caused to the citizens of Ulaanbaatar City, depending on the direction of wind.

In July, 1991 under such conditions, the Mongolian government requested the Japanese government a technical cooperation and grant aid for the rehabilitation of 4th Thermal Power Station in Ulaanbaatar City.

In August 1991, the Japan International Cooperation Agency (JICA) had forthwith sent a project finding study team for two weeks to confirm the details of the request and study the scope of possible cooperation and its particulars. In addition, an expert dispatch and material supply study team was dispatched separately in August based on judgement that the implementation of the urgent rehabilitation would be effective for the 4th Thermal Power Station to cope with the peak power demand in the winter of 1991. As the result, a decision was made to send four experts and to supply a part of materials and machinery needed, which was put into realization during one month from November 1991.

Based on the result of the project finding study, JICA decided that to the project shall be limited to the 4th Thermal Power Station and to send the basic design study team headed by Mr. Shoji Shimbo, Managing Director, Grant Aid Study and Design Department of JICA from October 11 to November 8, 1991. The study team thus sent to Mongolia, held meeting with the parties concerned of the Mongolian government including the Ministry of Fuel and Energy and the Ministry of Trade and Industry, had discussions with persons responsible for the operation and maintenance of the 4th Thermal Power Station, collected lots of data and conducted field survey and confirmed an agreement in the form of minutes.

Upon returning to Japan, the Study Team examined in details the possible scope and contents of the rehabilitation for the project based on the above investigation. In the examination, the experience of urgent measures executed in November 1991 were also taken into consideration.

Then the Study Team developed a draft of the Final Report on the supply for rehabilitation through examinating the benefits and effects, a master plan, an execution plan and a management plan, and the calculation of approximate project costs.

In February 1992, JICA dispatched the study team again, headed by Mr. Takuo Kidokoro, Director of 1st Section of Grant Aid Department from 21 February, 1992 to 28 of same month to explain and disucss the contents of the Report.

The Report was further reviewed and finally summarized as a proposed implementation program of the project, taking into account the comments of the Mongolian side to the said team. The members of both Basic Design Study teams, their itinerary the representatives of the Government Agency of Mongolia with whom the teams interviewed, the minutes of discussions, list of data and documents collected in Mongolia, are attached in the Appendix.

CHAPTER 2 BACKGROUND OF THE PROJECT

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2.1 Outline of the Mongolia

The Mongolian government started reformation of the economic system from 1987, and strived to strengthen the relationship with western countries through a more open policy in 1990. Despite such efforts, however, the Mongolian economy has steadily worsened year after year, affected by worsening economic conditions in the ex-Soviet Union and East European countries.

The economic reform is presently under way with an emphasis on switching from a socialistic to a democratic market economy. Being in a transitional period with drastic reformation, noticeable decline has been observed in the activities of both the production and service sectors since the end of 1990. The country is confronted with economic difficulty in the fiscal year 1991. In addition, the shortage of commodities has reached to a serious stage due to the substantial retreat and suspension of economic assistance from the ex-Soviet Union.

In June 1991, the Mongolian government announced drastic measures to sell more than half of the state-owned properties to private sectors and place them under private management in a period of the coming two and a half years.

The Japanese government had strengthened its assistance to Mongolia around the visit of Prime Minister Kaifu in August, which was the first visit among the Western countries. A grant aid in funds amounting to two billion yen was also disclosed at the time of his visit. Furthermore, a conference of Mongolia assisting countries was opened in Tokyo under the leadership of Japan. With participation of advanced countries and international organizations in the world, such as the International Monetary Fund (IMF) and Asian Development Bank (ADB), joint assistance amounting to US$155 million was decided. Japan has become the country to provide the largest portion of assistance. The second conference is scheduled to be held in the spring of 1992. In parallel with such movements, cultural exchange on the private sector level has become popular.

After the revolution, Mongolia had depended on the ex-Soviet Union for its food, daily sundries, equipment and petroleum. The trade with the ex-Soviet Union accounted for 89% of the foreign trade in 1990. Because of such dependency, Mongolia was directly hit by the crumbling of the ex-Soviet Union economy and thrown into a serious shortage of commodities. The food rationing system has been started from urban areas from April 1991. Despite the desire to purchase food from the western countries, especially from Asian countries, they are in no position to do it for shortage of foreign exchange reserve.

In Mongolia where the market economy is still in the stage of trial and error, job openings are extremely scarce which spurs the increase of the unemployed. Anxiety about the future is expanding under rushing waves of liberalization.

Amid such a situation, a shift to private ownership of state-owned enterprises is to be implemented from 1991 to 1992. Discussions about the new constitution have been held at the People's Great Conference. The shift to a perfect market economy will be completed within three years.

2.2 Outline of Energy Industry Sector

The energy of the Mongolia consists of electric power and heat, originating from native coal. Since the country is located in a cold district where the lowest national average winter temperature registers minus 21°C and the hottest national average summer temperature around 17°C, it is not rare for the temperature to go below minus 40°C in the daily variation, the electric power and heat supply system is adopted by the thermal power stations, in which steam is supplied to nearby factories and hot water for the general public in addition to the supply of electric power.

It would not be correct, therefore, to express the size of power station by its generating capacity alone. The boiler capacity of power stations is normally 2 or 3 times bigger than the generating capacity, as compared with the unit system of large utility power stations in Japan, which are exclusively used for power generation.

It is necessary when considering the operation and maintenance of the power station to consider the supply not only of electric power, but also of steam and hot water. The energy industry sector has been deemed to combine them all into one.

The Mongolia development has centered around Ulaanbaatar city, the capital, and its adjacent industrial cities, Erdenet city (Bulgan prefectue) and Darkhan city (Selenge prefecture). Future development will also center around these three districts. The electric power network covering a total of six prefectures, including three other prefectures in the vicinity and the capital city's prefecture, Tov prefecture, in connected with 110 kV and 220 kV power transmission lines, and controlled by the central energy system. The total generating capacity as of August 1991 amounts to 713.5 MW. Further expansion of the electric power network is intended in the future. The power transmission line from the ex-Soviet Union is connected to the substation in Darkhan to receive this supply of power.

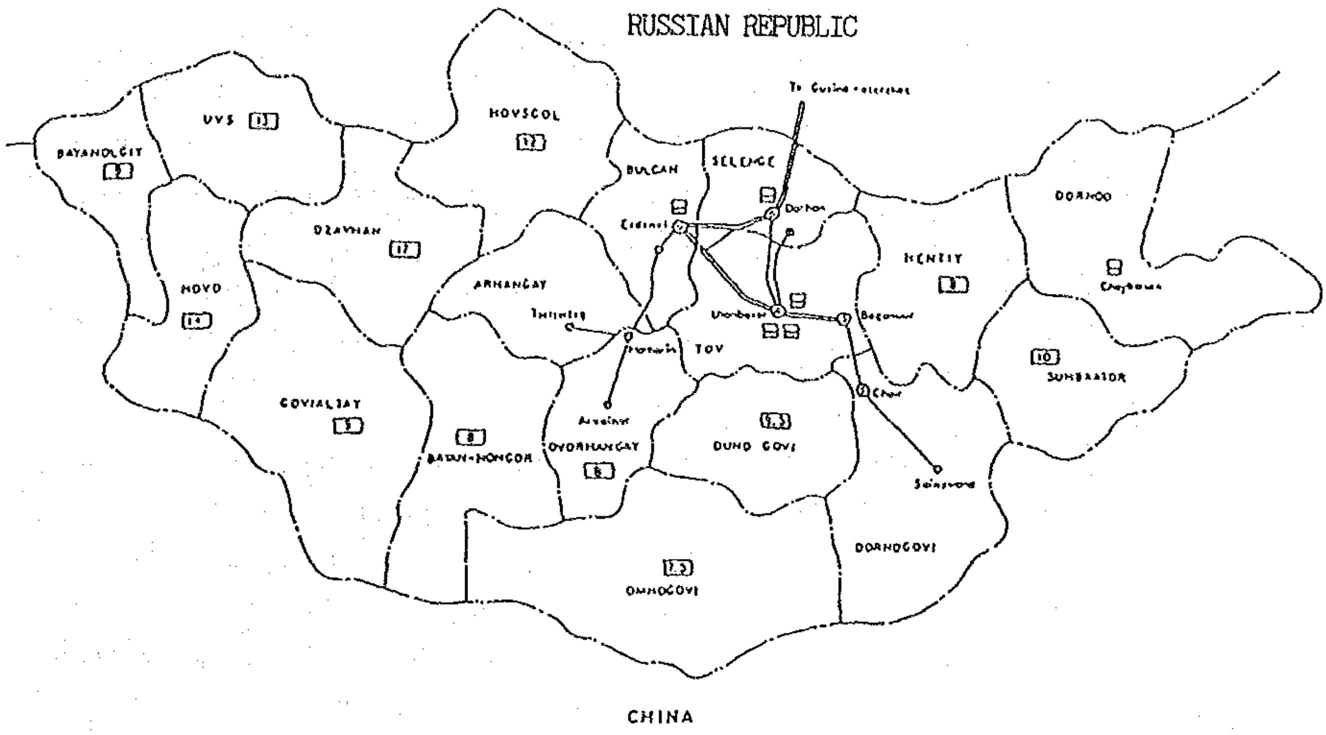
Eleven provinces other than the six provinces under the cental energy system have their own diesel power generating facilities for an independent supply of electric power. In addition, they have their own boilers to supply hot water. Choybalsan city in Dornod provinces has a thermal power station for the supply of heat and electric power.

The generating capacity of the Mongolia as a whole amounts to approximately 877 MW.

The main transmission lines in Mongolia is shown in Fig. 2-2-1.

The central energy system has five thermal power stations as shown in Table 3-4-1, and their capacity are as follows:

	Generating capacity (MW)	Boiler capacity (t/h)
Ulaanbaatar city		
The 2nd thermal power station	21.5	220
The 3rd thermal power station	148	1,950
The 4th thermal power station	460	2,940
Darkhan city	48	750
Erdenet city	36	450
Total	713.5	6,240



Legend

⊟ : Thermal power station

◎ : 220kV Substation

o : 110kV Substation (main substation only)

═ : 220kV Transmission line

— : 110kV Transmission line (main transmission line only)

[MW] : Installed capacity of isolated diesel generator (main only)

Fig. 2-2-1 The Main Transmission Lines in Mongolia (as of the end of 1990)

2.3 Outline of Related Plans

2.3.1 National Development Plan

According to the draft policy for plans for 1991 onward, the development of products and technical innovations are planned by about 600 establishments and factories. Funds amounting to about 68.9 billion Tugriks, including foreign money of 8 billion U.S. dollars, are required for these purposes.

Furthermore, 73.7% of total capital investment is scheduled for construction of new large factories such as mine-mouth thermal power station and copper smelting, etc., 15.8% for the renewal of existing establishments and 10.5% for the development of medium and small sized factories as cement poles, etc. The construction of about 200 new factories, including the Tavan-Tolgoyt coal mine for coke making, the Baganuur power station, a zinc ore dressing mill at Ovoo, metallurgical/metal refining and chemical industries, very important for the acceleration of this country's development are planned.

Funds amounting to 51 billion Tugriks, including foreign money of 8 billion U.S. dollars, are required for these purpose.

The statement by the chairman of the summit meeting of advanced countries (London summit) in July 1991 declared "the advance of reform in Mongolia deserves further assistance" to commit the assistance in a collective opinion of advanced countries. Moreover, international assistance was confirmed by "The Conference of Mongolia Supporting Countries" held in Tokyo in September 1991. With concrete movement of such assistance, distinct movements will be seen in the national development plan.

2.3.2 Regional Development Plan

No regional development plan is yet been worked out since the national development plan has not been approved by the parliament.

The supply of housing is an urgent task since 44% of households in Ulaanbaatar city where 570,000 people, or 27% of the total population concentrate, still dwell in nomadic tents, and about 50% of the population in the city is said to be under 30 years old.

The development of six central provinces centering around Ulaanbaatar will be pushed forward ahead of other regions, considering the necessity of improvement of infrastructure and securing a labor force.

2.3.3 Development Plan of Energy Industry Sector

According to the estimation from the Mongolian National Development Plan, the demand for electric power in 1995 will grow 1.6 times the 1990 rate. To meet with such growth, the construction of a new power supply source will be necessary. One of the key source is a coal fired thermal power station for electric power and heat supply with its final capacity of 600 MW at Baganuur. A feasibility study on its construction has already been made by Japan Consulting Institute.

The construction of a 150 - 200 MW hydraulic power station will also become necessary in order to reduce the import of electric power and heighten the controllability of load change. Furthermore, rehabilitation projects are scheduled for the improvement of availability factor of the 3rd and the 4th thermal power stations in Ulaanbaatar.

It will also be necessary to construct medium-and-small sized factories for the manufacture of cement poles, copper cables, aluminium cables and insulators. Major new construction and rehabilitation projects are as follows:

<u>New construction projects</u>

1.	Baganuur thermal power station		600 MW
2.	Small thermal power station	Dalandzadgad	10 MW
		Altai	15 MW
		Balonorto	15 MW
3.	110 kV and 220 kV power transmission lines		
4.	Hot water boilers in nine provinces		
5.	Hot water boilers in Darkhan		

Rehabilitation projects

1. Ulaanbaatar the 3rd thermal power station
2. Ulaanbaatar the 4th thermal power station
3. Darkhan thermal power station
4. Dornod thermal power station
5. Ulaanbaatar power dispatching center

Shown in Table 2-3-1 is a forecast on power demand and supply up to the year 2000 for the cental energy system. The table shows a balance sheet of maximum supply versus maximum demand.

Table 2-3-1 Forecast on Power Demand and Supply Up To the Year 2000

(Unit: MW)

	Year	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Demand	Maximum demand	590	630	676	722	760	814	860	924	988	1,050	1,115	1,180
	Reserve capacity	-	100	110	110	120	150	150	150	150	150	200	210
	Required capacity (A)	590	730	786	832	880	964	1,010	1,074	1,138	1,200	1,315	1,390
Supply	The 1st Thermal Power Station	-	-	-	-	-	-	-	-	-	-	-	-
	The 2nd Thermal Power Station	12.5	14	14	14	14	14	-	-	-	-	-	-
	The 3rd Thermal Power Station	106	110	110	110	110	110	110	136	136	136	136	136
	The 4th Thermal Power Station	390	380	460	460	500	500	500	500	540	540	540	540
	Darkhan Thermal Power Station	43.5	40	40	40	40	40	40	40	40	36	36	36
	Erdenet Thermal Power Station	18	20	20	20	20	20	20	24	24	29	29	29
	Choybalsan Thermal Power Station	-	-	-	-	-	-	24	24	24	24	12	-
	Baganuur Thermal Power Station	-	-	-	-	-	150	300	300	450	600	600	750
	Imported electric power	20	166 (0)	142 (0)	188 (0)	196 (0)	130 (0)	16 (0)	50 (0)	0	0	0	0
	Total supply capacity (B)	590	730 (564)	786 (644)	832 (644)	880 (684)	964 (834)	1,010 (994)	1,074 (1,024)	1,214	1,365	1,353	1,491
Difference (B) - (A)		0	0 (-166)	0 (-142)	0 (-188)	0 (-196)	0 (-130)	0 (-16)	0 (-50)	+76	+165	+30	+101

Note:
1. Plant capacity is shown for supply.
2. Imported power denotes imports from the ex-Soviet Union. Figures in [ ] represent cases where the imports were impossible.
3. Confirmed with the Ministry of Energy in November 1991.
4. The maximum output of The 4th Thermal Power Station is 660 MW though the nominal capacity is rated at 540 MW. Assuming the plant-use power to be 16%, the maximum generating capacity will become 550 MW.
5. Obtained from Fuel & Energy Ministry in March 1991.

2.4 Background and Contents of Request

2.4.1 Background of Request

During the visit of Vice-Minister Suzuki of Foreign Affairs to Mongolia in June 1991, the Mongolian government cited the power related project as one of the four most important economic cooperation projects it is requesting to Japan, in particular the rehabilitation of existing facilities and construction of new power stations. After that, the following two items were requested as urgent tasks by the Mongolian Ministry of Trade and Industry by its letter dated July 5:

(1) Dispatch of experts for urgent rehabilitation of the 4th thermal power station, and

(2) Economic assistance through the supply of materials and machinery by grant aid to improve the availability factor of the said power station.

With respect to (1) above, an expert dispatch and material supply study team was sent by JICA to the Ministry of Fuel and Energy in August, 1991 to finalize the supply and the dispatch of experts. The study thus was carried out determined the number of experts to be dispatched, the fields of their activities as well as the scope of materials and machinery. Finally, four experts were dispatched for one month in November the same year to enable to tide over the peak demand in the winter of 1991.

With respect to (2) above, a project finding study team was sent by the government in August the same year to confirm the particulars of the request. Based on the report of the study team by the government, JICA dispatched the basic design study team to the country of Mongolia.

A grant aid assistance was also confirmed in the visit to ex-Prime Minister Kaifu in August, 1991.

2.4.2 Contents of Request

The contents of the request are to select the 4th thermal power station of Ulaanbaatar as the object of grant aid, in order to secure a stable supply of electricity and to improve the living standard of people, through the improvement of the availability factor of boiler by adopting measures against the wear of the pulverized coal feed system and through the reduction of dust discharged from the stack by the rehabilitation of the ash treatment system. Accepting the request, the basic design study team confirmed that the rehabilitation project consisted primarily of the supply of following materials and machinery, and compiled minutes of discussion as a basic agreement between the parties after the meeting with the personnel concerned of the Mongolian government:

1) Ash slurry pipe and sluice valves
2) Feedwater pipes and valves for ash treatment
3) Ash level meter
4) Vacuum car for dust removal
5) Dust measuring instrument
6) Ceramics tiles
7) Carbon steel plates lined with wear-resistant material
8) Welding rods for primary fan blades
9) Wear-resistant steel plates
10) Magnet separator for coal conveyor
11) SO_2/NO_x meter
12) Dust-proof/explosion-proof lighting equipment

CHAPTER 3 OVERVIEW OF PROJECT SITE

CHAPTER 3 OVERVIEW OF PROJECT SITE

3.1 Location and Economic Status of Project Site

The 4th thermal power station, the object of this rehabilitation project, is located in Ulaanbaatar city, the capital of Mongolia. Ulaanbaatar city is located in Tov prefecture which is situated nearly in the middle of the Mongolia. Latitudinally, the location of the city is nearly the same as Paris, Khabarovsk and Seattle while longitudinally nearly the same as Hanoi and Jakarta. The city is the largest in Mongolia with a population of 575,000, as of March 1991, or about 27% of the total population of Mongolia. 2,149,300 people are living in it. As a result, the population density is 4 persons/km^2, or three times as much as compared with entire Mongolia, 1.35 persons/km^2. The number of household totals 116,400. "Gel" (nomadic tent), the traditional dwelling in Mongolia, accounts for 44.2% of the households though on the other hand, blocks of modern complexes have been constructed.

The peoples living in the complex are not avairable cooking when electric failure would be occurred because only electricity is used for cooking in the complex while the coal is mainly used for cooking and heating in "Gel". Since heating source in the complex rely on the hot water from the thermal power station, the duty of thermal power station is very important for the citizen's life from a point of view in the stable energy supply.

The fuel and maintenance parts for power stations are in short supply due to the drastic curtailment of economic assistance from the ex-Soviet Union. So urgent assistance of China, Japan and other Western nations is sought.

3.2 Natural Conditions

Ulaanbaatar city is located on a highland with an altitude of 1,351 m, as a town developed on the right bank of the River Tuul flowing from the east to west, a tributary of the River Orkhon which ultimately empties into the Lake Baikal. The city is situated in a basin surrounded by mountains, and the area is about 2,000 km^2, almost the same as Tokyo in Japan. The climate is continental. The coldest month throughout the year is January and the hottest month July. The annual average temperature is 0.9°C, relative humidity 67% and the annual rainfall is a very scarce, 233 mm.

The monthly average temperature, humidity and rainfall are as shown in Table 3-2-1.

Table 3-2-1 Annual Climatic Conditions in Ulaanbaatar District

Month		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annaul average
Temper-ature (°C)	Highest	-18.3	-14.1	-3.1	4.2	11.2	16.9	17.3	15.7	9.7	5.0	-7.3	-15.7	
	Lowest	-23.1	-20.2	-12.8	6.5	7.7	12.8	16.3	13.5	6.9	-2.1	-14.8	-21.4	
	Average	-21.1	-17.4	-8.8	1.4	9.8	14.3	16.6	14.9	8.4	1.1	-11.6	-18.0	0.9
Average humidity (%)		82	78	67	55	52	60	66	67	64	64	73	81	67
Rainfall (mm)		1.5	1.9	2.2	7.2	15.3	48.8	72.6	47.8	24.4	6.0	3.7	1.6	233.0
Numbers of days with rainfall (day)		-	-	-	1.0	4.1	9.0	14.0	12.0	7.0	2.0	0.0	-	Total 49.1
Numbers of days with snowfall (day)		3.7	3.0	3.5	3.0	2.1	-	-	-	1.3	2.8	4.6	3.4	Total 30.4

Data covering 1985 - 1986, was obtained from the Ministry of Energy.
However, the amount of rainfall and snowfall is based on official announcement from 1921 to 1986. Both data were recorded in Ulaanbaatar City.

3.3 Energy Status of Ulaanbaatar City

Table 3-3-1 shows the transition of energy consumption in Ulaanbaatar city in the latest decade. The table indicates that the supply of heat increased by 55% and electric power by 69% in the past ten years while the increase in population was 34%. According to the draft of the "Master Plan and Policy for Future" compiled by the Ministry of National Development of Mongolia in November 1991, the annual population increase is estimated to be 2.5% (or 50,000 persons) and the total population will reach the 2.7 million level by the year 2000.

Table 3-3-1 Energy Consumption and Growth of Population in Ulaanbaatar city in the Latest Decade

		Unit	A			B		
			1978	1979	1980	1988	1989	1990
Heat consumption	Hot water	10^6 Kcal/h	1,944	1,488	1,783	2,830	2,857	2,840
	Steam	10^6 Kcal/h	667	688	694	943	937	924
	Total	10^6 Kcal/h	2,661	2,176	2,477	3,773	3,794	3,764
	Average of three years	10^6 Kcal/h	2,438 (1.00)			3,777 (1.55)		
Power consumption		10^3 MWh	490	580	650	907	981	1,018
		10^3 MWh	573 (1.00)			969 (1.69)		
Population		10^3	10.0	418.7	431.3	548.4	560.6	575.0
		10^3	420.0 (1.00)			561.3 (1.34)		

(Note)
- Hot water and steam are delivered by pipe from the power stations, the former for people's livelihood and both for industries.
- Taking the three years average from 1978 to 1980 as A and the same for 1988 to 1990 a decade later as B, the figures in ( ) denotes the multiplying factor of B in case of taking A as 1.0.
- Obtained from the Ministry of Fuel and Energy in October, 1991.

3.4 Energy Tariff

The energy is divided into electricity, hot water and steam. The hot water is supplied through piping from the thermal power station within the city to each households, shops, public facilities and factories. The steam is only for factories. It is reheated if necessary, however, the heat loss is great with the heat insulator of piping run through the city peeled off at places. The boiler of the thermal power station is required of continuous operation even at night since the maintenance of room temperature is important when the air temperature drops down (at dawn) in winter seasons. A stable operation of boiler including the improvement of piping is desired to firmly establish the energy system including the collection of energy tariff. As of the date of investigation, the monthly salary of maintenance personnel of the power station averaged from 1,000 to 2,000 Tugriks while the energy tariff amounted to 30 to 50 Tugriks a month, or 2 to 5% of the salary. Therefore, the tariff is almost same as compared with 3 to 6% of the average household in Japan.

3.4.1 Electricity Tariff

The electricity tariff in Mongolia is set very cheaply as compared with Japan. Taking the official exchange rate of US$1 = 40 Tugriks, the electricity tariff for household use costs ¥1.6/kWh (Assuming US$1 = ¥130) in comparison with approximately ¥24/kWh in Japan.

(1) Unit electricity tariff (Tugrik/kWh)

District	Industry	Household
. Ulaanbaatar Central System	0.35	0.50
. Choybalsan and its District	0.95	0.50
. Other Regional District	0.93	0.50

However, 0.35 Tugrik/kWh rate applies to all public organizations except factories. In order to level off the electric power load, electricity tariff for industrial users will be adjusted as follows to vary the rates during peak and low load times.

During peak load:	AM 7:00 - AM 10:00	x 5
	PM 5:00 - PM 10:00	x 5
During low load:	PM 10:00 - AM 7:00	x 1/7

(2) The following electricity tariff will apply to household without Watthour meters.

Classification	Tariff (Tugrik/month)
1. Per each Socket	50.00
2. Per each 25W bulb	2.80
3. Per each 40W bulb	4.60
4. Per each 60W bulb	7.00
5. Per each 75W bulb	8.80
6. Per each 100W bulb	11.60
7. Per each 150W bulb	17.40
8. Per each 200W bulb	23.20
9. Per each 500W bulb	58.00
10. Per each 1,000W bulb	116.00

3.4.2 Hot Water Tariff (for heating)

Classification	Category	Unit	Tugrik/Month
. Heating	Housing Housing complex Student dormitory	m^2	4.50
. Heating	Basement	m^2	2.50
. Industrial	Service industry	Gcal	55.00
. Hot Water	Housing Student dormitory	Per capita	1.60
. Heating	Factory Public office	m^3	1.85
. Industrial		Gcal	55.00

* Hot water is supplied during the period beginning September 15 and ending May 15. Charges are collected during this period only.

3.4.3 Steam Tariff (for industrial Tugrik/Gcal)

Steam Pressure (kg/cm^2)	Tugrik/Gcal
. 1.2 - 2.5	48.00
. 2.6 - 7.0	51.00
. 7.1 - 13.0	55.00
. 13.1 - 21.0	57.00
. 21.1 <	61.00

CHAPTER 4 STUDY OF PROJECT FOR COOPERATION

CHAPTER 4 STUDY OF PROJECT FOR REHABILITATION

4.1 Purpose

The 4th thermal power station in Ulaanbaatar city of the Mongolia was mainly built in the 1980s by technology from the ex-Soviet Union. Although ten years have not yet passed since the station started operation, the station cannot afford to supply power smoothly as the availability factor has lowered due to a lack of imported materials and parts for operation and maintenance as well as due to station equipment failures, a part of which is caused by withdrawal of ex-Soviet engineers and lack of maintenance and management technology. Those are all caused by a large reduction or in some cases a suspension of financial and technological assistance influenced by deterioration in the ex-Soviet economy. As a result of that, power outages are unavoidably frequent. Heat supply is also failing. It is seriously obstracting the economic development of Mongolia.

The Electrostatic Precipitators (ESP) improperly operated discharge a lot of dust and aggravate air pollution in winter under formation of inverted atmosheric layer.

Since the Mongolia government is afraid this situation may become a factor that will obstruct the presently promoted policies for democratic and economic reform, the government has planed a project for rehabilitating the 4th thermal power station as an urgent measure with the object of stable supply of electric power and improving the environment. The main measures are to raise the availability factor and to operate ESP normally.

4.2 Study of the Contents Requested

4.2.1 Study of Appropriateness and Necessity of Project

(1) Study of appropriateness

The appropriateness of the rehabilitation project was examined in comparison with other alternatives in the followings as urgent measure project for the stable electricity supply in Ulaanbaatar city.

1) Proposal for construciton of new power station

In the proposed new construction as a substitute of the rehabilitation works, a new thermal power station with capacity of 200 MW will be constructed in the outskirt of Ulaanbaatar city. If no rehabilitation was given to the existing 4th thermal power station and its load were reduced to a half, the amount of dust discharged from the stack will be reduced to 50%, and the electricity and heat will be supplied from the new thermal power station and the 4th thermal power station. The influence of dust to Ulaanbaatar city can be disregarded since the new station of an Western country type will be constructed in the outskirt.

The plan to newly construct coal fired thermal power station with 200 MW capacity will require a total fund amounting to ¥45 billions, approximately ¥40 billions for construction costs and ¥5 billions for the additional construction of power transmission lines and pipings for steam and hot water. The period to commissioning of four to six years is necessary. These two factors will lead to the new construction hardly met with the present requests of Mongolia. In addition, the amount of dust will be reduced by only about 50%, and the operation of the 4th thermal power station will have to be continued. Therefore, the cost of repair will keep on increasing.

The proposed new construction is a plan to be considered in future to meet with the increase in energy in future. It can never be a substitute of the rehabilitation project.

2) Rehabilitation of other power stations

As described before, the 4th thermal power station having an electric generating power of 540 MW is the largest and latest power station meeting with 70% of power demand in the central energy system. The majority of dust discharged from stacks belongs to this power station. As contrasted to it, the 2nd thermal power station stared its operation some 20 - 30 years ago. It is an old station with a small electric generating power of 21.5 MW, and is destined to be phased out in near future. The 3rd thermal power station, on the other hand, started its operation during 1968 and 1981. The electric generating power is as small as 148 MW, and a rehabilitation project is now pushed forward with an assistance from the United States of America.

It can be concluded from the foregoing that the Japanese grant aid cannot be intended for the rehabilitation of other power stations in Ulaanbaatar city.

3) Purchase of power from the ex-Soviet Union

With the central energy system linked with the power network of the ex-Soviet Union, Mongolia has a normal way to purchase power from there every year, 160,000 MWh in 1989 and 230,000 MWh in 1990. It was possible hitherto to obtain power from the ex-Soviet Union to cover its shortage though the unit price was high (formerly 3.5 Kopecks/kWh = ¥3/kWh). However, the contract for 1991 onward had to face rough going, and the unit price increased more than double to US$0.05/kWh (Approximately ¥7/kWH). Though switched to a barter contract, the Mongolian government intends to suppress the purchase of power, even if it is possible, from the viewpoint of saving foreign currency. At present, furthermore, the link is unilaterally cut off due to the domestic situations in the ex-Soviet Union.

So the purchase cannot be a substitute.

As a result of study described above, the rehabilitation project for improvement of 4th thermal power station is concluded as an appropriate counter measure for the problems which the Mongolia is facing now.

(2) Study of necessity

The necessity of the project will be examined by analyzing the current status of the amount of dust discharging from stack and the power shortage in the central energy system.

1) Low availability factors and low electric charging factors of electrostatic precipitator (ESP)

(a) Status of the 4th thermal power station

Table 4-2-1 shows the monthly operating time of ESP for each boiler and their availability factors based on the operating time of each boiler. The availability factors for boilers are on the level of 50% and the average availability factors for ESP based on the operating time of boilers is 72.9%. This indicates that 27.1% of the available operating time of ESP are not in service at all although the boilers are in operation. Furthermore, an average of electric charging factors of ESP included in 72.9% of them is 40%, as clarified in other section of the Report. Is not existing the status of such full charging for ESP as shown in Japanese power station.

Table 4-2-1 The Operating Time of ESP and their Availability Factors Based on the Operating Time of Each Boiler of the 4th Thermal Power Station in 1990

Months \ Boilers	N1	N2	N3	N4	N5	N6	N7	Total
1	223	432	468	445	443	485	-	2,496
2	249	316	268	416	468	75	416	2,208
3	-	319	479	349	344	271	356	2,118
4	-	337	452	113	228	382	197	1,709
5	-	178	386	100	487	336	651	2,138
6	-	-	144	459	352	50	322	1,327
7	-	184	-	93	-	339	438	1,054
8	-	438	-	175	161	251	268	1,293
9	-	113	-	338	-	347	491	1,289
10	-	197	237	130	-	433	375	1,372
11	-	334	266	448	-	-	432	1,480
12	-	252	515	434	220	186	253	1,860
Total	472	3,100	3,216	3,500	2,703	3,155	4,199	20,344
Operating time of boilers (h)	671	4,971	4,590	4,956	3,086	4,140	4,774	27,908
Availability factors based on the operating time of boilers (%)	70.3	62.4	70.1	70.6	75.9	76.2	88.0	72.9

* Obtained from the 4th Thermal Power Station in October, 1991

The low availability factor is caused mostly by troubles in the motor-driven units for rapping system of ESP, and not by the precipitator itself. The troubles consist of motor damage due to lack of lubrication, a short life of only about one month in the reduction gear due to low quality of materials and machining precision, bend-down and cut-off of the hammer rods, etc. Furthermore, the ash treatment system, including the air slider, has problems such as clogging, abrasion and opening of canvas, malfunction of the hopper ash level sensor, and shortage of air supply to the hopper. Although the bottom of hopper is located in a separate building, the inside is dark and the maintenance environment is inferior due to the leakage of fly ash. In the ash treatment system, the troubles of abrasion and scaling (clogging of piping) are caused in the ash discharge line and feed water line, attributing to the low availability factor of the electrostatic precipitator. For the same reason, the electrostatic precipitator has been put into charging only about 40% of the time while in operation, so the collection efficiency is extremely poor. Moreover, a strong sense of commitment that the electrostatic precipitator must be operated by all means while the boiler is in operation is not thoroughly driven into the minds of the maintenance personnels.

It is possible to cope with a lack of materials and machinery to some extent by selecting and providing substitutes in this rehabilitation project, but it is imagined to take considerable time to improve improper operation and lack of awareness.

(b) Increase of respiratory disease patients in Ulaanbaatar city

Table 4-2-2 shows the increasing trend of respiratory disease patients in the three most recent years in Ulaanbaatar city. They accounted for 19.1% of the total population in 1988 and increased to 42.8% in 1990. In fact, this is considered to be a serious issue of people's health while a lot of young people are moving to Ulaanbaatar city and about 50% of the total population of the city is said to be people of 30 years old or younger.

Table 4-2-2 Increasing Trend of Respiratory Disease Patients in the Three Most Recent Years in Ulaanbaatar City

Types of deseases		Years / Number of patients per 10,000 people	1988	1989	1990
Respiratory disease		Total Number of patients	1,991.0	2,722.5	4,275.4
Contents	Bronchitis		1,441.5	1,938.2	2,983.6
	Pneumonia		205.9	264.1	274.7
	Chronic tuberculosis		18.5	36.8	45.0
	Other respiratory diseases		245.1	483.4	972.1

(Note) Obtained in March, 1991 through Ministry of Energy, from Ulaanbaatar City Health Bureau

In Japan, a lot of accusatory investigations were made for some years after 1965 saying that there was a close relationship between air pollution and the frequency of asthmatic paroxysms, but the situation of epidemiological investigations on the influence of air pollution has recently changed while the actual conditions have been clearly researched on investigations. According to this stream of history, it is obvious that people in Ulaanbaatar city emotionally tend to simply relate the increase of the respiratory disease patients to the color of smoke emitted from the 4th thermal power station. People in the city generally want to make the color of smoke white as strongly as they want to improve the situation of frequent power outages. The Mongolian State Committee for Environmental Control in charge of pollution measures also shows much interest in the results of the rehabilitation project. Even if the color of smoke from the thermal power station is not directly related to the increase of patients, it is necessary to improve the living environment by decreasing dust in the air. It is very important for the Mongolian people to increase the availability factors of ESP at the 4th thermal power station regarded as the biggest dust emission source in addition to the supply of power and heating.

(c) Concentration of dust on the ground in Ulaanbaatar city

Table 4-2-3 shows monthly changes of average ground level dust concentration in the five most recent years. As shown in this table, there is in conclusion no big difference in the values in comparison between two seasons, that is, from June to August when the minimum loads are imposed on boilers at the 4th thermal power station and from December to February when the maximum loads are imposed on them.

The minimum values are 0.10 and 0.13 in the former and in the later respectively, and the maximum values are 0.33 and 0.28 in the former and in the later respectively. Since one hour average value of Japanese environmental quality standard is 0.20, the concentration of dust in Ulaanbaatar city is by no means high. However, the State Committee for Environmental Control is actually concerned about the accuracy of the observed values since the values themselves were obtained from outdated ex-Soviet automatic measuring instruments and the instruments have not been maintained and adjusted perfectly in consideration to the Mongolian situation.

Table 4-2-3 Monthly Changes of Average Ground Level Dust Concentration in Ulaanbaatar City for Five Years from 1987 to 1991

(Unit: mg/m^3)

Months	Minimum (Average)	Maximum (Average)
1	0.13	0.27
2	0.13	0.27
3	0.14	0.29
4	0.19	0.86
5	0.14	0.41
6	0.10	0.23
7	0.10	0.42
8	0.09	0.36
9	0.13	0.65
10	0.13	0.26
11	0.18	0.39
12	0.13	0.30

(Note) Obtained in October, 1990 through the Ministry of Energy from the Mongolian National State Committee for Environmental Control

It is important for Japan to persuade people in Ulaanbaatar city and the State Commitee for Environmental Control to grasp the real situation by measuring the concentration of dust in exhaust gas from boilers at the 4th thermal power station regarded as the biggest source of dust emission.

2) Status of shortage of electric energy

(a) Status of the 4th thermal power station

The number of forced outages which annually occurred at the 4th thermal power station in 1990 was 245 and the shortage of electric energy was 221,301 MWh as shown in Table 4-2-4. As for monthly changes, the shortage of electric energy was rather large from June to August when fewer loads were imposed on the thermal power station. However it is important to consider that boilers were intentionally shut down for fixing in summer when there is few affect even if transmission electric energy come short. This is done in order to get ready for the peak loads in winter.

Table 4-2-4 also shows monthly changes in the shortage of electric energy (82,982 MWh in total) from January to September in 1991. Since the shortage of electric energy in this period of 1990 was 162,841 MWh, the quantity in the first half of 1991 was half as much as that in the period. This is due to the relatively stable economy and society, which have violently changed, but it is skeptical that the total shortage of electric energy will become half as much as that in the entire year since it has been more difficult to get materials and machinery from the ex-Soviet Union in 1991 than in 1990.

This shortage of electric energy was supposed to be supplemented by the ex-Soviet Union, but in reality this problem was solved by electric outages and factory shutdowns.

Since the total transmission electric energy generated by the 4th thermal power station in 1990 was 2,018,921 MWh, the shortage of electric energy accounted to 10.96% and it was big and equivalent to 44 MW assuming that the annual power transmission hours was 5,000.

Table 4-2-4 The Monthly Shortage of Electric Energy from the Viewpoint of the 4th Thermal Power Station

Months	1990				1991
	Number of forced outages	Difference between power demand and actual generated output (Shortage of electric energy)			
		10^3kWh	MW	kWh/forced outage	10^3kWh
1	15	5,736	8.0	382.4	5,808
2	14	5,274	7.3	376.7	7,356
3	27	18,048	25.1	668.4	14,239
4	15	5,640	7.8	376.0	1,196
5	19	14,269	19.8	751.0	17,046
6	26	23,918	33.2	919.9	14,598
7	26	41,226	57.3	1,585.6	17,201
8	24	31,933	44.4	1,330.5	3,894
9	21	16,797	23.3	799.9	1,644
10	14	19,994	27.8	1,428.1	
11	20	13,035	18.1	653.8	
12	24	25,431	35.3	1,059.6	
Total	245	221,301	307.4		
Average	20.4	18,442	25.6	903.3	
	Acquired in March, 1991				Acquired in October, 1991

(Note) . This table indicates the difference between the electric energy (power demand) the 4th thermal power station was asked for by the central energy system and the electric energy the 4th thermal power station actually generated.
. Obtained from the Ministry of Fuel and Energy in October, 1991.

(b) Status of the cenral energy system

Although the 4th thermal power station causes shortage of electric energy, the shortage will tend to decrease to some extent if other power stations connected in the same power transmission lines back it up. Table 4-2-5 confirms this tendency. In short, the shortage of electric energy in 1990 was 228,400 MWh, almost same amount of the shortage caused by the 4th thermal power station and the central energy system was also considered to have suffered from the shortage equivalent to that caused by the 4th thermal power station. As a result of the above examination, the project is considered indispensable for the reduction of dust and the solution to the energy shortage.

Table 4-2-5 The Annual Shortage of Electric Energy in the Central Energy System

	Total power demand 10^3MWH	Total power transmission of electric energy 10^3MWH	Shortage of electric energy (imported from the ex-Soviet Union) 10^3MWH
1988	3,136.9	3,062.0	74.9
1989	3,248.4	3,090.2	158.2
1990	3,194.1	2,965.7	228.4
1991	(3,445)	(3,100)	(245)

(Note) Obtained from the Ministry of Fuel and Energy in October, 1991

4.2.2 Outline of the Power Station

The 4th thermal power station is the largest and latest coal fired one for electric power and heat supply among three thermal power stations located in Ulaanbaatar city, the capital of Mongolia.

It is the most important thermal power station to Mongolia since it delivers hot water for people's livelihood in Ulaanbaatar city and steam to factories in addition to power for consumers in six provinces. The coal used there is black lignite supplied from an open-cut mine at Baganuur, which has the largest deposit in Mongolia and located at about 130 km from Ulaanbaatar city.

As regards the positioning of the station, it provides about 70% of the total power output among the five thermal power stations in the six central provinces. Its breakdown is shown in Table 4-2-6. The organization and the number of personnel are shown in Table 4-2-14.

Seen from the basis of nominal capacity, the generating power accounts for 64.5%, as of October 1991, and 75.7% from 1992 onward. Examining the boiler capacity at three thermal power stations in Ulaanbaatar city, it accounts for 57.5%, as of October 1991, and 65.8% from 1992 onward. As seen from either viewpoint, the influence of fluctuation of its availability factor, even with its only 1% up or down, will be very significant.

The total nominal capacity of five units of turbine/generators is 460 MW, as of October 1990. The nominal capacity will increase to 540 MW with the installation of an additional unit at the end of 1991. The rated capacity is 590 MW and the total maximum capacity is 660 MW. The station has seven boiler units, each of which is sized the same and has the maximum continuous capacity of 420 t/h. An additional unit will start up at the end of 1991, so that the total steam generation of boilers will become 420 t/h x 8 = 3,360 t/h in terms of the maximum continuous capacity.

Since the rehabilitation project will start in effect from the latter half of 1992 and the availability factor of the additionally installed unit will sooner or later decline, judging from the poor current maintenance, the object of rehabilitation will amount to 8 units.

The start-up date of boilers and turbine/generators are shown in Table 4-2-7. Every one of them are new. Even the oldest, No. 1

boiler, has been only about eight years in service. Main specification of major equipment are shown in Table 4-2-8 and Table 4-2-9. Seen in the light of Japanese standards, the designs of both boilers and turbines are old-fashioned and their dimensions are rather large.

General layout of the 4th thermal power station, the layout of boiler, turbine and section of plant house are shown in Fig. 4-2-1, Fig. 4-2-2 and Fig. 4-2-3 respectively. All equipment and devices are installed in buildings as the site is located in an extremely cold region.

Table 4-2-6 Positioning of the 4th Thermal Power Station as Seen from Amount of Power Generation

(Unit: 10^3MWh)

	1988	1989	1990
The 2nd Thermal Power Station	63.5	64.3	57.8
The 3rd Thermal Power Station	516.3	473.2	444.7
The 4th Thermal Power Station	1,717.2	1,774.1	1,703.3
Dahan Thermal Power Station	191.6	185.9	151.3
Erdenet Thermal Power Station	58.5	73.5	70.4
Total	2,547.1	2,571.0	2,427.5
Positioning of the 4th Thermal Power Station (%)	67.4	69.0	70.2

(Note) Obtained from Ministry of Energy in March 1991

Table 4-2-7 Start-up Date of Boiler and Turbine/Generator of the 4th Thermal Power Station

	Unit No.	Capacity	Start-up Date
Boiler	#1	420 t/h	30 - 8 - 1983
	#2	420 t/h	16 - 1 - 1984
	#3	420 t/h	9 -12 - 1984
	#4	420 t/h	25 -12 - 1985
	#5	420 t/h	27 -12 - 1986
	#6	420 t/h	31 -10 - 1987
	#7	420 t/h	7 - 2 - 1990
	#8	420 t/h	23 -12 - 1991
Turbine generator	#1	80 MW	18 -10 - 1983
	#2	100 MW	26 -11 - 1984
	#3	100 MW	27 -12 - 1985
	#4	100 MW	27 -12 - 1986
	#5	80 MW	17 - 2 - 1990
	#6	80 MW	25 -12 - 1991

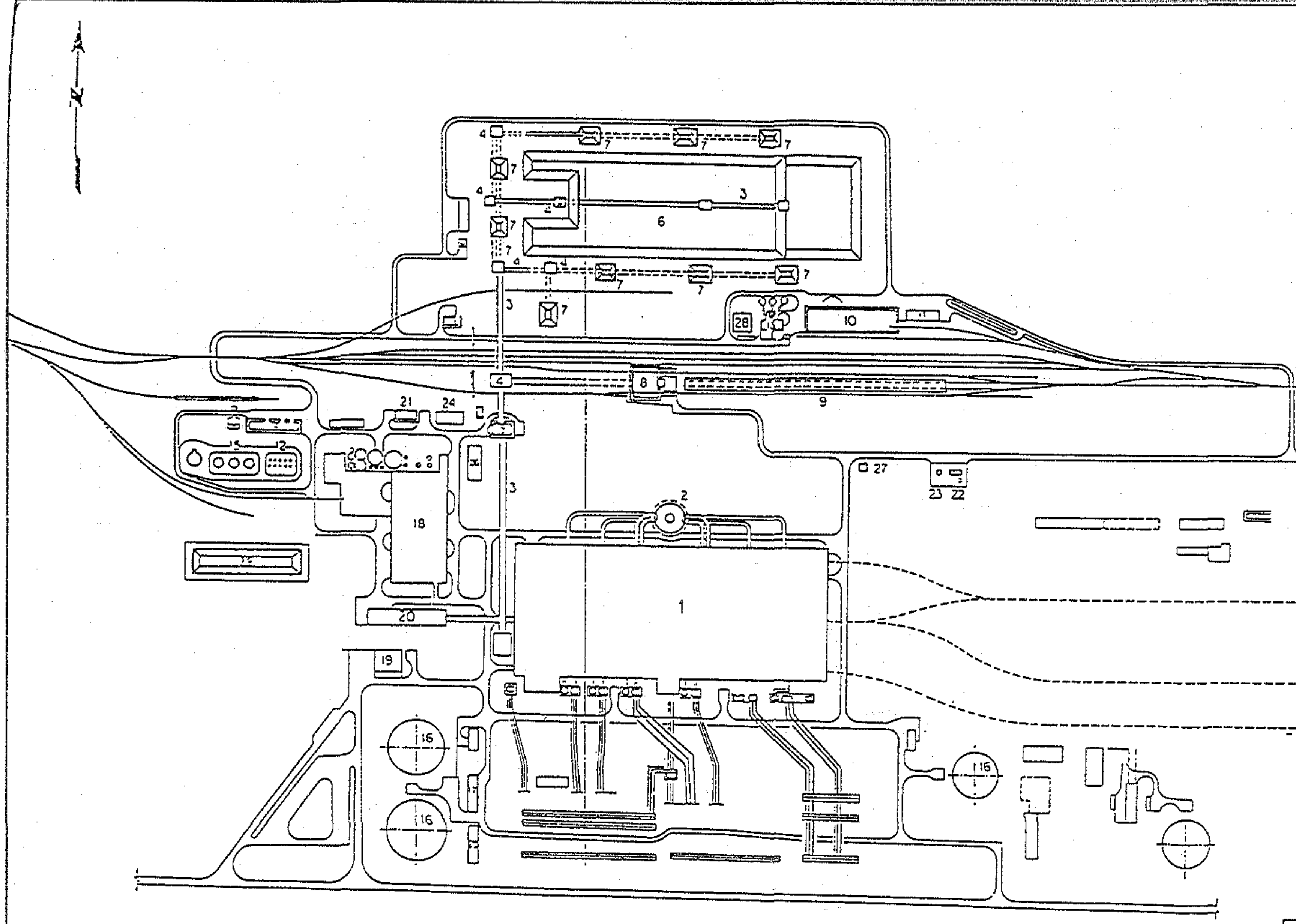
(Note) Obtained from the 4th Thermal Power Station in March 1991.

Table 4-2-8 Main Specification of Boiler at The 4th Thermal Power Station

Manufacturer		ex-Soviet Union
Type		Indoor, radiant, single drum, natural circulation type
Unit No.		#1 - #8
Boiler steam condition	Boiler capacity	420 t/h (Superheater outlet)
	Steam pressure	140 kgf/cm^2 (14 MPa) (Superheater outlet)
	Steam temperature	560°C (Superheater outlet)
Fuel used	Description	Mongolian coal (Baganuur)
	High calorific value	4,000 Kcal/kg (956 KJ/kg)
Type	Superheater	Pendant type
	Boiler furnace	Single furnace, water wall
	Air heater	Tubular type
	Coal burner (Numbers)	Corner firing (4 x 3 stages)
	ESP	Electrostatic type
	Ash treatment system	Well water mixed transport and circulation system
	Coal pulverizer (Numbers)	Horizontal Ball-tube mill (2 units)
	Pulverized coal firing system	Semi-direct storage bin (Blowing by primary fan)
Ventilation system		Balanced draft

Table 4-2-9 Main Specification of Turbine at the 4th Thermal Power Station

Manufacturer		ex-Soviet Union	ex-Soviet Union
Type of steam turbine		Non-reheat, condensing type	Same as the left
Unit No.		#1, #5, #6	#2 - #4
Inlet steam condition	Nominal output	80 MW	100 MW
	Rated output	80 MW	110 MW
	Maximum output	100 MW	120 MW
	Steam pressure	130 kgf/cm^2 (12.7 MPa) (before stop valve)	
	Steam temperature	555°C (before stop valve)	
Inflow of steam		Max. 470 t/h	Max. 485 t/h, rated 480 t/h
Turbine exhaust	Flow		Max. 325 t/h
	Pressure	Design 0.057 kgf/cm^3 (0.0056 MPa)	
Cooling water temperature		20°C	
Rotation speed		3,000 rpm	3,000 rpm



NO.	Facilities
29	Rain Water Settling Pond
28	Coal Handling Facility Control Room
27	Inspection Gate
26	Ash Pond Water Treatment Facility
25	Heating Water Distributing Room
24	Hydrogen , Oxygen, Nitrogen Reciever
23	Carbide Storehouse
22	Acetylene Storehouse
21	Oxygen Storehouse
20	Serrice Building
19	Engineers Building
18	Maintenance Building
17	Cooling Water Pump Room
16	Cooling Tower
15	Heavy Oil Storage Tank
14	Heavy Oil Pump
13	Waggon Inspection Facility
12	Lubrication Oil Warehouse
11	Bulldozer Garage
10	Repair Shop
9	Freezed Waggon Warming House
8	Waggon Tumbling Down
7	Underground Coal Hopper
6	Open Door Coal Storage Yard
5	Crusher Room
4	Conveyor Junction House
3	Conveyor
2	Stack
1	Boiler Turbine House

Mongolia
The 4th Thermal Power Station
General layout
Fig.

Fig. 4-2-1 General Layout of the 4th Thermal Power Station

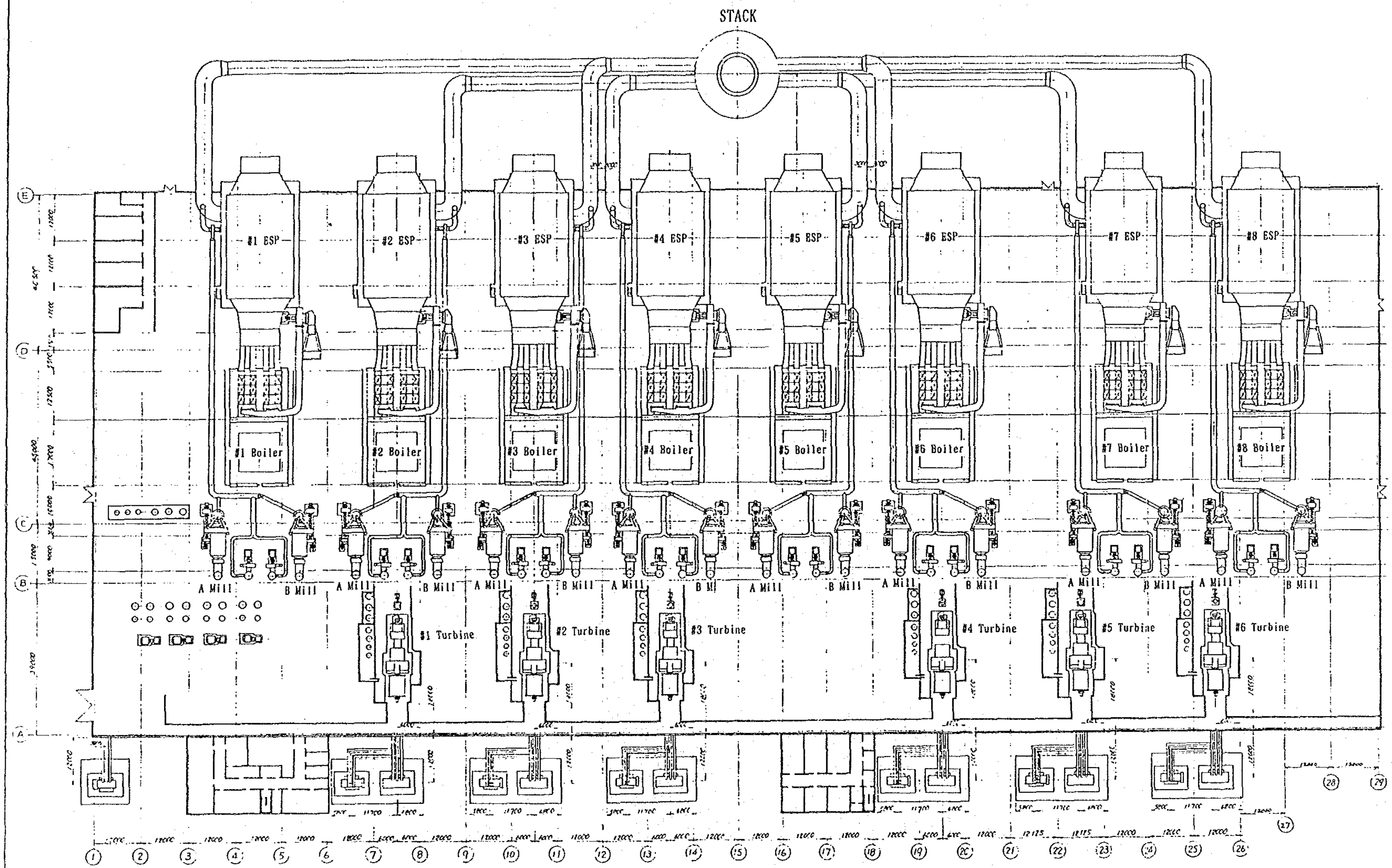


Fig. 4-2-2 Boiler, Turbine Layout

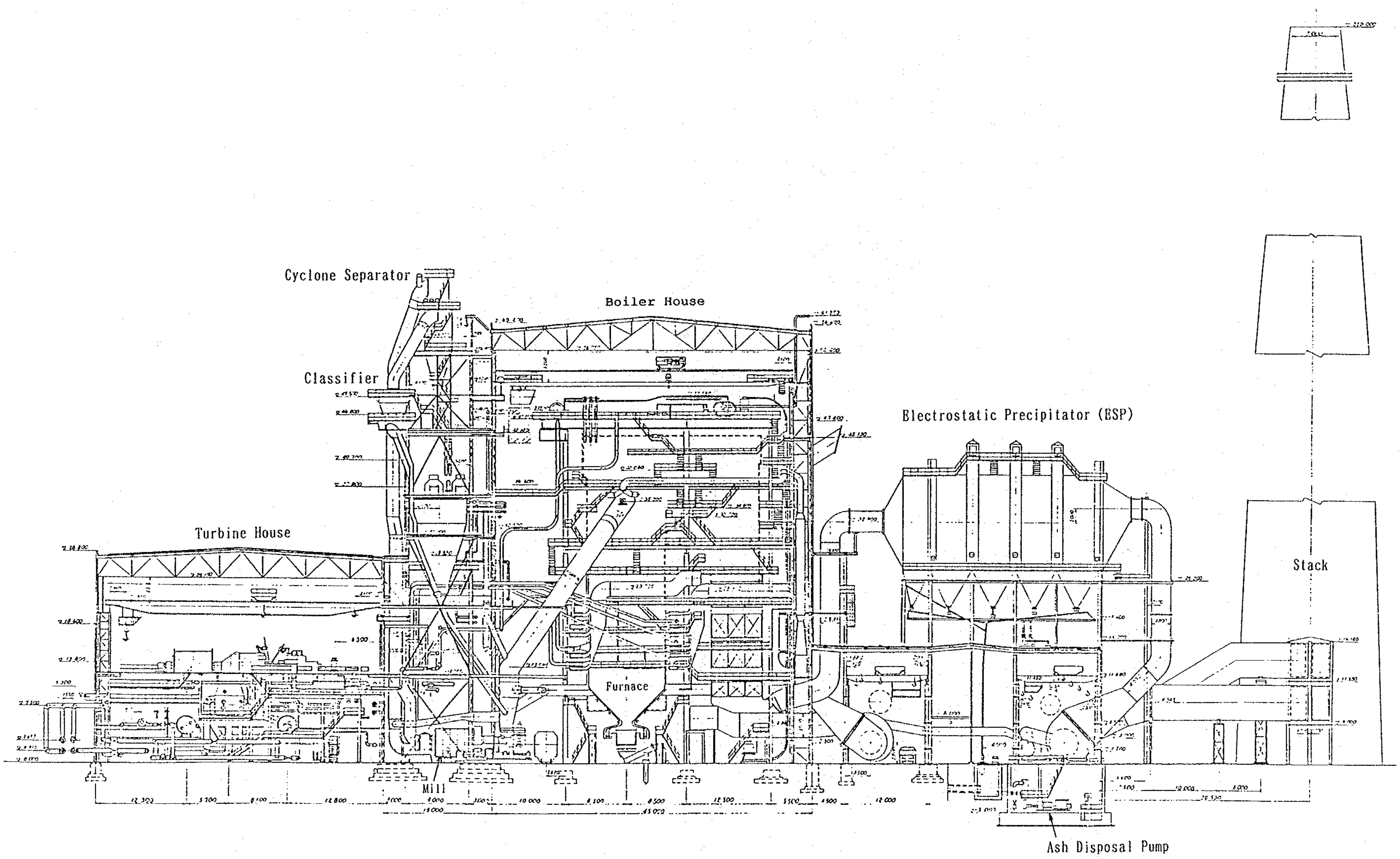


Fig. 4-2-3 Plant House Section

The present status of the 4th thermal power station will be summarized below.

(1) Power station in general

The inside of the plant house where the boiler and turbine are installed is dark and lots of pulverized coal and fly ash accumulates everywhere. In addition, since they are washed away with water at times, troubles are induced in the electric systems. The environment of operation as well as of maintenance is kept in poor conditions. In the light of current Japanese status, in spite of its comparatively new and powerful station, it appears an outworn station having been in service for 20 to 30 years, which poor environment is additionally giving birth to new problems. The necessity and urgency for rehabilitation are high.

(2) Boiler pressure part and large capacity pump

The operation of the boiler has been suspended at times due to furnace explosion and its associated various causes or their combination. Including this, the boiler trouble on boiler pressure parts accounted for 29%, which however, was not caused by any fundamental problems in boiler itself. Also less troubles occurred for large capacity pump. As the boiler and large capacity pumps themselves seem to be designed with ample allowances, and are all less than eight years old since the commencement of their operation, no urgent problem on them has occurred.

(3) Mill and pulverized coal feed system

Most trouble have occurred in this system, accounting for approximately 57% of boiler trouble.

These problems are mainly caused by wear. The major cause of the low availability factor of the boiler lies in the trouble with this system. The first step to be taken to reduce boiler trouble is to reduce trouble in the pulverized coal feed system. It can also be expected to see a reduction in trouble related to the boiler pressure part through improvement of the feed system and its associated maintenance.

(4) Steam turbine and generator

As these equipment, similar to the boiler, under the category of station major machinery were manufactured with ex-Soviet Union technology, no procurement will be possible in Japan, even for their partial rehabilitation. However, there appears no particular problem for them. With the availability factor as high as about 70%, the operation records (vibration, bearing oil temperature, etc.) show no sign of any problem at present.

(5) Coal handling system

The coal measuring equipment in the power station has been damaged and no reliable measurement is being taken on the amount of coal consumed, presenting a problem for station management. Furthermore, the receiving coal contains lots of foreign materials (stones, metal pieces), which would be responsible for problems such as broken belts, and in addition, for wear in the pulverized coal feed system. The measrue is therefore in need of prompt installation.

(6) Electrostatic Precipitator (ESP)

The electrostatic precipitator is often not operating or not in full charge, even when the boiler is operation. As to the causes of such status, there exists no particular problem in the ESP itself. What are most responsible for non-operation is the rapping system of the ESP, the troubles of which are electric motor burnt-down, too short reducer life of approx. one (1) month due to low quality of material and manufacturing and bend-down or cut-off of the rapping rod. The fly ash discharging portion also has problems of choke, wear and leak of fly ash in canvas for air slider and of malfunction of hopper ash level sensor and shortage of air supply for hopper.

The hopper is located in a separate building, which inside is also dark and the maintenance environment is also poor due to the leakage of fly ash. In the ash treatment system, problems of wear and scaling (pluggage of pipe) occurs at its ash slurry transport and water feed portion resulting in a low availability factor of the precipitator. For the same reasons, as the electrostatic precipitator cannot be electrically charged fully, that is, with approx. 40% of its capacity at times, even when the electrostatic precipitator itself is in operation, efficiency of dust collecting is quite low. Taking the above current status into consideration, to suppress the dut emission from the stack, it is necessary to always put the ESP in 100% charge whenever the boiler is in operation. The urgency is great.

(7) Measurement instruments

Measuring instruments are of too old type as used over 30 years ago, all of which are of electric type. In addition, it seems that no calibration test for them has been conducted because of lack of tools or materials. It can accordingly hardly be said that the instruments in the central control room as well as those on the field possess a kind of reliability, presenting a wicked problem for operation and management. Since their functions are directly related with functions of all the equipment, their malfunctions are including the troubles of each equipment. Therefore, it is necessary for Mongolian personnel to be able to do the calibration test of existing instruments at first to make the risk raised by the troubles as small as possible.

(8) Electrical equipment

There are still lots of problems such as cable fires, power leakages and shorts, which are all caused by the accumulation of pulverized coal, washing with water and incomplete daily inspection, and a remarkable improvement can be expected through betterment of the environment.

4.2.3 Study of Relationship, Duplication and so on with Similar Projects or Several Aid Projects of International Organizations, etc.

Described in the following are the major movements of various countries and international organizations in the field of energy: The one related to the 4th thermal power station, the object of the current project, is the provision of funds amounting to approximately 2.8 million dollars by the United States of America for procurement of materials and machinery in short supply, details of which are shown in Table 4-2-10. Since control and coordination are made by the Mongolian Ministry of Trade and Industry, there will be no problems of duplication or other similar problems.

(1) Austria

Representatives from Austrian ELIN Corporation visited the Mongolia, and carried out a survey on the problems concerning rehabilitation of power stations, construction of hydraulic and wind power stations, and installation of scrubbers in the country.

The two countries (Mongolia and Austria) have made up a project concept concerning basic technological and economical plans for rehabilitation of the Choybalsan coal fired thermal power station (36 MW) in Dornod province, for which the Austrian side is now preparing the final plan. The officials of the Mongolian government visited Austria to study about experience of the country in the field of energy, and concluded an agreement for joint works of the rehabilitation of the station.

(2) The United States of America

Treatment of Mongolia as a most-favored nation was started in January, 1991 when the president of the Mongolia visited the United States.

In association with the movement to assist the Mongolia, representatives of the US Trade/Development Plan Bureau visited the Mongolia, and discussed the problems in the field of energy with officials of the Mongolian government. Additionally, for development of projects in the field of energy and a basic study on technological and economical problems in the country, an agreement for granting $600,000 was concluded in May, 1991 between the two countries. This study was carried out for rehabilitation of the Central Power Dispatching Center and the heat supply network in Ulaanbaator city as well as for technological and economic Basic Study required for rehabilitation of the power station (48 MW) in Darkhan city and the 3rd power station (148 MW) in Ulaanbaatar city. The feasibility study for the 3rd power station will be conducted in the spring of 1992. After the study for technological and economical conditions is carried out, rehabilitation work will be started. The Mongolian government has requested several international organizations such as the World Bank and ADB to provide them with funds for the project.

Representatives of the Mongolian government visited the United States, explained the current situation of energy development in the Mongolia to officials of the US government, and also studied the current situation of power stations and industries in the United States.

Additionally, the US Government has decided to grant 10 million dollars for the Mongolian government to purchase materials and machinery from the ex-Soviet Union, about 2.8 million dollars of which is to be used to purchase those for each power station under control by the Ministry of Fuel and Energy. The mill spare parts, turbine spare parts, pump sapre parts, etc. are scheduled to be procured for the 4th thermal power station. (Refer to Table 4-2-10)

Table 4-2-10 List of Materials and Machinery under the Ministry of Fuel and Energy, which are to be Procured from ex-Soviet Union with Financial Assistance from the USA (Data obtained from the Ministry of Fuel and Energy in November, 1991)

Name of equipment and materials		Required amount		Assistance from the USA		Date of agreement
		Quantity	Sum of money 10^3 US$	Quantity	Sum of money 10^3 US$	
1. Each size of steel pipe Outer diameter 32 - 133		1,768 ton	1,279.8	1,182 ton	892.1 (892.1)	1991.2.28 1991.5.12 (1991.9.20 - 28)
2. Valves for piping		614 pcs.	214.3	314 pcs.	113.3 (113.3)	1991.3.19 (1991.9.19)
3. Spare parts for machinery		-	788.0		365.0	1991.3.19
4. Spare parts for mill	No. 3	16 types	165.4		147.7	1991.1.17
	No. 4	10 types	92.5			
	Erdenet	18 types	76.2			
	Darkhan	11 types	27.3			
	Dornod	3 types	48.5			
	No. 2	3 types	1.3			
	Total	61 types	411.2		147.7	

Name of equipment and materials	Required amount		Assistance from the USA		Date of agreement
	Quantity	Sum of money 10^3 US$	Quantity	Sum of money 10^3 US$	
5. Transformers for instrument	107 piece	13.7	10.7 piece	13.7	1991.6.04
6. Spare parts for turbines in the 4th Thermal Power Station	2 types	3.3	2 types	3.3	1991.6.01
7. Coal conveyor belt Width: 500 to 1,400 mm [For use in the 4th Thermal Power Station]	4,877 m [1,176 m]	204.8 [49.4]	2,657 m [600 m]	111.6 [25.2]	1991.6.05
Conveyor parts		30.1		11.8	
Total				123.4 (123.4)	(1991.10.09)
8. Reinforcement for piping	2 types	5.2	2 types	5.2 (5.2)	1991.7.31 (1991.9.19)
9. Parts for turbines in the 3rd Thermal Power Station	9 types	24.7	9 types	12.5 (12.5)	1991.7.31 (1991.9.19)
10. Spare parts for pumps in the 4th Thermal Power Station	19 types	71.1	-	35.0 (35.0)	1991.8.19 (1991.9.19)

Name of equipment and materials	Required amount		Assistance from the USA		Date of agreement
	Quantity	Sum of money 10^3 US$	Quantity	Sum of money 10^3 US$	
11. Welding rod	10 types	24.2	-	24.3 (24.3)	1991.3.11 (1991.10.19)
12. Motor	7 units	217.1	7 units	217.1 (217.1)	1991.4.17 (1991.10.07)
13. Spare parts such as insulators for high voltage power	-	202.0	-	92.6	1991.1.04
14. Transformers in substations	243 units	1,337.4	60 units	207.0	1991.11.22
15. Parts for diesel power generator	8 types	52.2	8 types	26.0 (26.0)	1991.7.16 (1991.10.04)
16. High voltage power motor	43 units	132.3	43 units	132.3	-
17. Spare parts for pumps (including water pumps, drain pumps, and ash slurry pumps) [For ash slurry pumps]	- [For 26 units]	961.0 [156.8]	- [For 13 units]	334.0 [74.8]	1991.3.14
18. Spare parts for pumps	20 types	4.9	20 types	4.9	1991.3.06

Name of equipment and materials	Required amount		Assistance from the USA		Date of agreement
	Quantity	Sum of money 10^3 US$	Quantity	Sum of money 10^3 US$	
19. Mill ball (Diameter: 40 mm)	540 ton	284.0	540 ton	284.0 (284.0)	1991.5.08 (1991.10.11)
20. Fire-proof cement	260 ton	39.0	260 ton	39.0	-
21. Various types of bearing		350.9	-	192.2	-
22. Spare parts for diesel power generators	41 types	244.3	29 types	124.0 (124.0)	- (1991.9.19)
23. Spare parts for compact boilers in rural areas	29 types	157.8	29 types	157.8	1990.12.18
Total				3,546.4	
(Remittance)				1,856.9	

* The sum of money in parenthese in the "Assistance from the USA" column has been sent to ex-Soviet Union, while the data in parenthese in the "Data of agreement" column indicates the date when the money was sent to the ex-Soviet Union.

(3) South Korea

Foreign Affairs Ministers of South Korea and the Mongolia concluded in March, 1991 agreements for cooperation in the fields of science and technology, international trade, investment, and cultural exchange.

Specialists of South Korea visited the the Mongolia to discuss plans to construct a small hydro-electric power station, which was proposed by the Mongolian government. They made up a draft plan for the project to construct a small hydro-electric power station in Dalandzadgad city in Omnogovi province. The Mongolian side regards this project as an important one, and now negotiations for cost are underway between the two countries.

(4) Unified Germany

Officials of the German government are now carrying out a study on the plan proposed by the Mongolian side to construct a small hydro-electric power station in Baruun city in Sufbaatar province. Representatives from the Mongolian government visited Germany, introduced the current situation of energy development in the Mongolia to officials of the German government, and discussed the possibility of cooperation between the two countries.

(5) People's Republic of China

The People's Republic of China is asserting superiority of socialist regime on the one hand, and at the same time they are now trying to introduce a market economy. So the situation in this country is very complicated to Mongolia trying to introduce a marketing economy.

In August, 1991, National Chairman of the country visited the Mongolia, and concluded an agreement for expansion of economical relations between the two countries. As there is their basic position regarding their relations with the ex-Soviet Union and China as the most important ones the Mongolian government has recently changed its diplomatic policy from the out-and-out pro-ex-Soviet to the so-called neutral diplomacy. This change of attitude has been welcomed by Chinese government. Also the Chinese government has permitted the Mongolian government to use the Tientsin port for expansion of their exports, which is very significant.

In the field of energy, the Mongolia side proposed to construct a small hydro-electric power station, but it still has several problems especially concerning the funds required for the project.

(6) The ex-Soviet Union

Not only the equipment now being used in the 4th thermal power station, but almost all of the equipment used in power stations throughout in the Mongolia are made in the ex-Soviet Union. So the Mongolian government orders most main-tenance parts from the ex-Soviet Union every year.

The problem concerning debt from the ex-Soviet Union has not been settled, but government leaders of the two countries reached in February 1991 a common recognition that the problem should be solved according to the principle of mutual reliance, and now settlement of costs for purchase of parts and electricity are made according to the so-called barter system.

However, because of the recent economical disorder in the ex-Soviet Union, even if the Mongolian side order them formally, they are not delivered within a promised period, and the situation is fairly unstable.

(7) International organizations

In order to assist the Mongolia in overcoming their economical difficulties and smoothly sifting to the market economy system with funds and technologies required for this purpose, international organizations such as the United Nations

Development Plan (UNDP), International Money Fund (IMF), and Asian Development Bank (ADB) have recently dispatched study teams. They have studied the possibility of medium-term and long-term assistance projects including those for urgent assistance.

Participation of the Mongolia in IMF was formally recognized in February, 1991.

4.2.4 Study on the Power Station Equipment

(1) Station equipment

As a result of examinations made in Sections, 4.2.2 and 4.2.3, it was judged appropriate to select the following facilities, whose rehabilitation is urgently needed, but no assistance is scheduled from other countries, as the objects of the present project:

1) Electrostatic precipitator and ash treatment system
2) Pulverized coal feed system
3) Coal supplying equipment
4) Measuring instrument
5) Auxiliary countermeasures for maintenance of the station

As station major equipment or machinery such as boiler, turbine, generator, mill, large capacity pumps and so on as well as instruments and control systems, are all manufactured with ex-Soviet Union technology, no procurement will be possible in Japan.

Especially for ash slurry pumps, directly related with the boiler operation in the Project, it was emphasized on February, 1992 that the procurement of the parts must be done by the Mongolian on top priority, if required in the current status.

Described in the following are the major problems in respect to the object of the station equipment and their proposed solutions.

1) Electrostatic Precipitator (ESP) and ash treatment system

Coal ash can be classified as slug ash to be mostly discharged from the hopper of furnace and fly ash to be mostly collected in ESP. If any trouble occurs in the slug ash discharge system, it can be big trouble to stop the boiler operation, though it has fortunately not yet taken place.

ESP plays a leading role in the fly ash collection and discharge system, and its full operation and charge can function only at the time when the following systems are all satisfactorily in operation, playing their respective roles.

. ESP itself
. Fly ash discharge system of ESP
. Ash slurry pit
. Ash slurry transfer system
. Feed water system for ash treatment

In other words, if any one of the above systems are in trouble and out of operation, ESP cannot be in charge despite of its complete readiness to be in charge.

Table 4-2-11 which was prepared by a Mongolian staff person in charge of ESP operation shows the causes, according to priority, which make ESP go out of service (operation and/or charge) during boiler operation. Since these data do not directly relate to the availability factor of the boiler, complete numerical records are not in hand at the thermal power station.

In "Failure of motor reduction gear", merely "Motor reduction gear dismounting" is included. For example, it was explained during this study that, in order to test the No. 8 ESP which was then under construction, the existing motor reduction gears of the No. 7 ESP was dismounted for use in No. 8 boiler. This is probably because delivery from the ex-Soviets was delayed.

Table 4-2-11 Causes that make ESP out of Service During Boiler Operation

Priority	Cause	Remarks
3	Too much ash is in ash hopper located under ESP	Ash pluggage in ash hopper.
1	Failure of motor reduction gear	It is found that service life of the reduction gear is too short despite prior judgment that it can be used since it is produced in Erdenet machinery factory.
2	Failure in operation of air slider located under ESP	Too much ash accumulation on air slider due to air pressure drop and ash pluggage in porous plate makes it out of order.
4	Failure of ash slurry pump	Reinforcement of eroded parts by welding is already underway. Packings are not enough. A pump for normal service and 2 pumps for backup, for #1 to #6 boilers
5	Pluggage due to scaling in ash slurry piping	Tanks to cleaning, it is not clogged now. (Periodic cleaning for removal of scaling is necessary.)
9	Insufficient water feed to ash treatment system	Pluggage due to scaling in feed water pipe
6	Failure of feed water pump of settling pond	Damage of pump impellers or pluggage due to inner scaling in inlet pipe
7	Power failure for ash treatment system (transformer, etc.)	Because of lack of spare parts
8	To make ESP out of service while heavy oil is fired for boilers	Manuals prepared by the ex-Soviet side should be changed.

(Note) Obtained from the 4th Thermal Power Station in October, 1991