2) Pulverized coal feed system

Fig. 4-2-4, No. 1 shows the percentage of all troubles which occurred during the period from the start-up date of all boilers (seven in all) until the end of December, 1990, which become as follows:

Pulverized coal feed system	57.3%
Boiler pressure parts (include furnace explosion) ..	28.7%
Ash treatment system	4.3%
Improper combustion	3.7%
Others	6.0%

It is known from the table that the suspension of the boiler operation was mostly caused by trouble in the pulverized coal feed system. Because boiler is composed of complex systems, the various problems shown in the above table interrelates with each other. For example, if a hole is made due to wear in a certain part of the pulverized coal feed system, ingress of air (oxygen) induces trouble such as occurrence of a fire or a small explosion, which in turn leads to an explosion or improper combustion in the furnace.

As to the boiler pressure parts, it is difficult to supply necessary materials from Japan because of the different design conducted under ex-Soviet standards and criteria. It has been decided after due discussion that those matters are to be undertaken by the Mongolian side rather than by the ex-Soviet Union.

In order to reduce boiler trouble, it is most important to reduce the trouble in the pulverized coal feed system. If improvement of maintenance related with it and timely supply of the necessary materials are executed, it can also lead to reduction of trouble in the boiler pressure parts. In addition, though the reduction of trouble in the ash treatment system may not contribute so much to prevent the suspension of the boiler operation, the supply of the necessary materials and machinery of the system will contribute to raise the availability factor of the boiler as well as the improvement of the environment and atmosphere.

Fig. 4-2-4, No. 2 shows the percentage of all troubles which occurred during the period from the start-up date of all boilers (seven in all) until the end of December, 1990, which become as follows:

Mill (mostly explosion and lubrication system trouble)	62.5%
Primary fan	13.8%
Explosion	16.3%
Wear	4.2%
Others	3.2%

It is known that most of the trouble shown in the table occurred in Mill. And the mill troubles accounted for about 50% of all the trouble in the No. 1 boiler were also concentrated in the No. 2 and No. 3 boilers next. The mill explosion is apparently caused by the admission of air for some kind of reasons unknown. Since such a mill explosion was not experienced often in other boilers, the construction of the mill itself will not be directly responsible for it. It is expected that the mill explosion will be relieved to a greater extent with the supply of maintenance parts from the ex-Soviet Union and through the improvement of the maintenance environment. As a direct measure against it, the Japan side can only contribute a little to the hopefull solution of troubles in the lubrication system by supplying a part of the mill lubrication pumps in question.

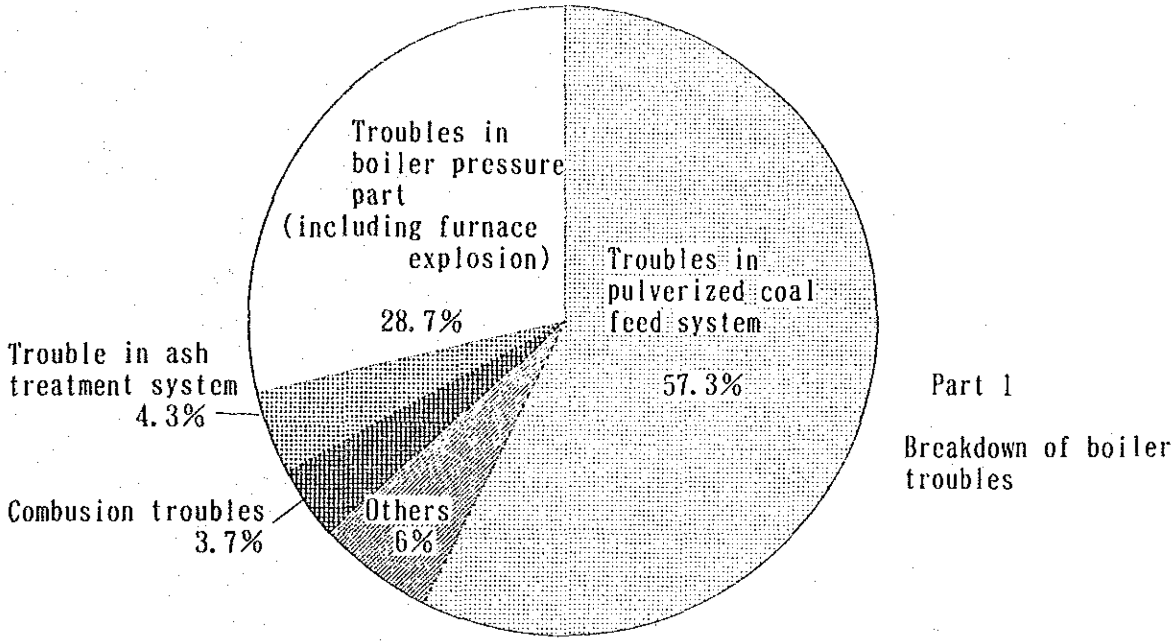
In addition, it is desired that the improvement of the maintenance of mill itself and re-adjustment and repairs of instruments, both of which must be undertaken by the

Mongolian side, in order to prevent the pulverized coal against leakage from inside the mill and against badly scattering, can also contribute to the elimination of the mill troubles.

The trouble in Primary fan was caused mostly owing to wear in the blades. This trouble can be eliminated by executing measures against wear to the blades. Further, it is most probable that Explosion is induced from the prior small explosions in the system which are caused by ingress of air through an opening due to wear. Accordingly, if the measures against wear are implemented, a substantial part of the explosion trouble may be eliminated.

3) Coal supplying equipment

Receiving coal includes foreign materials such as stones and metal chips, which cause the break-off of belts and mill abrasion, so that the removal of such materials is necessary.



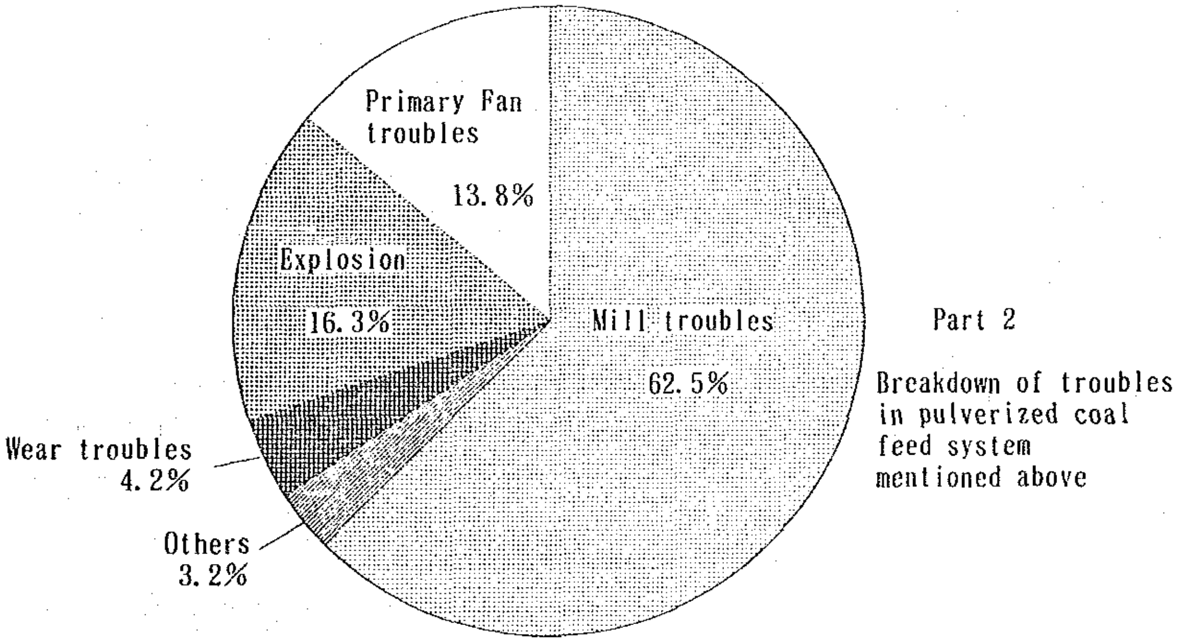


Fig. 4-2-4 The Percentage of Boiler Troubles of the 4th Thermal Power Station (from start-up date of all boiler to the end of December, 1990)

4) Measurement instruments

It can hardly be said that the measuring instruments which constantly monitor operating conditions of the station equipment are thoroughly calibrated, though they affect all the facilities. Since defective instruments directly lead to the equipment's troubles, it will be necessary to supply a part of devices for the calibration of such instruments as an only possible aid of Japan side, in order to lessen as far as possible the risk raised by the troubles.

5) Supplementary measure for plant maintenance

The present environment of operation and maintenance of the entire power station is extremely poor, and such an inferior environment is leading to the occurrence of new trouble. Supplementary measures to counter them are considered an effective means in the sense that they will reduce troubles caused by human error.

4.2.5 Examination of Executing Agency and Structure

(1) Current executing organization and structure

1) Ministry of Trade and Industry (Project planning organization)

As shown in Table 4-2-12.

The International Trade Department takes charge of planning of this project, and the related officials are as shown below.

. Assistant director: Mr. Yondon
. Secretary: Mr. Tagbasuren (in charge of energy)
. Secretary: Miss Nasanboyan (in charge of the Japan)

2) Ministry of Fuel and Energy (Project executing organization)

As shown in Table 4-2-13.

The energy policy committee headed by Director Jigjidorji takes charge of the execution of this project. The staff are as shown below.

. Director: Mr. Jigjiddorji (Chief engineer)
. Engineer: Mr. Avarzed

3) The 4th thermal power station (Project fulfilment organization)

As shown in Table 4-2-14.

This project is chiefly taken charge of by Chief Engineer, Mr. Battsend who is a key person responsible for operation and maintenance of this station; and Assistant Chief Engineer Mr. Bor, responsible for maintenance; and Engineer Mr. Sodonomu, responsible for production technology (operation) assisting the chief engineer.

Operation systems of the boiler department and electric department for operation and maintenance, both have the closest relations with this project, are shown in Table 4-2-15 and Table 4-2-16 respectively.

Table 4-2-12 Structure of Mongolian Ministry of Trade and Industry

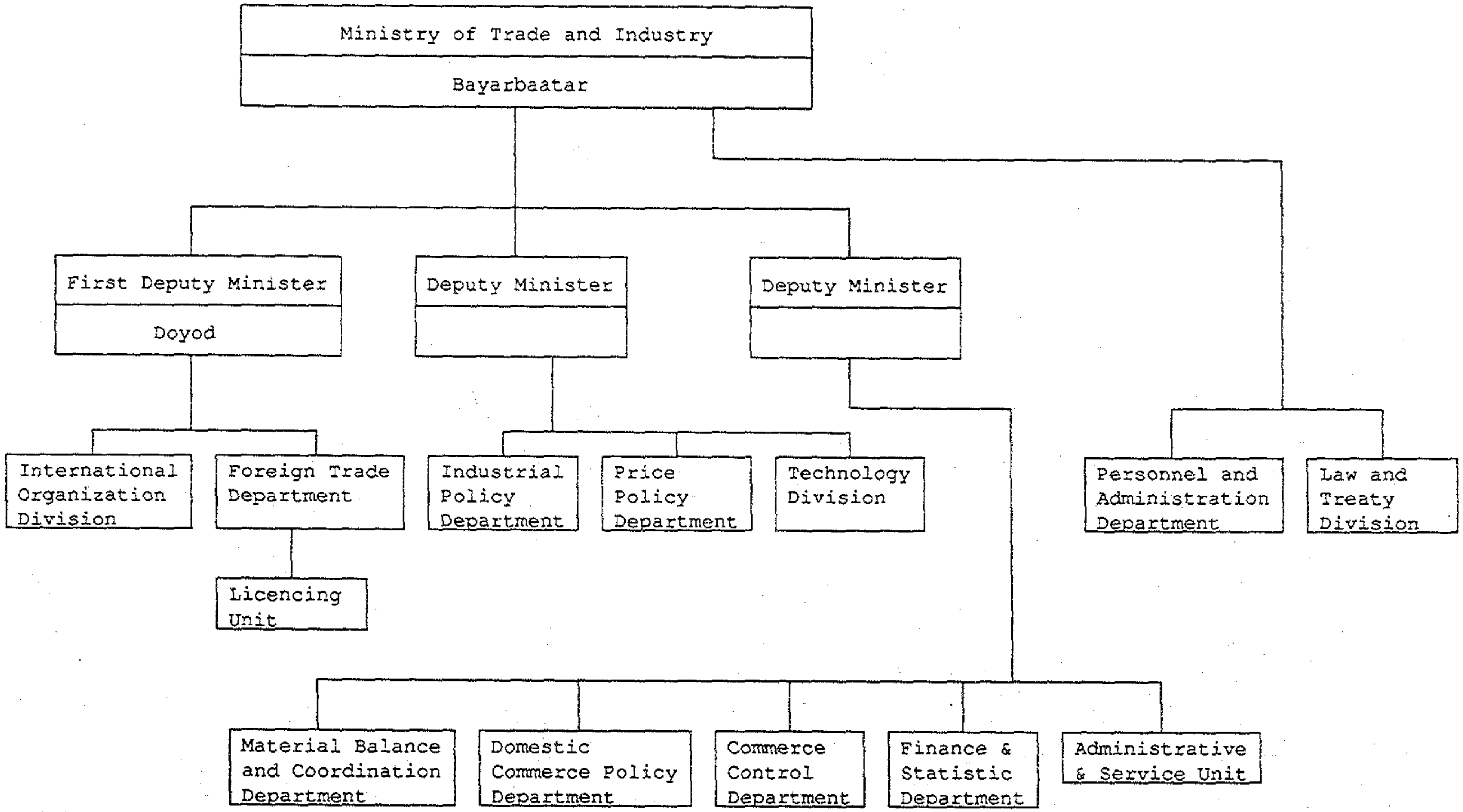


Table 4-2-13 Structure of the Ministry of Fuel and Energy

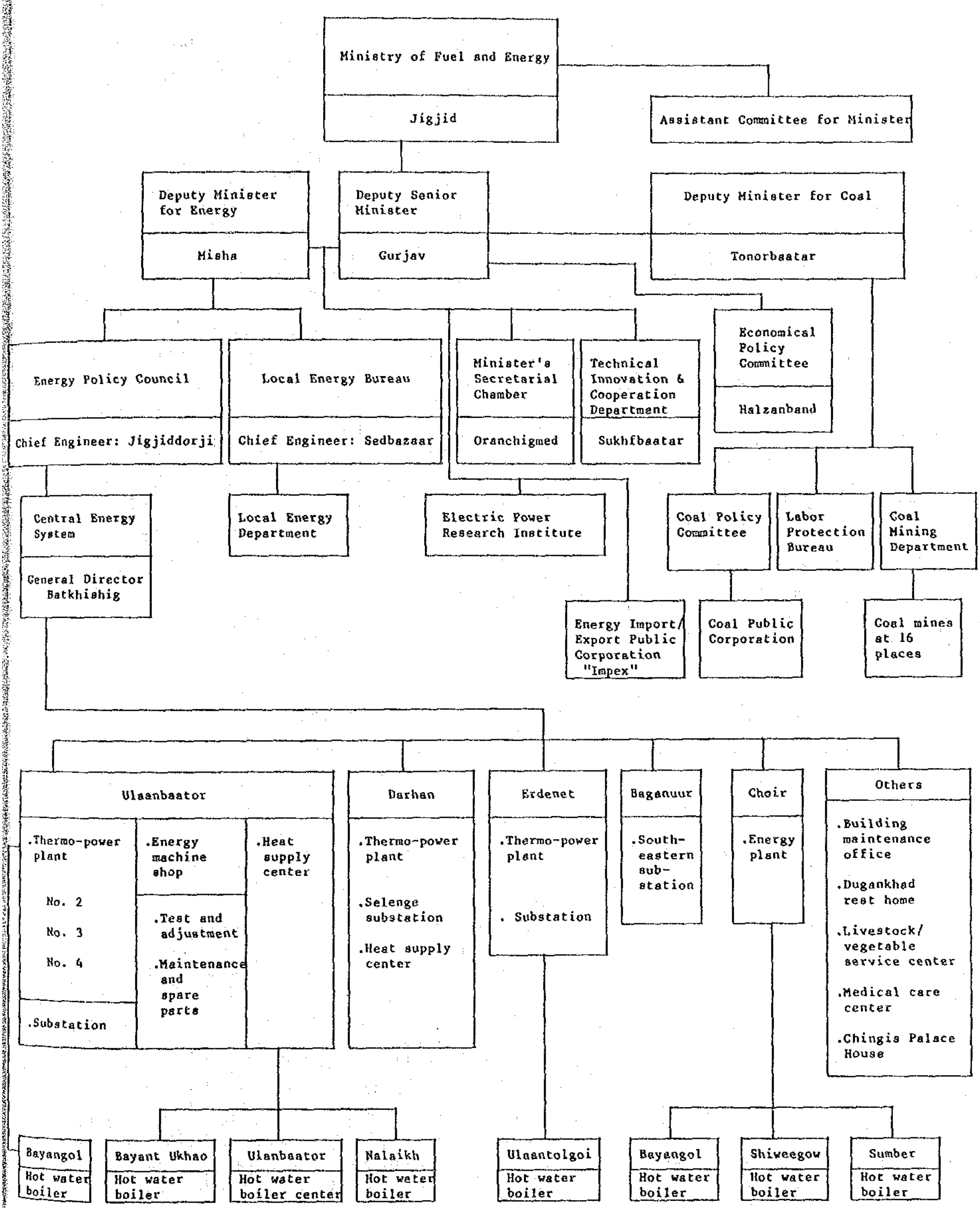


Table 4-2-14 Structure of the 4th Thermal Power Station

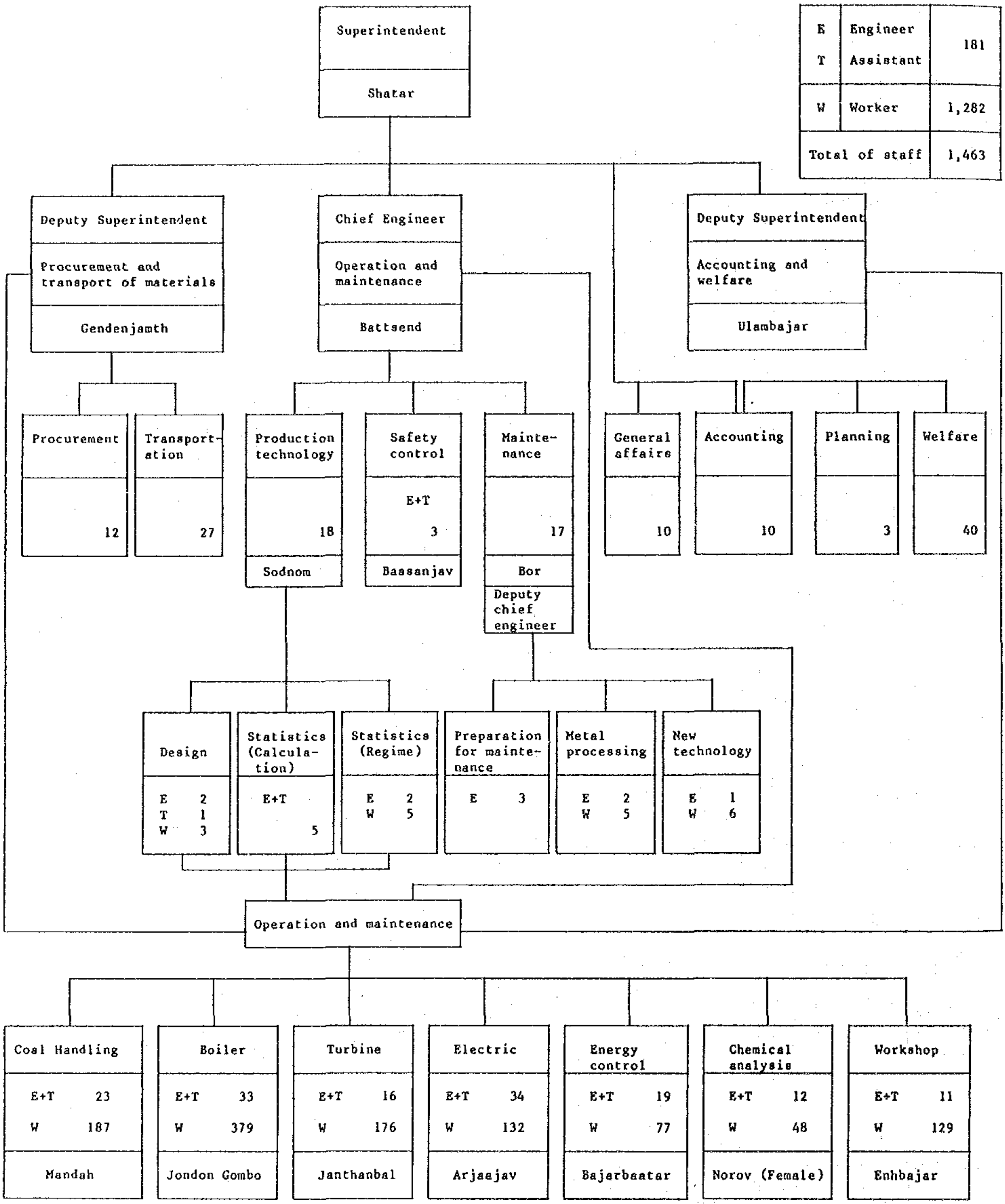


Table 4-2-15 Structure of Boiler Department in the 4th Thermal Power Station

Engineer Technician	33
Worker	379
Total	412

Boiler department
Department manager
Jondon Gombo

- Engineer 1
- Planning staff 1

Deputy manager: Tseelensurren

Technical group
- Preparation for maintenance Engineer 1
- Operation Engineer 1
- Maintenance Engineer 1
- Rotary machine balance Engineer 1

Operation group
- Engineer 1
- Shift chief (Engineer) 5
- Operator 117
- Clearing group
  - Master 1
  - Cleaning worker 9

Welding group
- Welder 32

Warehouse
- House keeper 1

ESP
Section manager: Davaajantsan
- Other engineers 2
- Maintenance 31

Ash treatment system (Including the ash disposal pond)
Section manager: Legseg
- Other engineers 2
- Maintenance 33

Mill
- Engineer 1
- Maintenance 22

Primary fan
- Engineer 1
- Maintenance 13

Pulverized coal feed system
Section manager: Samdansharab
- Other engineers 3
- Maintenance 34

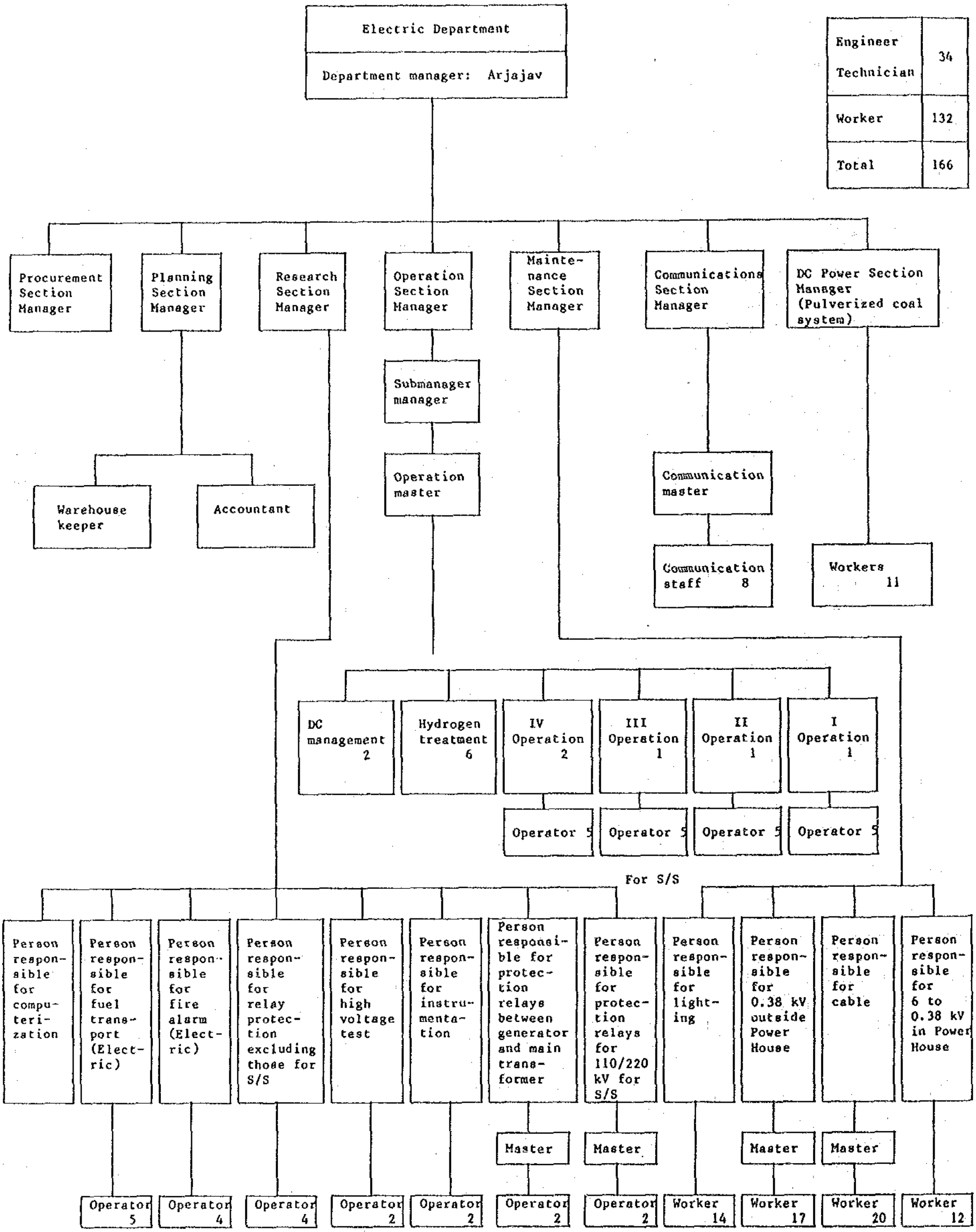
Pump and fan
- Engineer 1
- Maintenance 17

Boiler pressure part
- Engineers 2
- Maintenance 30

Piping for steam and water supply
- Engineer 1
- Maintenance 19

Thermal insulation
- Engineer 1
- Maintenance 21

Table 4-2-16 Structure of Electric Department of the 4th Thermal Power Station



(2) Examination of executing organization and technical level

1) Examination of executing general technical level

The result of an investigation and the same of examination based thereupon are shown in Table 4-2-17. As shown in the table, the general technical level for the rehabilitation project will be acceptable, as the site work will be an addition to or extension of the regular maintenance work having been performed thus far and can be properly dealt with in the present maintenance system of the 4th thermal power station. The current ones would be acceptable for the required number of personnel as well as the general technical level.

2) Examination on specific materials and machinery, and on work-schedule control

As part of the materials and machinery are specific, technical transfer by experts of the manufacturers, besides instruction manuals, will enable a more assured completion of the project. Then, it was decided that for the specific materials and machinery, technical transer will be made by dispatching experts of the manufacturers from Japan.

In the rehabilitation project, furthermore, the supply extends in various kinds and the work therefor will be congested, so that the assistant supervisory service of the Consultant will be sought for the control of work-schedules to assure timely completion of the work.

Table 4-2-17 Examination of Executing General Technical Level

No.	Item	Current organization for maintenance	Organization for rehabilitation work	Contents of rehabilitation work	Achievement of similar work	Necessity of technical guidance
1	Replacement of valves for ash slurry pipe	Maintenance group of ash treatment system 36	4 people x 2 days/unit x 19 units	.Removal of damaged valves .Cutting and mounting piping and flanges .Mounting of new valves	.Replacing now the similar type of valves (in their daily maintenance work)	None
2	Installation of water supply piping for ash treatment system	Group responsible for general 140	30 people x 1.5 months	.Cutting and processing of new piping .Attachment of supports, installation of piping .Welding for piping, mounting valves	Already installed water supply piping for ash slurry piping and so on	None
3	Ash level sensor	Maintenance group of ESP 34	1 person/unit x 120 units	.Cutting and processing of rubber pads .Removal of pads of level sensor .Mounting pads of level sensor .Installation of packaged compressor	Doing now similar work (in their daily maintenance work)	None
4	Vacuum car for removing ash (including piping)	Group responsible for general 140	20 people x 3 months	.Piping work .Cleaning work .Car is specific	.Vacuum car: None .Piping work: They have ever done similar works.	Necessary for operation and maintenance work guidance
5	Dust measurement instrument	Maintenance group of ESP	Only installation of measurement holes (footing) 2 people/ESP x 8 ESPs	Main work is for measurement. Instrument is specific.	There are four people who have done the ESP performance test with the Soviet engineer when ESP was constructed.	Necessary for measurement work guidance
6	Ceramics tile	Maintenance group of pulverized coal feed system: 37 Welding group 20	35 people x 1 month/boiler x 8 boilers	.Cutting or removal of the fuel pipe .Grinding finished of inner surface .Adhering ceramics tile .Restoration of fuel pipe .Adhesion of ceramics tile is specific	.Japanese experts for the urgent countermeasure visited the site and provided with technical guidance for adhering ceramics tile. .The same type of ceramics tile has been installed by the staff of the Mongolian side, and now tests are underway.	None

Table 4-2-17 Examination of Executing General Technical Level (continued)

No.	Item	Current organization for maintenance	Organization for rehabilitation work	Contents of rehabilitation work	Achievement of similar work	Necessity of technical guidance
7	Reinforcement by welding for the primary fan Wear-resistant steel plate	Maintenance of primary fan: 14 Welding group: 10	Production 4 people x 4 days/ unit x 16 units Attachment 6 people x 1.5 days/ unit x 16 units	.Production of fan blades .Disassemble of fan, replacement of fan blades, test running	.The technical guidance was already provided by the urgent countermeasure in Nov. 1991. .Similar work was done about 20 times a year in the past. .Technical guidance concerning work for the rotor was already provided by the urgent countermeasure. (If a rotor which has lining of ceramics tile is supplied, technical guidance would be necessary.)	None
8	Magnetic separator	Group of coal handling: 187	Installation, test running 6 people x 3 days	.Modification and installation of the support .Test running	They have replaced the No. 2 magnet separator and installed the No. 3 magnet separator.	None
9	Lighting equipment	Maintenance group of lighting 15	Mounting of lighting equipment 4 people x 1.5 months	.Mounting of lighting equipment .Wiring (from adjacent power supplies)	This kind of work was done when the plant was constructed and are being done in their daily maintenance.	None

4.2.6 Outline of Project Station Equipment

(1) Electrostatic precipitator (ESP)

An ESP is installed in each boiler with a capacity of 420 t/h, and there are 8 including the eighth one under construction (in trial operation).

The number of ESP in operation is seven in 1990 and the first one started operation in 1983. All 8 ESP, including the eighth one now in trial operation, share the same specifications, the main of which are as follows:

1) Gas volume: 677,520 m^3N/h
2) Gas temperature: 131°C
3) Number of sections: 4
4) Divisions in service: 8 (2 divisions/section)
5) Numer of hoppers: 15 (including 3 sedimentation hoppers)
6) Hopper capacity: About 60 m^3/section
7) Length of collector: 12 m
8) Width of collector: 640 mm/row x 5 rows
9) Frame for electric discharge poles: 11,930 mmH x 3,840 mmW
10) Electrode pitch: 300 mm
11) Number of gas passages: 58
12) Location: See Fig. 4-2-5-(1)
13) Dimensions: See Fig.4-2-5-(2)
14) Number of rapping reducers for collecting electrodes: 4
    for discharge electrodes: 16

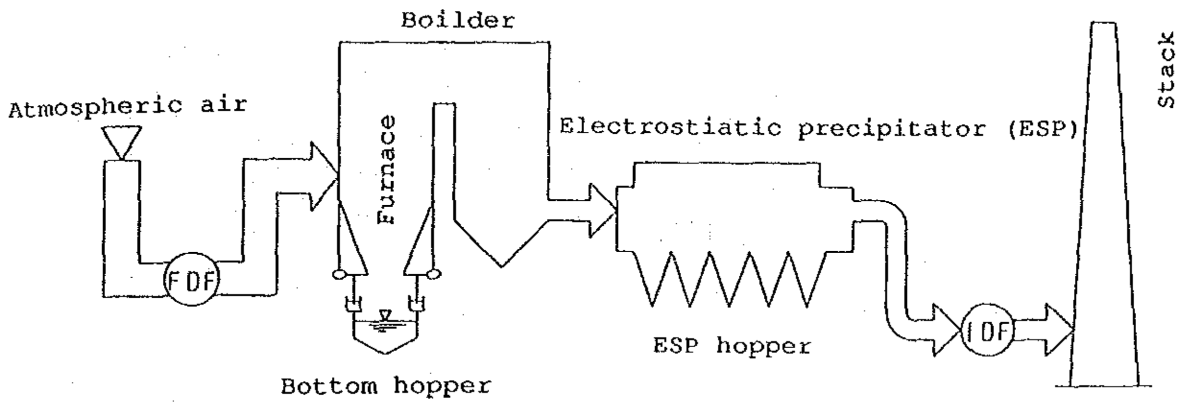


Fig. 4-2-5-(1) Location of ESP

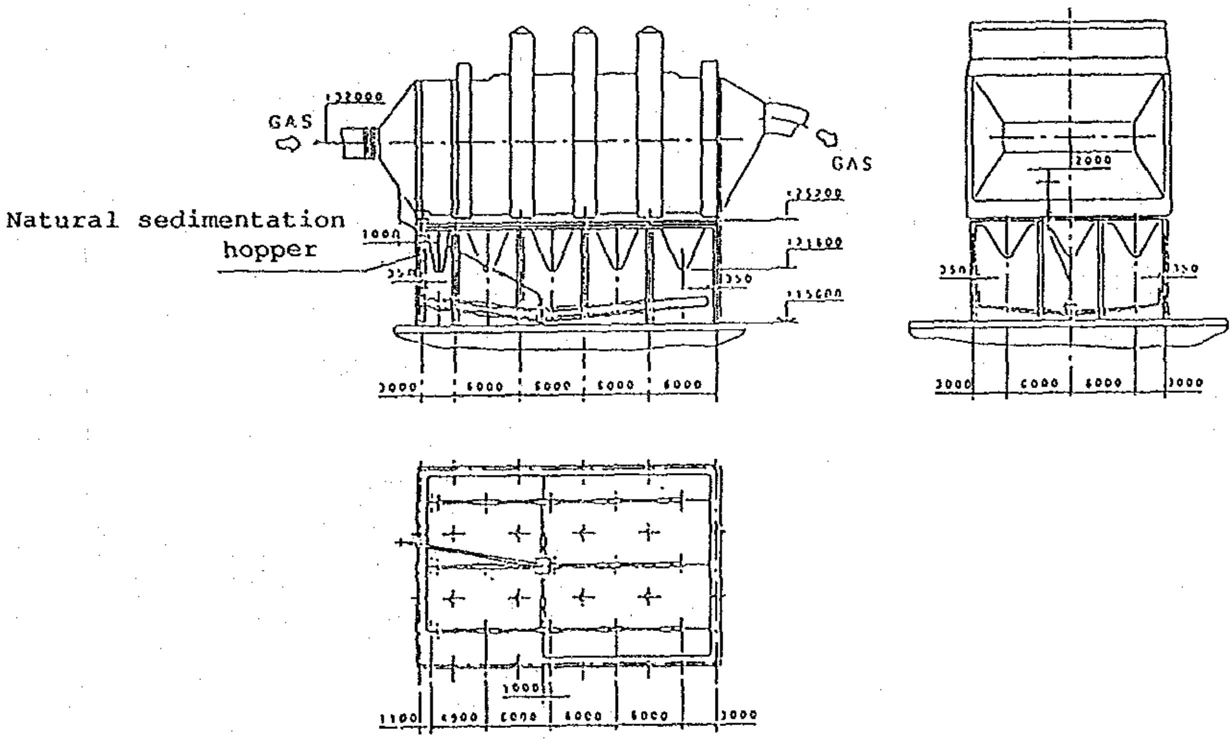


Fig. 4-2-5-(2) Dimensions of ESP

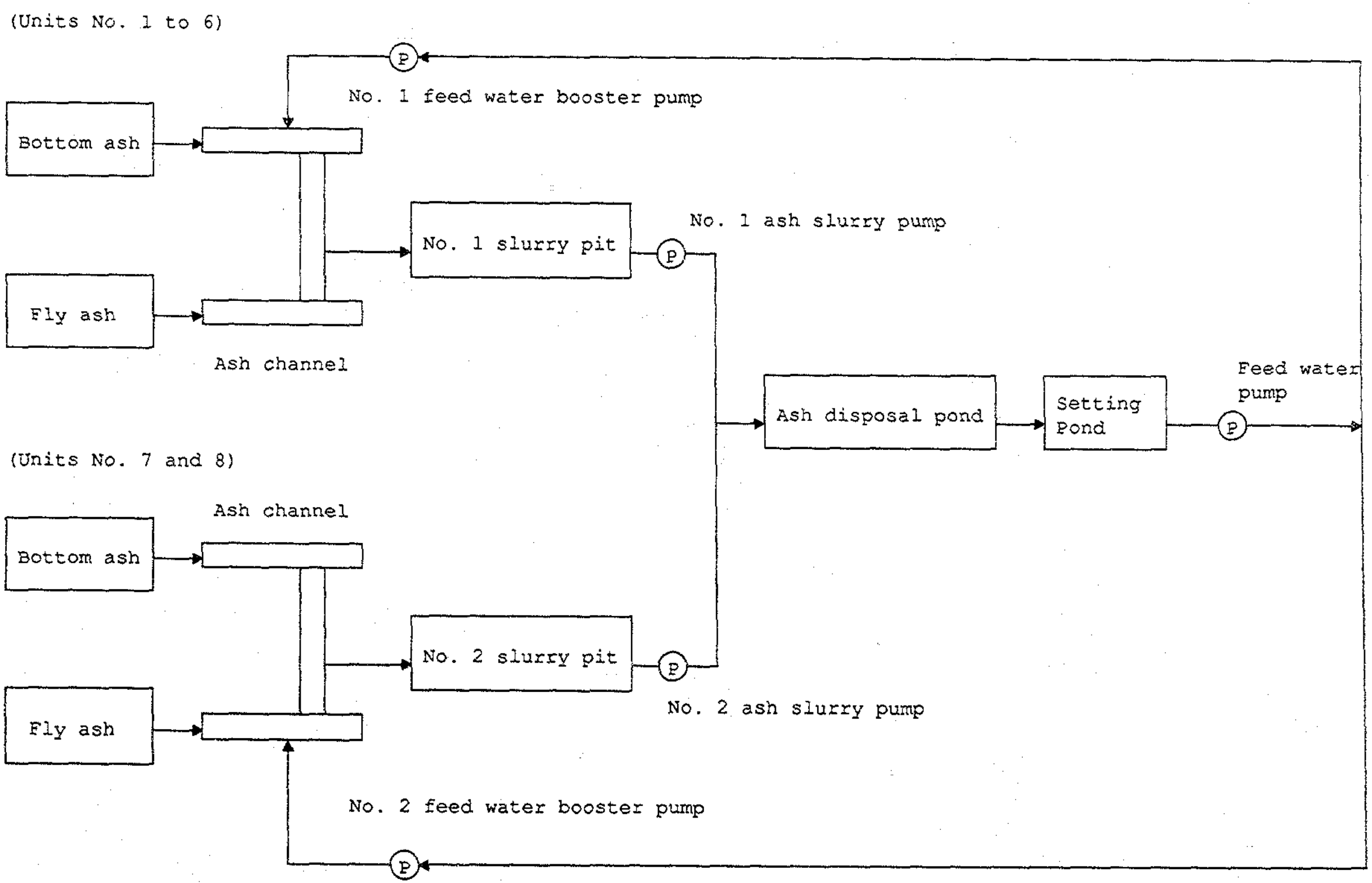


Fig. 4-2-5-(3) Flow Chart of Ash Treatment System

(2) Ash treatment system

The following ash treatment system is provided for whole eight pulverized coal firing boilers, which repectively uses 75 tons of coal per hour. It consists of ash disposal pond, a setting pond, feed water pumps, feed water booster pumps, feed water pipes, slurry pits and ash slurry pumps for common use, ash slurry pipes separately installed in two groups such as Units No. 1 to 6 and Units No. 7 and 8, and a slag ash discharge system and an ESP with a fly ash discharge system installed in each boiler. They can be divided into five lines of systems below.

* Bottom ash line (Slag ash line)
* Fly ash line
* Ash discharge line
* Feed water line
* Ash disposal pond and setting pond

Units No. 1 to 8 share the same basic concepts in design, but some modifications are seen in the new ESP. Since the eighth one is under construction and cannot be investigated, the contents of its design are not known at all.

1) Systems: The above-mentioned lines are shown in Fig. 4-2-5-(3)

2) Planned quantity of ash for design

(a) Bottom ash: 0.4 t/h unit
(b) Fly ash: 7.9 t/h unit

Total: 8.3 t/h unit (Coal ash = 11% of coal)

(Note) According to the record, the actual quantity of ash is expected to be bigger than the planned quantity of ash.

3) 24-hour continuous operation

(a) Bottom ash line (Slag ash line)

Slag ash is continuously discharged from each boiler's water filled three-divided bottom hopper to the ash channel by each hopper's screw conveyer. Slag ash is also discharged from the tubular type air heater's hopper, but its quantity is small.

Slag ash inside the ash channel is led to the slurry pit by water through booster nozzles. The water is used recycled from the ash disposal pond. (The slurry pit is shared with the fly ash system.)

Bottom ash is slagged ash which drops into the bottom hopper after floating pulverized coal is burnt in the boiler furnace. Being comparatively big in particle size, it tends to sink to the bottom of the ash channel, interferring with the operation of the system, booster nozzles were added from one row of nozzles to two rows in October 1987. The number of booster nozzles for each boiler is 6 to 8 in each row, and the pitch between them is 3 to 5 m.

The ash channel is 0.8 m in width and about 0.5 to 1.5 m in depth and slopes toward the slurry pit. The slurry flows down along the channel at a considerable speed with a depth of 0.2 to 0.3 m.

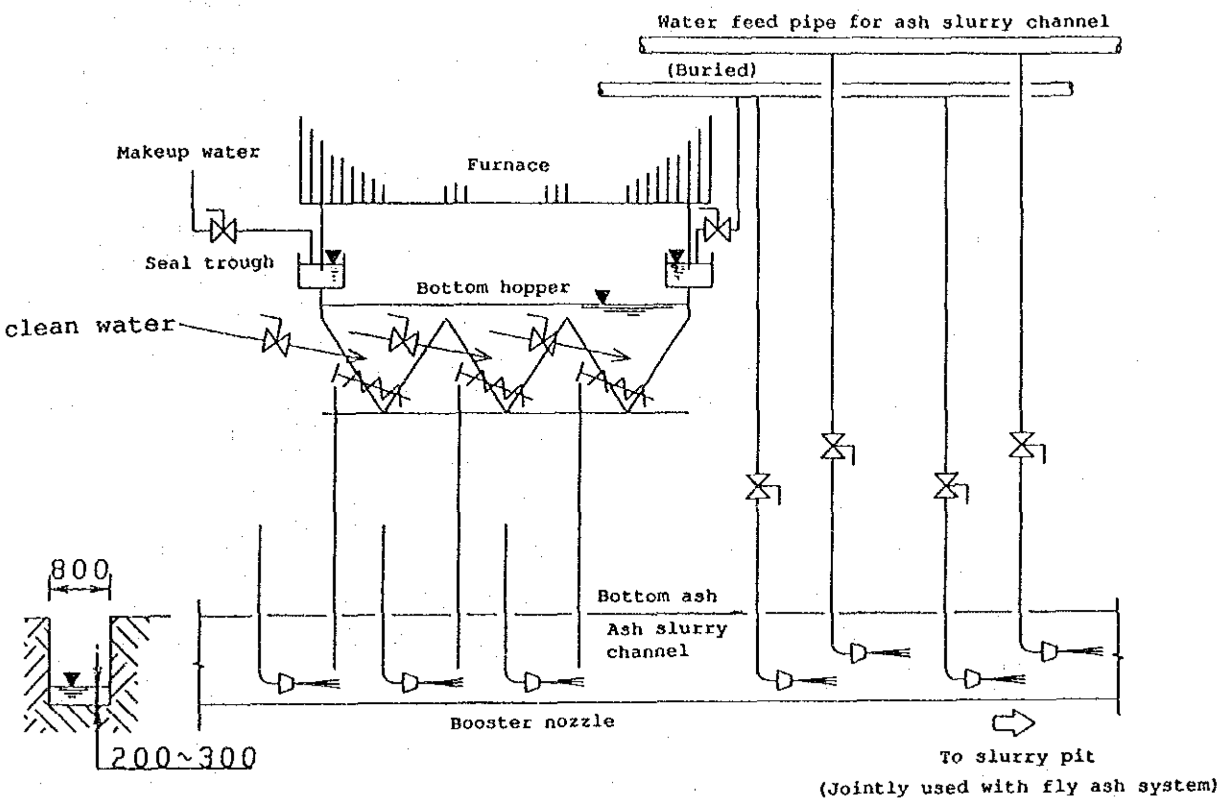


Fig. 4-2-5-(4) Flow Chart of Bottom Ash Line

(b) Fly ash line

Fly ash is stored in fifteen hoppers including three sedimentation hoppers after it is collected by ESP.

It is collected in the air separator through eight air sliders from these hoppers, sent through the chute to the mixer installed in 1FL, mixed there with water and led as water slurry to the slurry pit. (The slurry pit is shared with the bottom ash line).

Air used for floating ash inside the air slider is provided by its blower. Exhaust air is led to ESP inlet since it includes dust.

Facilities from the lower part of hoppers to air sliders are installed in the ESP hopper room (GL + 15 m).

Ash inside the ash channel is transported by using booster nozzles type in the same way as the bottom ash line. The booster nozzle line is occasionally shut down for its cleaning since it consists of only one line.

There is a system that can take out dry fly ash from the air separator and effectively use them, which has not been used at all.

A shut-off gate and a counter type damper are installed between the ESP hopper and the air slider and this system has a structure which may be opened and shut-off by the weight of accumulated ash when reaching a certain quantity. The counter type damper seems to prevent air from blowing up into the hopper from the air slider, only one damper is not enough for this purpose, and the reason why two dampers are not installed is not known.

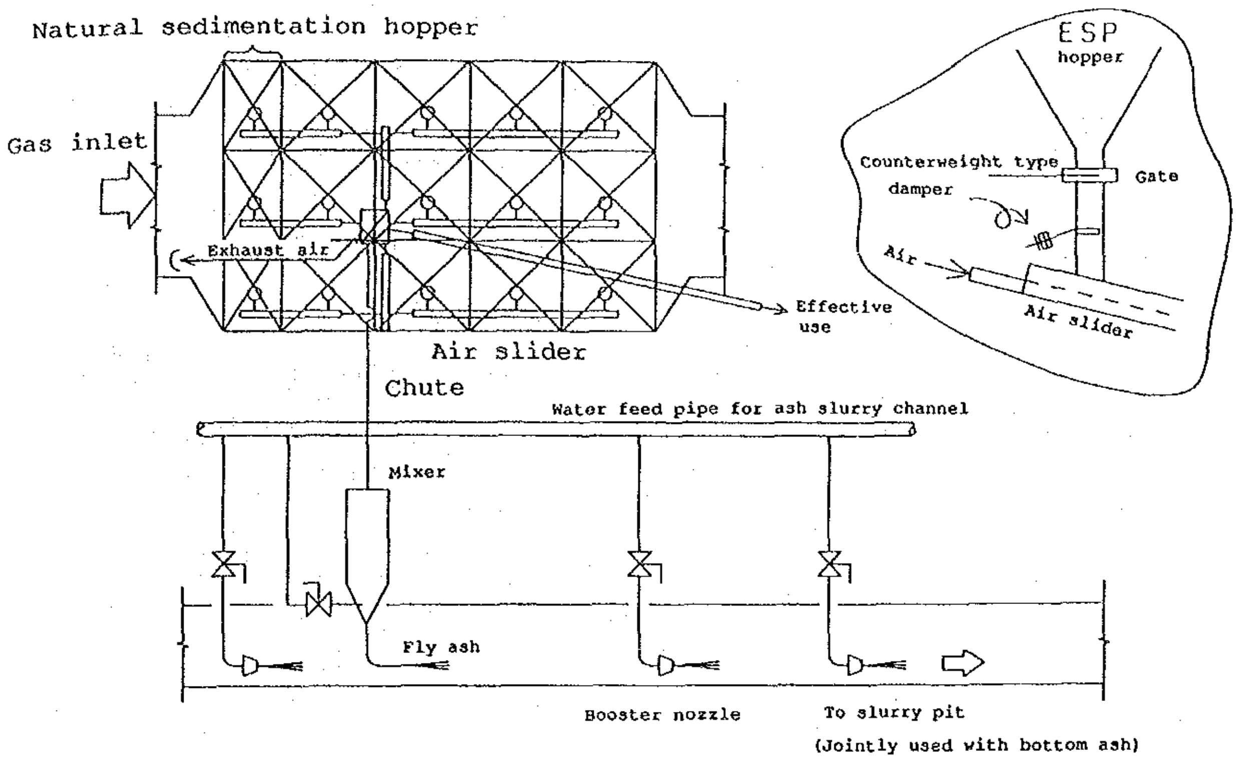


Fig. 4-2-5-(5) Flow Chart of Fly Ash line

a) Air slider (per 1 ESP)

. Capacity: 8.5 m^3/h unit (estimated based on the casing with a width of 100 mm)

. Dimensions and Number:

100 mmW x 13.5 mL x 3

100 mmW x 10.5 mL x 3

100 mmW x 6.0 mL x 3

b) Blower for air sliders

. Type: Turbo type

. Capacity: 29.5 m^3/min.

. Pressure: 560 mmHg (7,588 mm H_2O)

. Revolution: 2,800 rpm

. Motor output: 5.5 kW

. Number: 2 (1 blower in normal service)

. Design temperature: Inlet; 250°C, Outlet; 150°C

c) Mixer

. Type: Bottom cone water spray type

. Capacity: 2 m^3/unit

. Number: 1

(c) Ash disposal line

The system consists of No. 1 slurry pit line used for Units No. 1 to 6 and No. 2 slurry pit line used for Units No. 7 and 8, and transports ash through each ash slurry pipe by its ash disposal pump to the ash disposal pond 4 km away.

There are 3 ash slurry pumps. A pump is usually used and others for back-up. The ash slurry pipes consists of one in normal service and one backup.

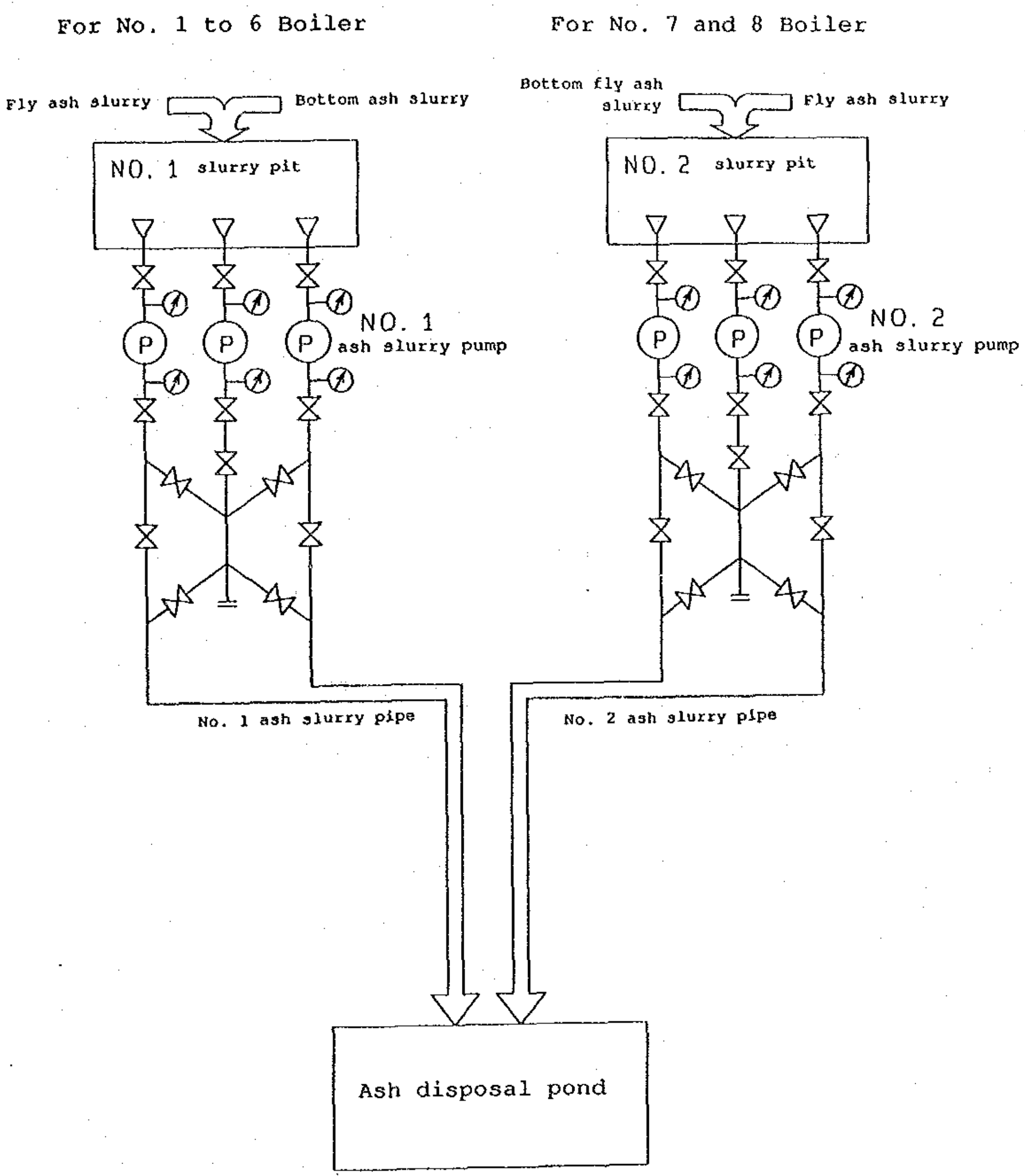


Fig. 4-2-5-(6) Flow Chart of Ash Disposal Line

a) (For Units No. 1 to 6)

a. No. 1 slurry pit

. Capacity: 100 m^3

. Dimensions: 3 mW x 10 mL x 3.5 mH

. Number: 1

b. Ash slurry pump

. Capacity: 1,250 t/h

. Outlet pressure: 7.1 kg/cm^2

. Motor output: 600 kW

. Revolution: 965 rpm

. Voltage: 6.0 kV

. Number: 3 (1 pump in normal service)

c. Ash slurry pipe

. Diameter: 426ø (12 t)

. Length: About 3.2 km

. Number: 2 systems (1 system in normal service)

b) (For Units No. 7 and 8)

a. No. 2 slurry pit

. Capacity: 100 m^3

. Dimensions: 3 mW x 10 mL x 3.5 mH

. Number: 1

b. Ash slurry pump

. Capacity: 800 t/h *

. Outlet pressure: 7.1 kg/cm^2

. Motor output: 400 kW

. Revolution: 965 rpm

. Voltage: 6.0 kV

. Number: 3 (1 pump in normal service)

c. Ash slurry pipe

. Diameter: 325ø (12 t)

. Length: About 3.7 km

. *Number: 2 systems (1 system in normal service)*

* One of the three ash disposal pumps for Units No. 7 and 8 is in operation at a smaller capacity of 350 t/h as a test of slurry pit level control.

(d) Feed water line

Overflow water from the ash disposal pond is stored in the settling pond and used again as water for ash treatment. This is the feed water line from the settling pond to the bottom ash line and the fly ash line. The settling pond is about 4 km away from the 4th thermal power station. The area between them is almost flat.

The system consists of feed water pumps, feed water booster pumps, feed water pipes, etc.

Feed water pumps and some feed water pipes are shared with all boilers No. 1 through 8 as common facilities. The rest of the feed water pipes and feed water booster pumps are divided into facilities for Units No. 1 to 6 and Units No. 7 and 8.

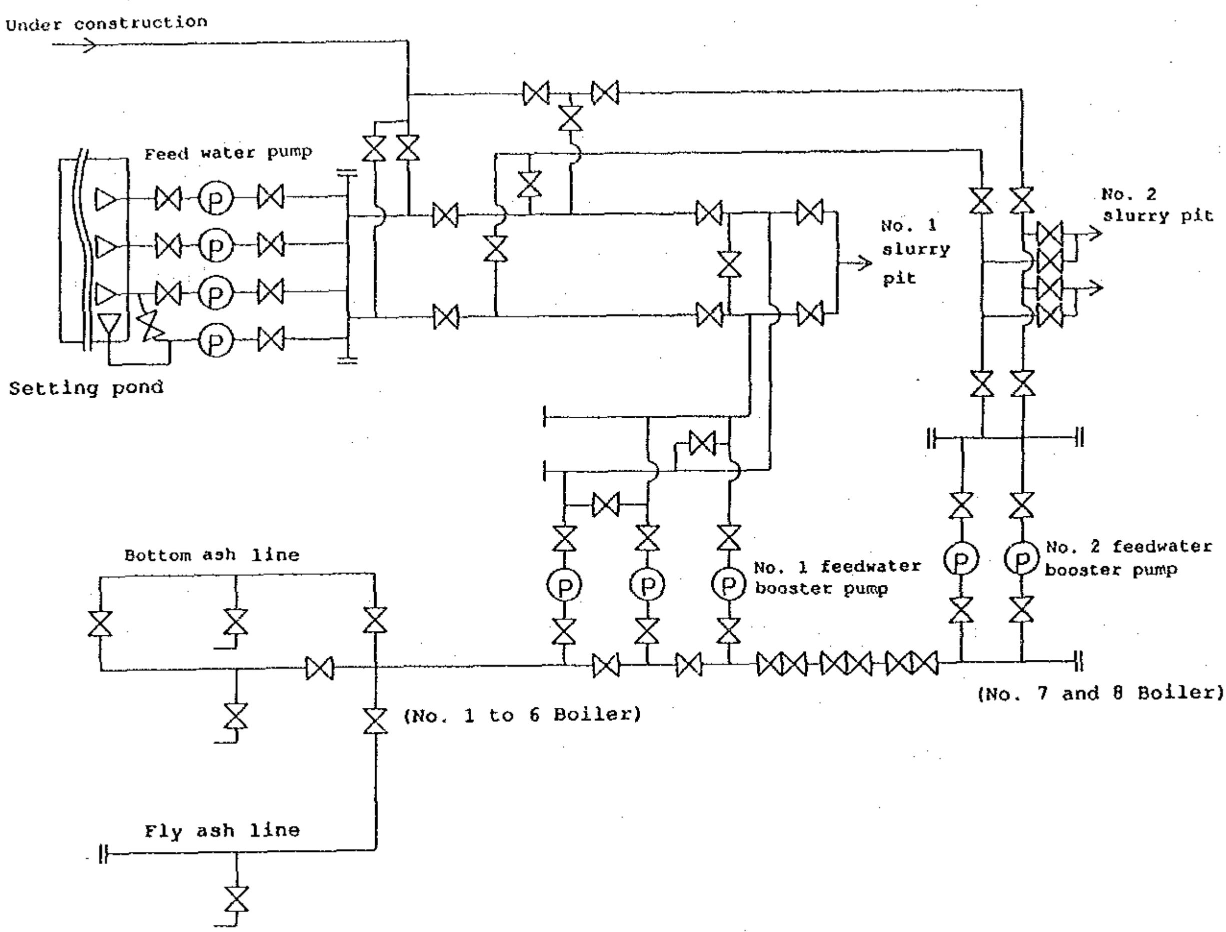


Fig. 4-2-5-(7) Flow Chart of Feedwater Line for Ash Treatment

a) Feed water pump for ash treatment

. Capacity: 800 t/h
. Outlet pressure: 6.0 kg/cm^2
. Motor output: 200 kW
. Revolution: 1,450 rpm
. Voltage: 6.0 kV
. Number: 4 (2 pumps in normal service)

b) No. 1 feed water booster pump

- . Capacity: 400 t/h
- . Outlet pressure: 10.0 kg/cm^2
- . Motor output: 160 kW
- . Revolution: 1,470 rpm
- . Voltage: 380 kV
- . Number: 3 (a pump in normal service)

c) No. 2 feed water booster pump

- . Capacity: 400 t/h
- . Outlet pressure: 10.0 kg/cm^2
- . Motor output: 160 kW
- . Revolution: 1,470 rpm
- . Voltage: 380 kV
- . Number: 2 (a pump in normal service)

(e) Ash disposal pond

Ash slurry, which is transported through the ash slurry pipe from the 4th thermal power station, is separated into ash and water at the ash disposal pond. Overflow water from the pond is led to the neighboring setting pond.

There are three ash disposal ponds 4 km away from the the 4th thermal power station. The first one has been filled completely and is no longer used.

The second one is now used and the third one is under construction.

The site for the ash disposal pond used for the 3rd thermal power station has been obtained next to them.

a) No. 1 ash disposal pond (completely filled up)
b) No. 2 ash disposal pond: 780,000 m^3
(for 3.5 years)

c) No. 3 ash disposal pond: 1,960,000 m^3
(for 6.5 years)

* The time to fill the ponds was calculated on 13% ash in coal.

(f) Settling pond

The settling pond is located next to the ash disposal pond, and water from the ash disposal pond is stored to be used again. In this pond, further fine ash sinks naturally.

Water from the pond is pumped to the 4th thermal power station by feed water pumps to be used again.

a) Capacity: 10,000 m^3

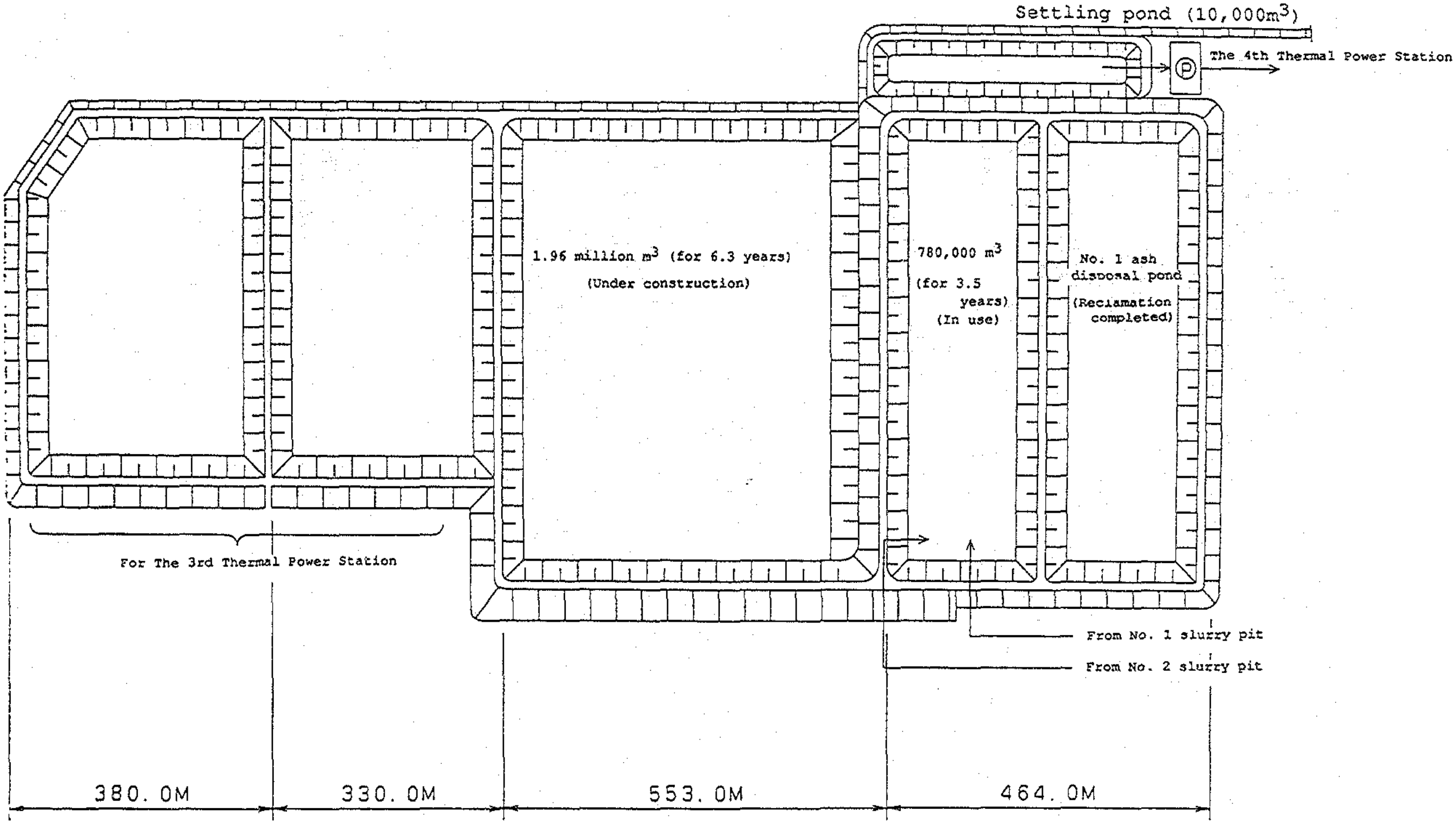


Fig. 4-2-5-(8) Layout of Ash Disposal Ponds

Photo-1 ESP (Inside)

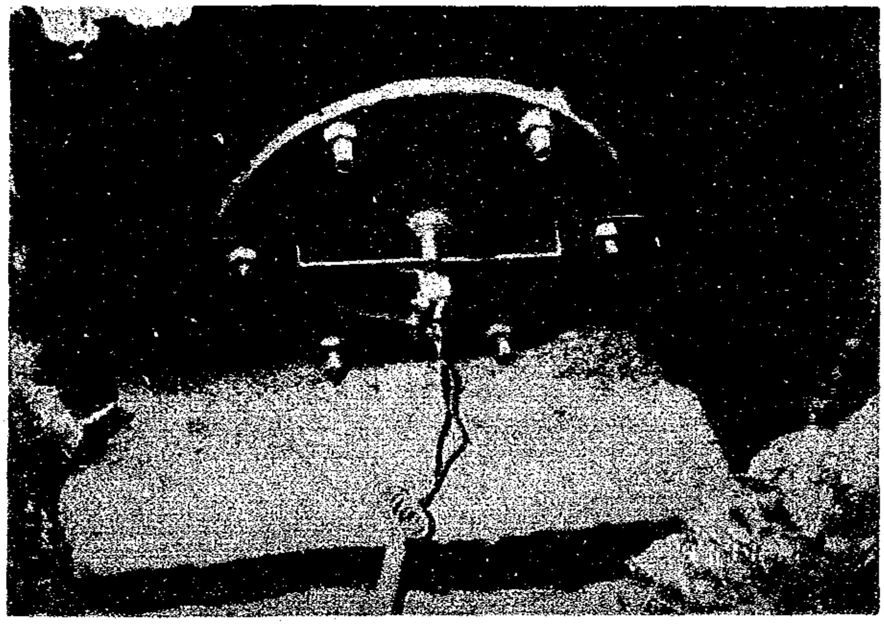


Photo-2 Present Situation of ESP Hopper Ash Level Sensor

Fig. 4-2-6 Photographs of Site Conditions

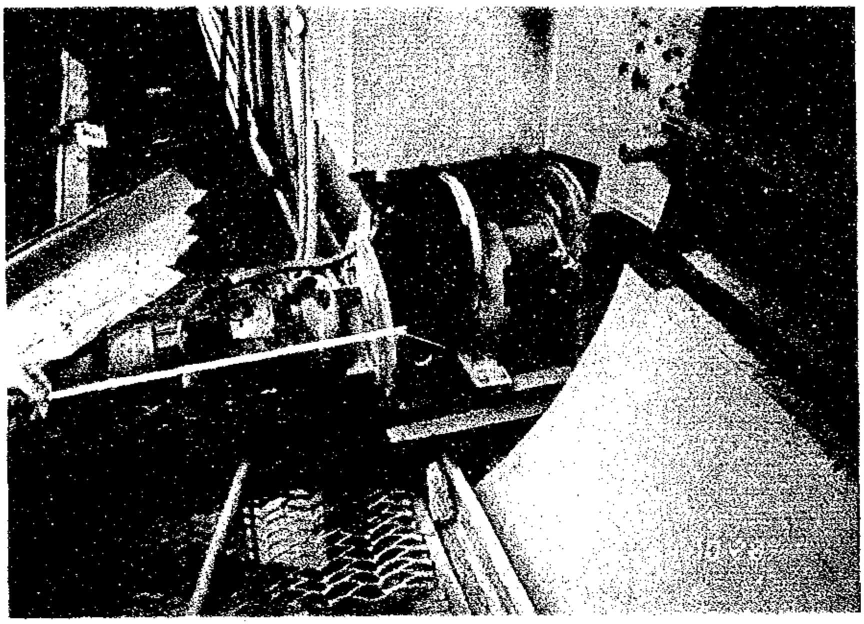


Photo-3 Motor-Driven Reducer for ESP Rapping System

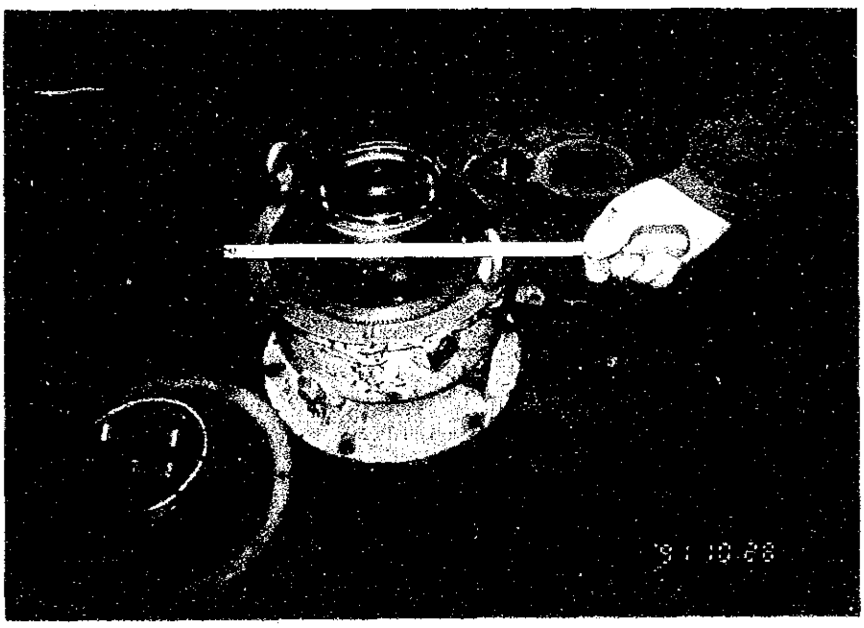


Photo-4 Reducer of ESP Rapping System
(Gear Removed from the Device)

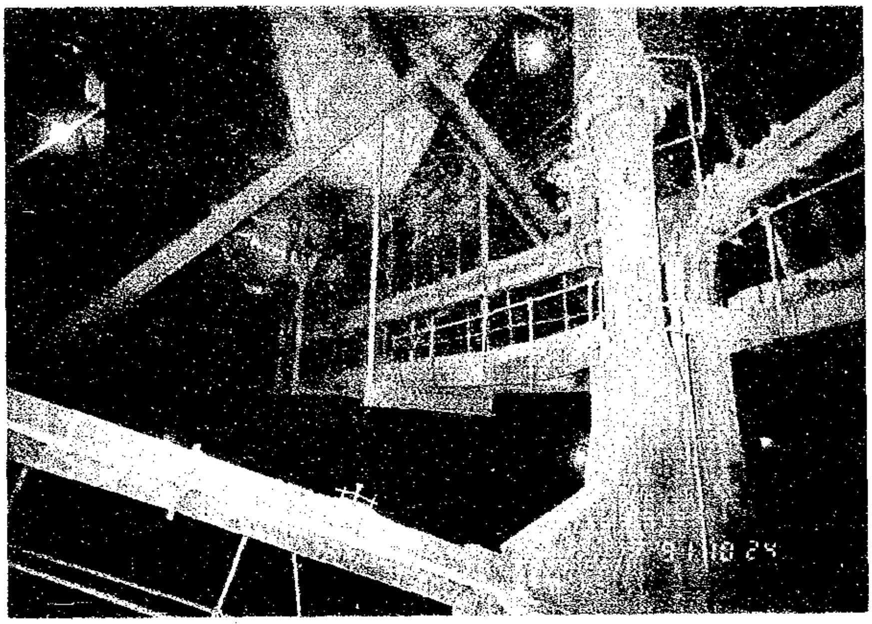


Photo-5 Air Slider of Fly Ash Line

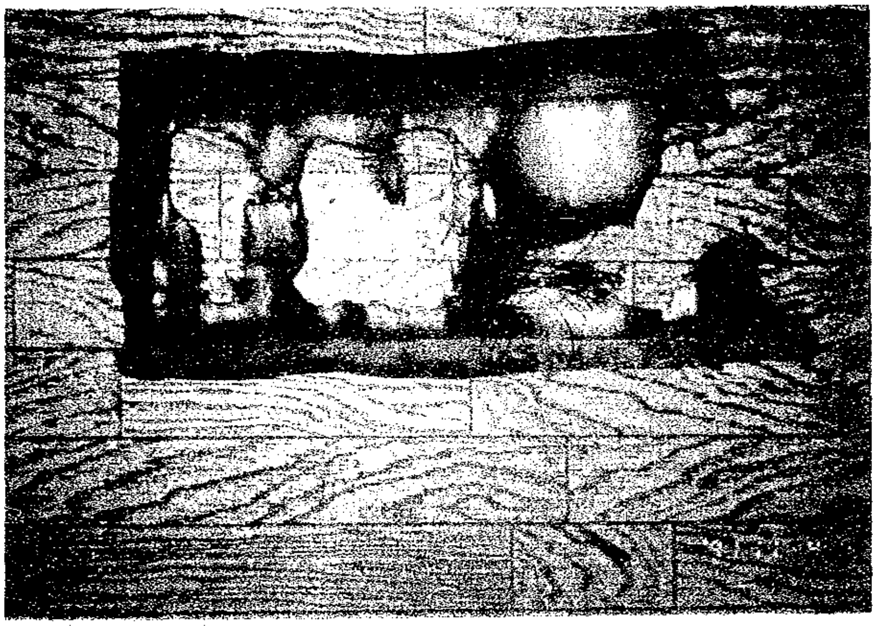


Photo-6 Damaged Air Slider Canvas (Wire Gauze)

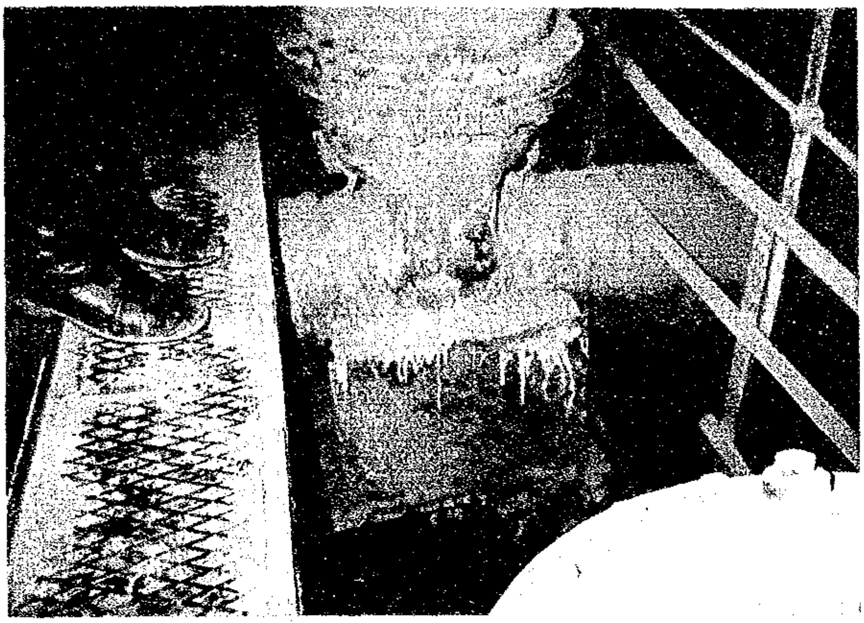


Photo-7 Slurry Valve at Ash Slurry Pump Outlet

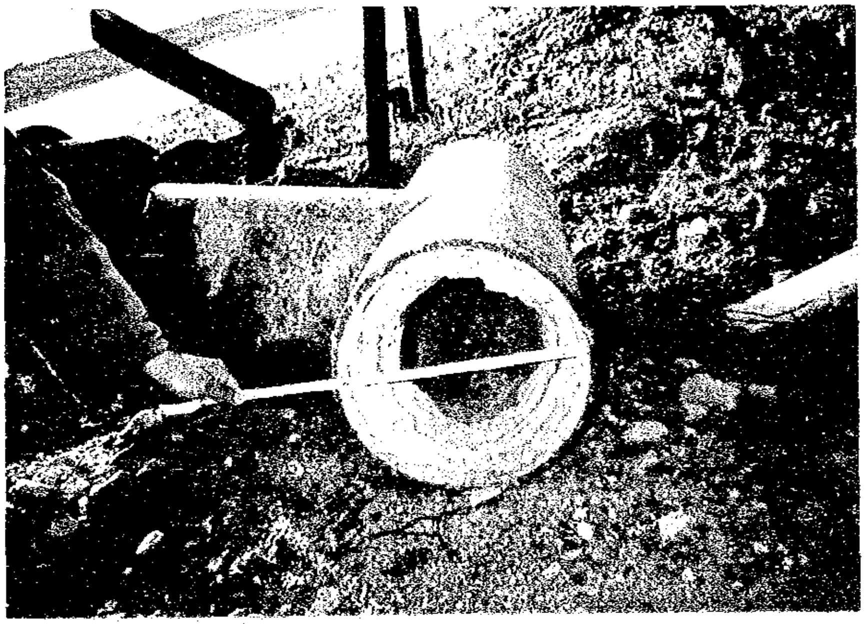


Photo-8 Scaling of Feed Water Pipe

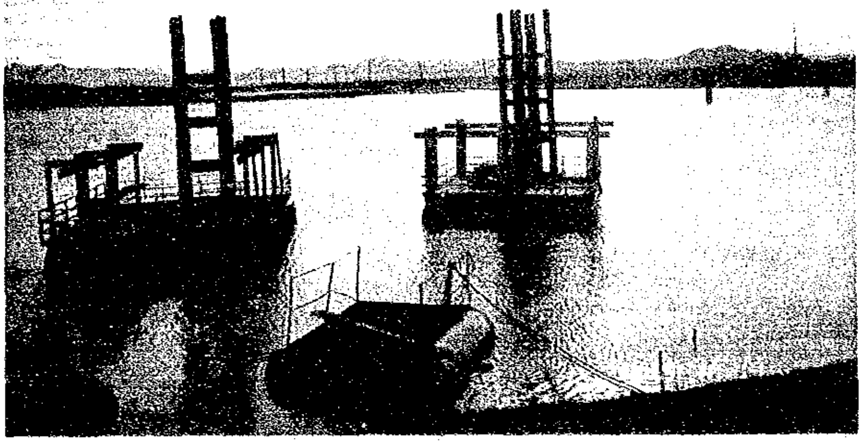


Photo-9 Floating Intake of Ash Disposal Pond

Photo-10 Ash Disposal Pond

(3) Pulverized coal feed system

This is a system to mill coal into powder, blow it into the furnace by the burner and burn pulverized coal there to improve the efficiency of combustion in each one of the boilers at the 4th thermal power station, and this system adopts a semi-direct storage bin system.

In the semi-direct storage bin system, pulverized coal is put in the bunker after coal is pulverized in the mill (coal pulverizer) and it is then transport to the burner by the primary fan from the pulverized coal feeder located below the bunker. The system has the following characteristics. Since this system is not completely divided into a storage system and a transpotation system, it is called a semi-direct storage bin system.

1) It is easy to follow the changes of boiler loads.

2) Pulverized coal can be burnt in a certain time even in case of the coal pulverizer's failure.

3) It is advantageous for combustion that the ratio of pulverized coal to air can be increased.

At the 4th thermal power station, since there are two pulverized coal firing systems which independently have combustion gas with a lower oxygen concentration in the primary fan's fluid (carrier fluid) for each boiler to avoid explosion and fire inside the pulverized coal pipe, it is characteristic of each boiler to be in operation while one of the two systems is repaired.

Fig. 4-2-7 shows the flowchart of the pulverized coal feed system.

In this system, exhaust gas from the boiler is transported to the coal pulverizer by the gas recirculation fan to dry coal.

Exhaust gas is separated at the outlet, and partly absorbs fan high temperature combustion gas and is controlled at a temperature required for drying coal.

Coal is pulverized and dried in the mill and then carried to the classifier by exhaust gas. The gas is controlled at a temperature of 90°C at the outlet of the mill.

The horizontal type tube mill, which contains steel balls, pulverized coal while the mill body itself if rotated. This type is said to be useful for low quality coal.

Pulverized coal in particle size smaller than specified is separated by centrifugal force in the classifier and carried to the cyclone separator while coal in the bigger particle size is returned again to the mill.

The cyclone separator also separates carrier gas from the pulverized coal by using centrifugal force and only lets pulverized coal drop into the bin, and only carrier gas is induced by the primary fan. Pulverized coal does not flow backward in the separator at all since there is a double counter weight damper between the separator and the bin.

An oxygen meter is installed in the duct between the cyclone separator and the primary fan to monitor the leakage of oxygen into the system, which is regarded as the cause of explosions.

Gas pressure is now controlled at 300 to 400 mmAq at the outlet of the primary fan, and pulverized coal is carried by this carrier's power from the pulverized coal bin to the burner through the pulverized coal feeder.

The main facilities used for the pulverized coal feed system are shown below.

1) Gas recirculation fan

- Type: Centrifugal
- Flow rate: 2,500 m^3/min.
- Discharge pressure: 0.04 kgf/cm^2
- Motor output: 400 kW
- Revolutions: 1,000 rpm
- Number: 1/unit

2) Mill (Coal Pulverizer)

- Type: Low-speed horizontal tube mill
- Flow rate of coal: Maximum 55 t/h
- Motor output: 1,600 kW
- Revolutions: 17.2 rpm
- Number: 2/unit

3) Classifier

- Type: Centrifugal force
- Materials: SS (Rolled steal for general structure) with thickness of 10 mm
- Approximate dimensions: 7 m in height x 4.3 m in diameter
- Number: 2/unit

4) Cyclone

- Type: Centrifugal force
- Design collection efficiency: 90.4% (project)
- Flow rate of coal: 2,333 to 3,000 m^3/min.
- Materials: SS (with thickness of 10 mm)
- Approximate dimensions: 16.1 m in height x 4.1 m in diameter
- Number: 2/unit

5) Primary fan

- Type: Centrifugal force
- Flow rate: 130 x 10^3 m^3/h

. Pressure: 737 kg/m^2

. Temperature: 75°C

. Motor output: 630 kW/1500 rpm

. Concentration of pulverized coal at the outlet: 44 g/m^3 (measured value)

* The pulverized coal pipe around the burner is shown in Fig. 4-2-8's Photo-1, and the classifier and the cyclone are shown in Fig. 4-2-8's Photo-2.

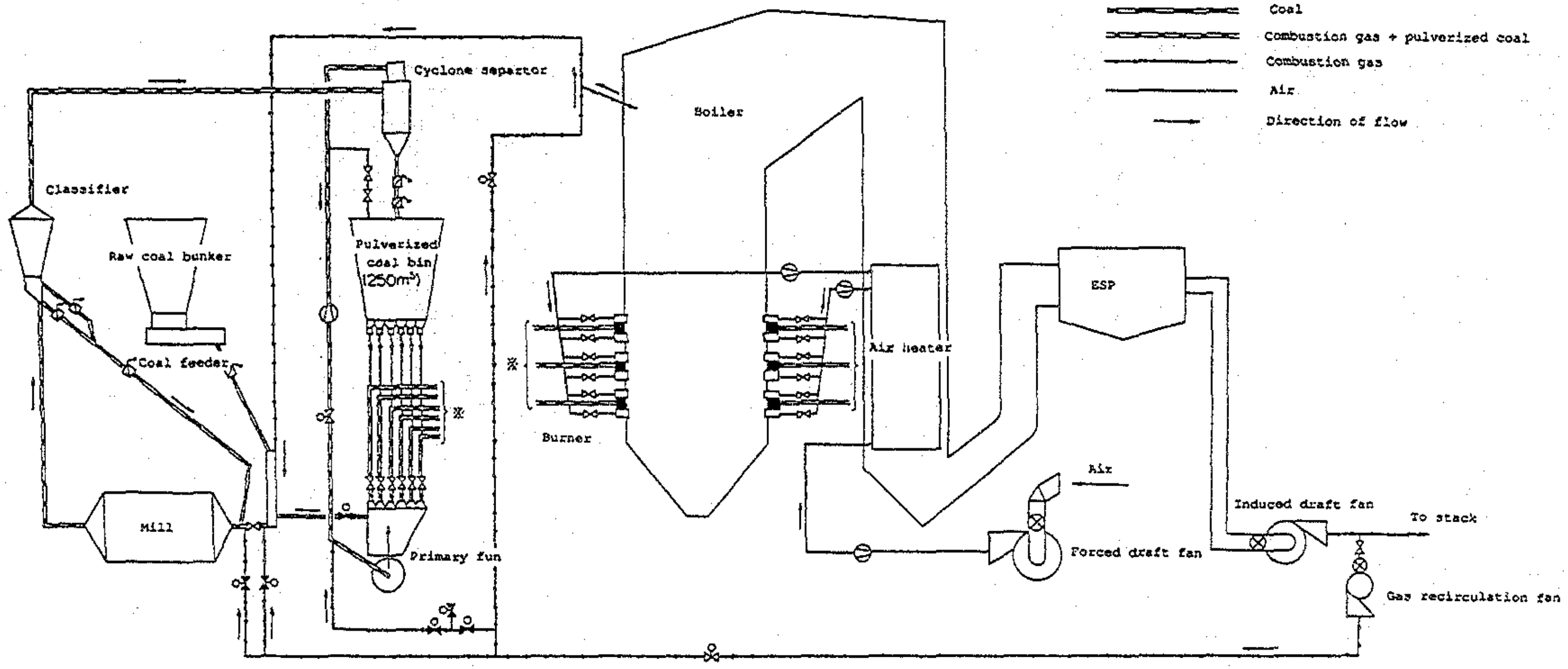


Fig. 4-2-7 Flow Chart of Pulverized Coal Feed System

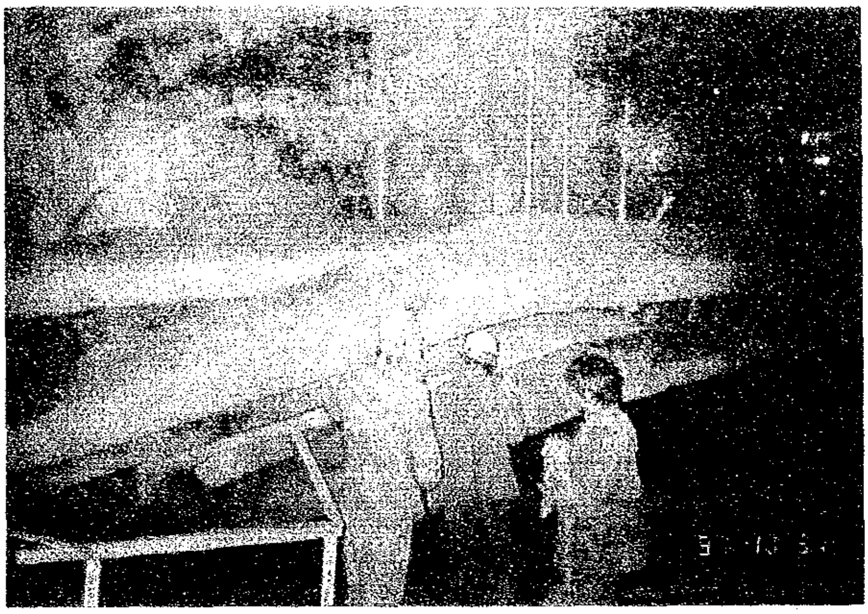


Photo-1   Pulverized Coal Pipe around the Boiler
(Condition of Pulverized Coal Leak)

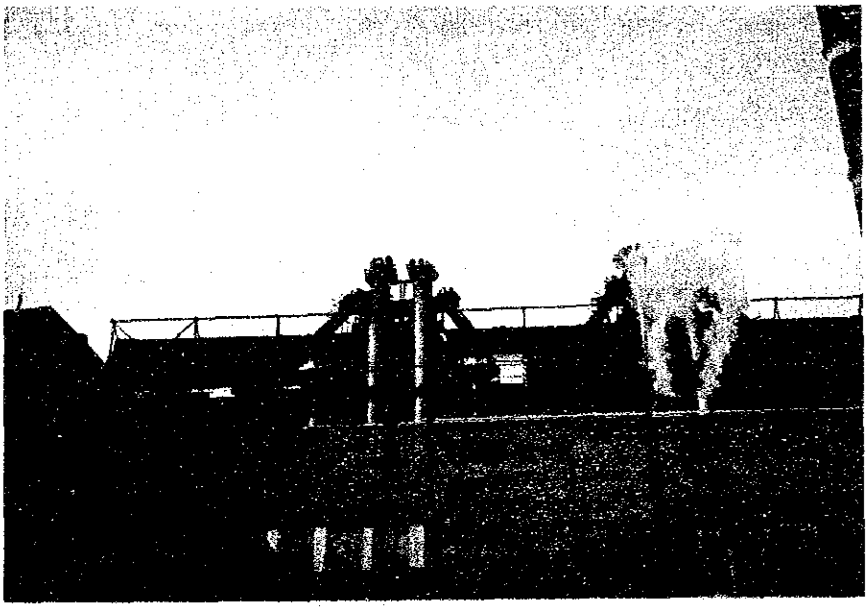


Photo-2 Classifier and Cyclone Separator

Fig. 4-2-8 Photographs of Site Conditions

(4) Coal handling system

Fig. 4-2-9 shows the entire coal handling system. Coal is brought in a freight car with a capacity of 60 tons from Baganuur Coal Mine located 130 km east from the power station. After it is measured at the wagon tumbler (now out of order) and dropped into the underground hopper, it is carried to the No. 1 conveyer house by the No. 1 conveyer. Magnetic materials are removed in the No. 1 magnet separator (not existing at present time) in front of the conveyer house.

At the No. 1 conveyer house, coal can be separated to be carried to the coal yard or to the bunker in front of the boiler. Coal is directly carried to the coal bunker in most cases when the bunker has enough space for coal storage.

Magnetic materials are removed from coal at the second magnet separator while coal is carried by the No. 2 conveyer from the first conveyer house to the No. 2 conveyer house. Coal is crushed into ones 10 m/m in size by the hummer crusher, measured on the No. 3 conveyer by the coal meter (not existing at present time), and carried to the boiler house. Coal, whose magnetic materials are removed on the No. 4 conveyer by the No. 3 magnet separator, is stored in the bunker and finally fed to the pulverized coal firing system through the coal feeder.

The specifications of each conveyer are as shown in Table 4-2-18.

Table 4-2-18 Specifications of Belt Conveyers in the 4th Thermal Power Station

Conveyers		No. 1 A, B	No. 2 A, B	No. 3 A, B	No. 4 A, B	No. 5 - 1	No. 5 - 2	No. 5 - 3	No. 6 - 1	No. 6 - 2	No. 6 - 3	No. 6 - 4	No. 6 - 5
Capacity	t/h	1,000	1,000	1,000	1,000	1,000	1,000	1,000	600	600	600	600	600
Belt width	m/m	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400
Conveyer length	m	145	61	218	270	180	78	177	262	270	235	48	127
Motor output	kW	200	55	315	100	100	75	50	75	160	75	40	100
Voltage	V	380	380	6,000	380	380	380	380	380	380	380	380	380
Belt speed	m/sec	1.603	1.8	2.22	1.87	1.87	1.87	1.87	1.87	1.53	1.87	1.8	2.22

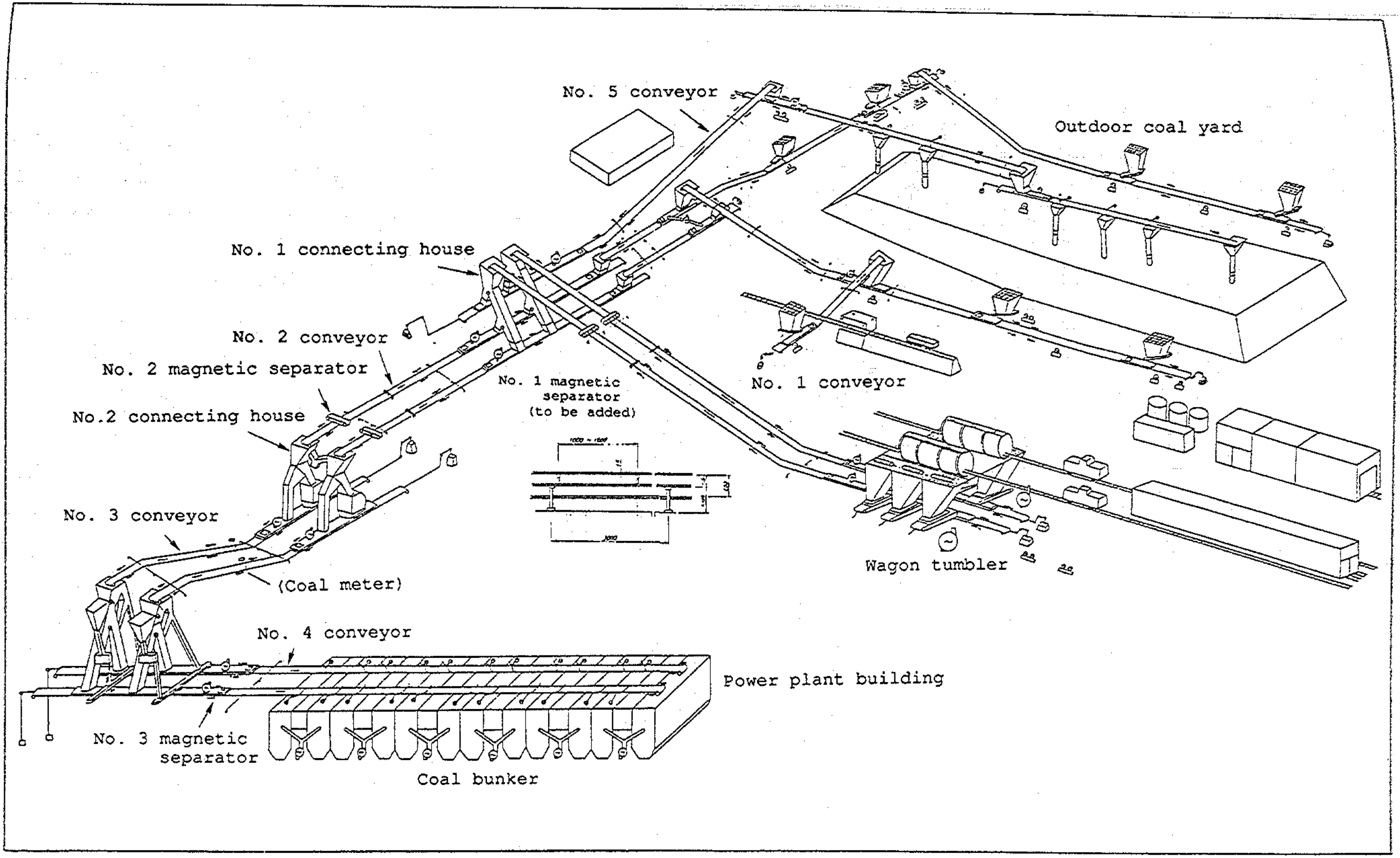


Fig. 4-2-9 Conveyor System Diagram

4.2.7 Outline of Present Status of Operating in the Project Station

(1) Electrostatic precipitators (ESP)

1) Operating conditions

As shown in Table 4-2-19-(1), the survey was made for only eight days. The availability of precipitators in-service was about 40% while units were in operation. This is a very low rate for ESP.

The situation is imagined to be almost the same all the year around in consideration of the maintenance of facilities. This situation was also confirmed by the Mongolian side.

Table 4-2-19-(1) Charge Factors of ESP in the 4th Thermal Power Station (October 22 to November 5, 1991)

Unit No. / Date	1	2	3	4	5	6	7	8	Average charge factor	Remarks
Oct. 22	1/4	-	2/4	2/4	3/4	-	-	Under construction	2/4 (50%)	
Oct. 23	1/4	-	2/4	2/4	3/4	-	-		2/4 (50%)	
Oct. 24	1/4	-	2/4	2/4	-	-	-		1.7/4 (42%)	
Oct. 28	1/4	-	2/4	2/4	-	-	-		1.7/4 (42%)	
Oct. 29	0/4	-	0/4	0/4	-	-	-		0/4 (0%)	All of them were shut down on October 29 since the feed water system was in trouble.
Oct. 31	1/4	-	2/4	-	-	-	2/4		1.7/4 (42%)	
Nov. 4	1/4	-	2/4	-	-	-	2/4		1.7/4 (42%)	
Nov. 5	1/4	2/4	2/4	-	-	-	2/4		1.8/4 (44%)	
Total	0.9/4	2/4	1.8/4	1.6/4	3/4	-	2/4	-	1.6/4	
	22%	50%	44%	40%	75%	-	50%	-	41%	

(Note) Obtained from the 4th Thermal Power Station

2) Contents of failure (As of October 31, 1991)

(a) Ash pluggage inside the hoppers

The rate of ash pluggage inside the each hopper for one the No. 1, No. 3 and No. 7 precipitators, which are in service while the boilers are in operation, is estimated at an average of 30 to 50%. The same tendency is assumed to last all year around in consideration of the situation. (Refer to Fig. 4-2-10-(1))

It can be said that certain hoppers do not tend to cause ash pluggage.

Since most part of fly ash in flue gas generally drops into hoppers on the gas inlet side of the precipitator, hoppers on the inlet side generally tend to suffer from ash pluggage. However, ash pluggage is imagined to take place also inside the hoppers on the gas outlet side because precipitators in the 4th thermal power station have partially been in service for a long period of time.

If all the precipitators are in normal service, ash pluggage tends to take place inside the hoppers on the gas inlet side.

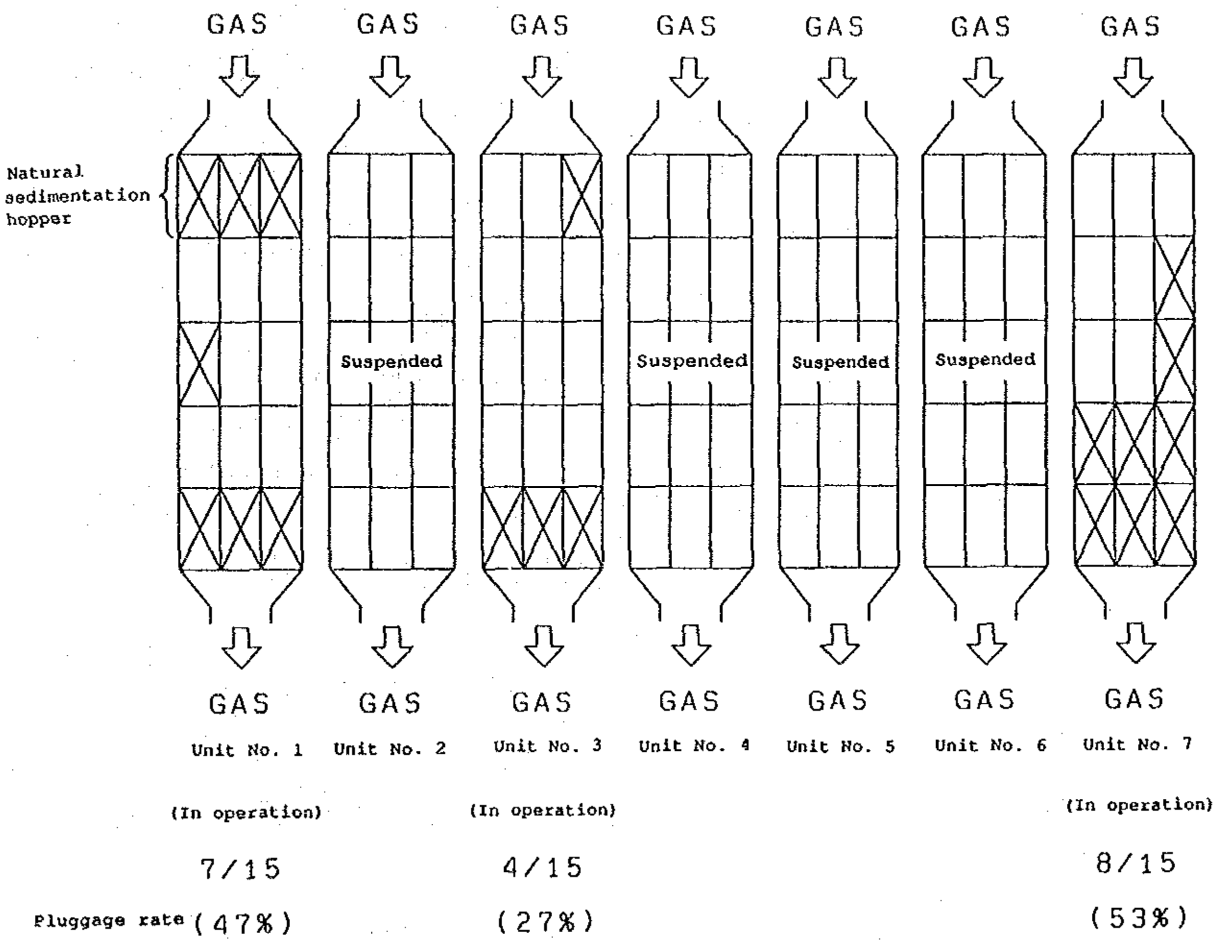


Fig. 4-2-10-(1) Ash Pluggage Condition in Hoppers

(b) Defective reducers for rapping system

a) Those in operation: (O,◎ : Refer to Fig. 4-2-10-(2))

. For collecting electrodes:
23 or about 80% of all the devices (28 in total) are in operation.

. For discharge electrodes
78 or about 70% of all the devices (112 in total) are in operation.

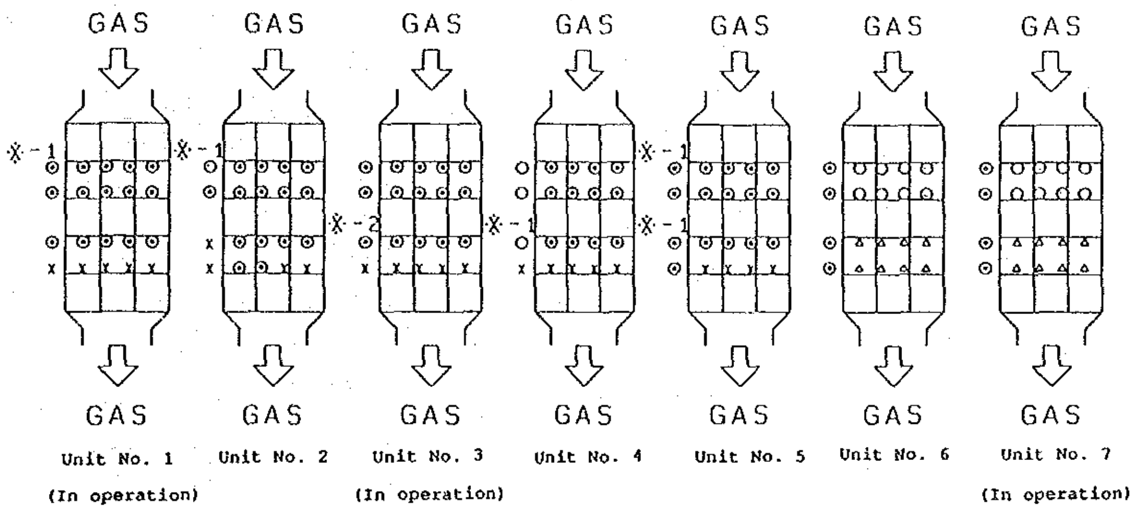
However, since Mongolian-made reduction gears are defective and last about one month only, the number of devices which need to be repaired often (◎) is 81 or accounts for 60% of all the devices (140 in total) including those for collecting and discharge electrodes.

b) Those impossible to be in operation: (x,)

. For collecting electrodes:
Those whose motors and reduction gears have been removed due to their damage (5 units = about 20%)

. For discharge electrodes:
They are in trouble in the same way as those for collecting electrodes, and some of them have no motors in Units No. 6 and 7 (34 units = about 30%).

c) Five hammer shafts were bent and one shaft was broken.



(Legends)

- o : In operation (ex-Soviet-made normal one)
- ⊙ : In operation (Mongolian-made reduction gear with a service life of one month)
- x : No motor with no reduction gear
- Δ : No motor (its reduction gear is normal)
- *-1 : Bend-down of rapping rod
- *-2 : Cut-off rapping rod

Fig. 4-2-10-(2) Malfunction Condition of Rapping Device

3) Maintenance history

The maintenance history of those related to ESP is shown in Table 4-2-19-(2). The following situation can be estimated according to the table.

(a) Periodic maintenance is normal since it is done once a year or more often.

(b) The frequency of ash pluggage inside the hoppers is imagined to be high since the maintenance history shows deformed discharge electrodes, deformed hammer shafts and others.

(c) The countermeasure for ash pluggage inside the hoppers is said to be ineffective according to the history of replacement of air slider canvas, the inspection of hopper heaters, etc.

Table 4-2-19-(2) Maintenance History of Those Related to ESP

Years		1989							1990							1991							Remarks
Item	Unit No.	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7	
Main body periodic maintenance	No. of times/ Year	2	2	1	1	1	1	-	2	2	2	2	2	1	1	2	3	2	2	2	2	2	
Air sliders and others, Inner side inspection maintenance	No. of times/ Year	1	1	0	0	0	0	-	1	0	0	0	0	0	0	0	1	0	0	0	1	0	
Air sliders and others, General inspection	No. of times/ Year	2	2	2	2	1	1	-	1	2	3	2	1	1	1	2	2	2	3	1	1	1	* Maintenance is not included.
Discharge electrode deformation repairs	No. of times/ Year	5	3	3	1	2	2	-	2	3	0	0	2	2	3	1	2	1	1	2	0	1	
Hammer replacement maintenance	No. of replaced ones/Year	5	9	8	6	6	2	-	10	10	4	8	2	1	1	8	5	4	8	5	2	1	
Hammer rod deformation repairs	No. of times/ Year	4	3	2	2	4	0	-	5	6	2	1	2	1	0	5	4	1	2	1	2	0	
Air sliders, Canvas replacement	No. of replaced ones/Year	8	8	2	2	1	1	-	4	5	2	1	1	0	0	2	8	2	3	1	8	3	*
Hopper heater inspection	No. of times/ Year	2	2	2	1	1	2	-	2	2	3	2	1	2	-	2	3	2	1	2	1	1	

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

(2) Ash treatment system

1) Operating situation

(a) Bottom ash line (Screw conveyer slurry pit)

a) Slag ash is continuously sent to the slurry pit from each three-divided hopper by each installed screw conveyer while the boiler is in operation.

According to the person in charge of the operation of the line, there is basically no big trouble in the line, and this line is not included in the rehabilitation project. According to the site investigation, if troubles are assumed, troubles such as foreign matters (slag ash) which may be bitten by screw conveyers etc. can be assumed.

According to the leakage of oil from the driving devices for the screw conveyers, periodic inspection and maintenance should be performed in advance of accidents in the screw conveyer driving devices.

b) Feed water booster line

As the feed water booster line consist of two lines, and scale regarded as the future causes of trouble can be removed from the inside wall of the ash slurry pipe without shutting down the system.

(b) Fly ash line (Hopper gate to slurry pit)

a) Air slider canvas

Air slider canvas has become the cause of defects in the ash treatment suffering from blinding, wear and having holes as it has deteriorated along with the passage of time.

The number of canvas with holes, which suffer from functional deteriorations, is 19 (about 30%) of all the 56 units.

The leakage of air/fly ash caused by defective packing seal for the casing is often seen.

The replacement of canvas is not generally needed under the normal operation. Therefore, there seems to be something wrong with the methods of operation and maintenance.

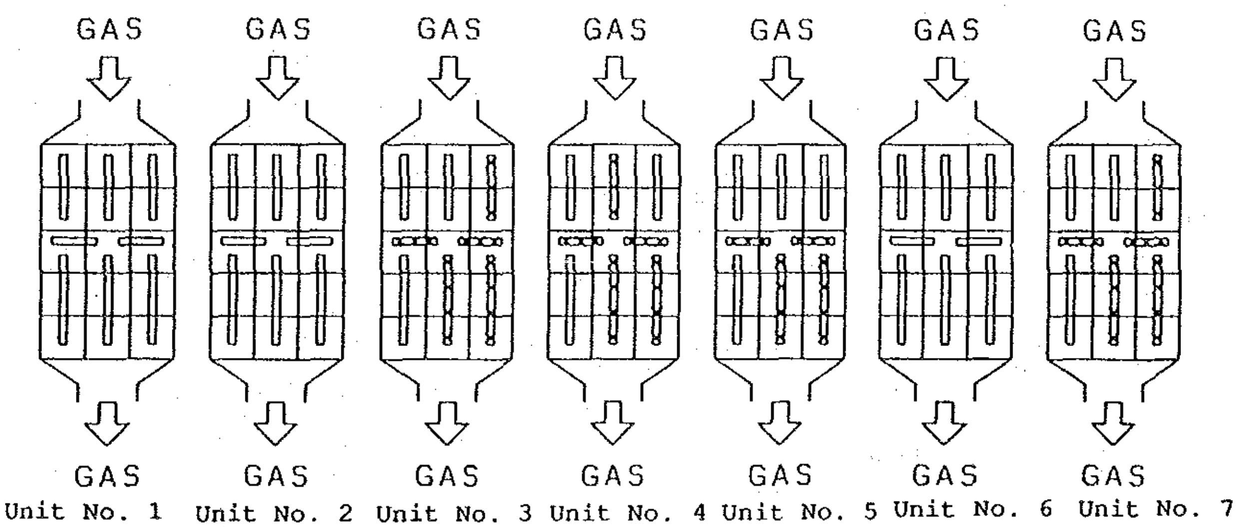


Fig. 4-2-10-(3) Distribution of Defective Places on Air Sliders (Worn or Damaged in holes)

b) Air for air sliders

Dry and warm air should be used for air sliders as much as possible. But, the leakage of outside air into the system, due to the damaged insulation of suction air pipes and defective casing seals, decreases the temperature of air.

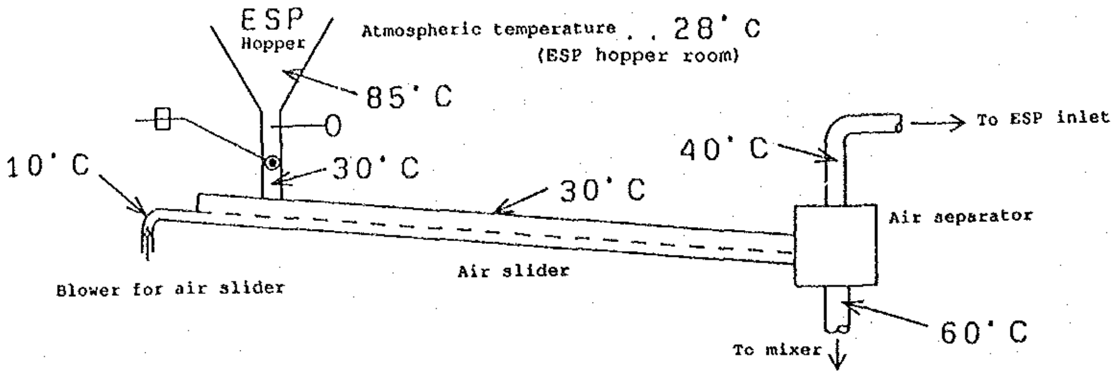


Fig. 4-2-10-(4) Temperature Condition in Fly Ash Line
(Unit No. 2, October 28, 1991)

(c) Ash disposal line

a) No. 1 and No. 2 's slurry pits water level control

Since the water level of slurry pits is control by manual operation of slurry pump outlet valves, the valves are wearing out and it makes long continuous operation difficult.

There is always one person in charge of this job (two people total are necessary for the No. 1 and No. 2 slurry pits) since the ten-minute-long operation shall be needed twice or three times in eight hours. As it is abnormal to allocate two persons for such a simple work, it should be improved.

b) Ash slurry pump outlet and inlet valves

The outlet valves cannot be closed completely since the lower portion of disk and bottom of seat of valves have been damaged by wear. When the ash slurry pumps are to be repaired, complete isolation cannot be achieved and repair of the pumps is difficult with such damaged valves.

It was proposed to the Mongolian side that the slurry pump outlet valves shall be in a position of full opening on full shut-out. When they are opened completely, the outlet valves' erosion problem is solved, but it can hardly control the water level in the slurry pits by existing facilities.

The inlet valves have a possibility that they cannot be completely closed either due to scale adhering and accumulation to them, but there are no distinct appearance for the moment.

c) Pressure gage at the outlet and inlet of the ash slurry pumps

Since there is no pressure gage at the outlet and inlet of the ash slurry pumps, the performance or operating condition of the pumps and the condition of the line (the condition of pressure loss due to the growth of scale inside the ash slurry pipe, etc.) cannot be grasped.

d) Ash slurry pump gland packing

Since the proper specifications (dimensions, materials) of packing haven't been used, water leakage takes place and grand sleeves are heavily weared out and then, the operation and maintenance of the pumps are troubled.

e) Ash slurry pipes

According to maintenance people, scale has grown up at a rate of about 20 mm, average thickness, inside all pipes in 3.5 and 4 years. In March

1991, the inside diameter was found to have decreased to an average of 80 to 120 mm at some parts of the ash slurry pipes of nominal diameter 400 mm. And the growth tend to decrease as it locates far from power station.

The growth rate of scale can be said to be the same as the growth rate of scale in Japan in consideration of the site conditions.

However, when it becomes impossible to transport ash slurry through even the back-up ash slurry pipe due to the growth of scale, such critical trouble as the shutdown of the boilers cannot be avoided. Therefore, the greatest attention should be given to this matter. Scale is piling up in layers and considerably hard.

The ash slurry pipes used for Units No. 1 to 6 were mechanically cleaned up for about four months from March 1991, and then the scale was completely removed from both systems on July 10, 1991. There was fortunately no problem with the pumping of ash slurry when it was confirmed in November, 1991.

Since the ash slurry pipes used for Units No. 7 and 8 have not been used for a long time since the completion of the pipes, scale adhering to them has not caused any problem yet.

(d) Feed water line (Feed water pumps - Feed water booster nozzles)

a) Pressure gages at the outlet and inlet of the feed water pumps

The pressure gages at the outlet and inlet of feed water pumps have not been maintained properly. The performance of the pumps and the situation of pressure loss increased by scale inside the feed water pipes cannot be grasped.

b) Feed water pipes for ash treatment

Scale inside the feed water pipes for Units No. 1 to 7 grew at the same rate as that of the ash slurry pipes, and the feed water pipes were cleaned by hydrochloric acid since pressure loss increased by scale interfered with the operation of the line.

Since the feed water pipes for Units No. 7 and 8 have not been used for a long time since the completion of the pipes, scale adhering to them has not caused any problem yet.

Scale piling up inside the feed water pipes is harder than that of the ash slurry pipes. And scale inside the three suction lines (with a length of about 10 m) for the feed water pumps grows rapidly in winter, and the lines should be washed at least once a year.

c) Feed water booster nozzle pipes

Scale growing inside the feed water booster nozzle pipes has caused slight pluggage.

The inside of the nozzle pipes cannot be washed by hydrochloric acid in the line.

Since the pipes have only one line, ash treatment cann't be done when the line is washed. Therefore, the continuous long time operation of the line will be difficult. A spare line should be installed quickly.

(e) Ash disposal pond

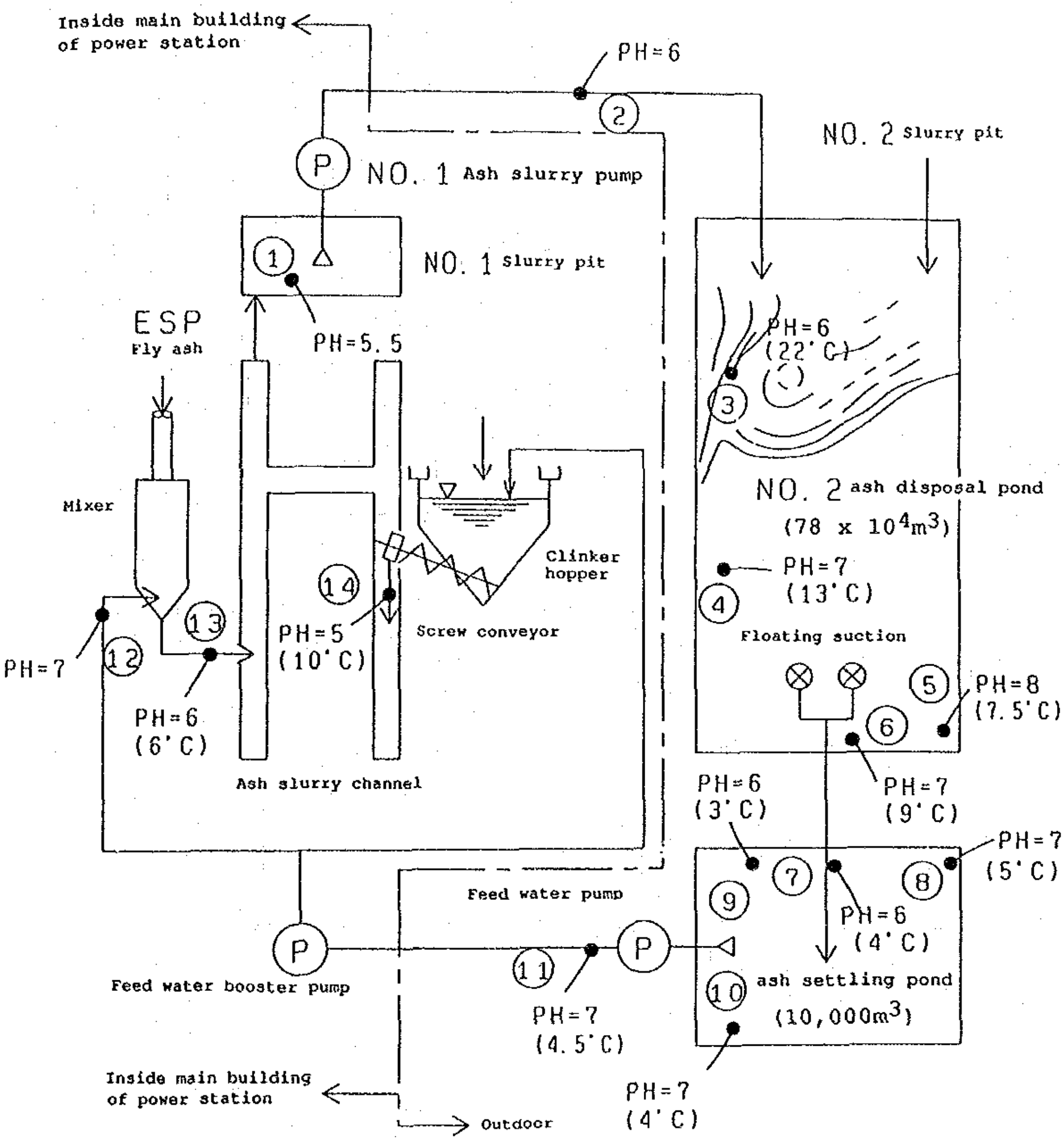
The ash disposal pond is about 4 km away from the power station, and believed to be systematically and properly managed and operated by giving consideration to area, location and so on.

(f) Settling pond

The settling pond is located next to the ash disposal pond and receives overflow water from the ash disposal pond.

Water is not recognized to be mixed with floating ash, and slightly looks white.

Fig. 4-2-10-(5) PH and Temperature of Water of Ash Treatment Water Line (October 28, 1991)



Location / Item	Slurry system		No. 2 ash disposal pond				Ash settling pond				Feed water system		Fly ash	Bottom ash	Remarks
	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫	⑬	⑭	
PH	5.5	6.0	6.0	7.0	8.0	7.0	6.0	7.0	6.0	7.0	7.0	7.0	6.0	5.0	
Temperature (°C)	—	—	22	13	7.5	9.0	4.0	5.0	3.0	4.0	4.5	—	—	10.0	

(Note: Obtained from the 4th Thermal Power Station)

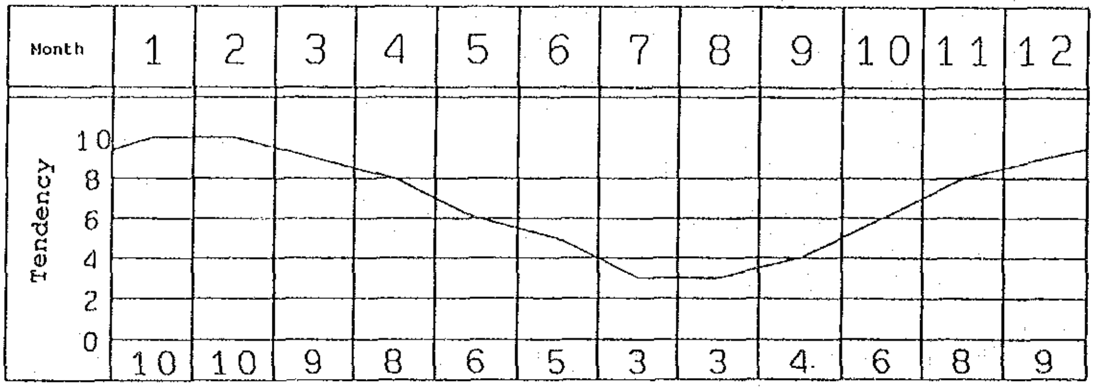


Fig. 4-2-10-(6) Tendency of Scaling in the Ash Treatment Water Line
(Note: Obtained from the 4th Thermal Power Station in October, 1991)

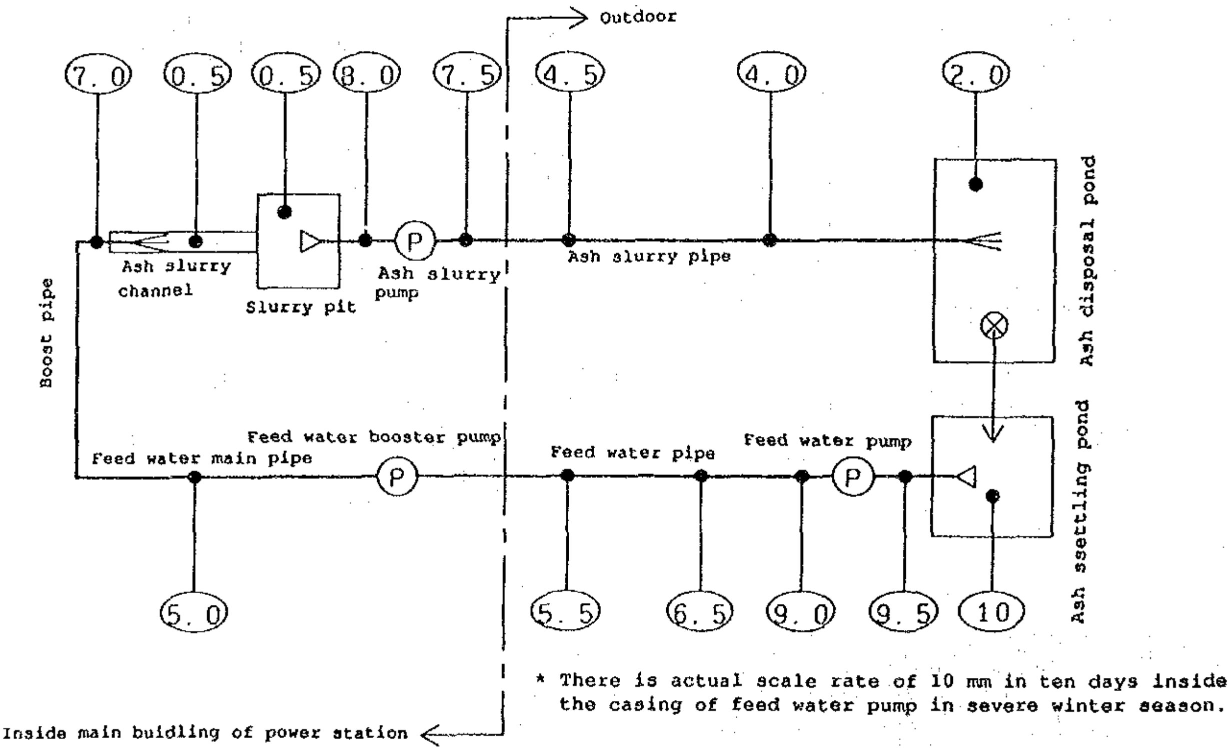


Fig. 4-2-10-(7) Scaling in Each Point of Ash Treatment Water Line
(Max. scale: 10 points)

2) Contents of failure and maintenance history

(a) Air sliders

a) Air slider canvas is replaced very frequently, once every two or three years.

If daily maintenance and periodic inspection are properly conducted, it should certainly last more than five years.

b) According to the number of inspections, shown in Table 4-2-19-(3), they can be said to be properly conducted from the viewpoint of their frequency. It would be assumed, however, that the current maintenance is incomplete as the canvas was not properly conserved after long-term shut-down of boiler and its inspection not fully executed before re-opertion of air slider from the viewpoint of the situation of canvas' choking.

Table 4-2-19 (3) Air Sliders' Maintenance History

Years		1989							1990							1991							Remarks
Item / Unit No.		1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7	
Air sliders and others, Inner side inspection maintenance	No. of times/ Year	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1	0	Repairs are not included.
Air sliders and others, General inspection	No. of times/ Year	2	2	2	2	1	1	0	1	2	3	2	2	1	1	2	2	2	3	1	1	1	
Air sliders, Canvas replacement	No. of replaced ones/Year	8	8	2	2	1	1	0	4	5	2	1	1	0	0	2	8	2	3	1	8	3	

(b) Pumps

As for damages of facilities in the ash treatment system, the frequency of pumps' repairs is very high since ash slurry is used and they are rotary machines.

The contents of damages and the maintenance history are shown in Table 4-2-20-(1). The record of ash slurry pumps in operation is also shown in Table 4-2-20-(2).

a) As shown in Table 4-2-20-(1), the number of pumps repair for 23 months from 1990 to October, 1991 is 89, and the average number is about 4 per month.

This number indicates the frequency of repairs is considerably high, and it is necessary to conduct protective maintenance from now on based on a more precise plan. If you are forced to try to execute the maintenance of pumps on a large scale such as the replacement of pumps themselves, the purchase of them will certainly take more than one year as you have to import them from the ex-Soviet Union. That is, the plan shall be completed more than one year before.

b) According to Table 4-2-20-(2), at least one of the ash slurry pumps (for Boilers No. 1 to 6) at the No. 1 pit is always in operation every month. Although those pumps are, always under sever conditions, pumping ash slurry and facing erosion, it is estimated that two spare pumps are used skillfully. The ash slurry pumps (for Boiler No. 7) in the No. 2 pit are also usually in operation except when the Boiler No. 7 is shut down, since the pumps is only used for Boiler No. 7 at the time. Therefore, operating hour may be less than 720 hours, but it doesn't mean the out of order of the pumps and the pumps themselves are imagined to have no problems at present.

c) The number of replaced gland sleeves was 39 and accounted for about 45% of the 89 total repaires.

   This valve indicates mal-setting of gland packing and immature maintenance technology. The seal water pressure may be inadequate but couldn't check it since these is no pressure gauge.

   Defective gland packing also seems to be used due to lack of proper one.

d) The number of replaced gland sleeves of ash slurry pumps is 25 and accounted for about 60% of the 39 total replacement of gland sleeves. The number of damage for ash slurry pump is clearly large.

e) The number of repaires related to bearings is large and standing at 18 (20%), which included 9 bearings damaged by burnt which take place after relatively-long period of operation.

   This valve indicates that daily inspection does not seem to be conducted satisfactory.

f) All the casings of feed water pumps for ash treatment were replaced three times due to their wear and so on in the past seven years.

   It is supposed that such pump casings were damaged by cavitation caused by decrease of the inside diameter of the suction pipes by scaling.

Table 4-2-20-(1) Maintenance History of Pumps in the Ash Treatment System at the 4th Thermal Power Station (November 5, 1991)

Item description	Year and month	1990: 1	2	3	4	5	6	7	8	9	10	11	12	1990 Sub-total	1991: 1	2	3	4	5	6	7	8	9	10	11	12	1991 Sub-total	Total
No. 1 ash slurry pump	A	○ ◪			○								◎	○-2, ◎-1, ◪-1: 4 cases	△ -●-		○			○ ※			○				○-3, △-1, -●--1, ※-1: 6 cases	○-15, ◎-2, △-2, ◪-5, ※-3, -●--2, ⊙-1: 30 cases
	B		○		○		◪		◪		◪			○-2, ◪-3: 5 cases		○ ※		※	○			○					○-3, ※-2: 5 cases	
	C			◪		○		○		○			⊙	○-3, ◪-1, ⊙-1: 5 cases	△ -●-			○		◎		○	Standby				○-2, ◎-1, △-1, -●--1: 5 cases	
No.2 ash slurry pump	A	◪		○			◪			△	⊙			○-1, ⊙-1, ◪-2, △-1: 5 cases	⊙					-●-			○	⊙ →			○-1, ⊙-2, -●--1: 4 cases	○-10, △-3, ◪-5, -●--1, ⊙-3: 22 cases
	B		◪		△			○			◪			○-1, ◪-2, △-1: 4 cases		○			Under test with capacity 800 t/h - 350 t/h								○-1: 1 case	
	C	○		◪			△			○				○-2, ◪-1, △-1: 4 cases	○		○			○			○				○-4: 4 cases	
No. 1 feed water booster pump	A		○			◎			□					○-1, ◎-1, □-1: 3 cases				◎									◎-1: 1 case	○-4, ◎-4, □-5: 13 cases
	B	□			○				○					○-2, □-1: 3 cases		○			◎						□		○-1, ◎-1, □-1: 3 cases	
	C					□			◎					◎-1, □-1: 2 cases			□										□-1: 1 case	
No. 2 feed water booster pump	A														⊙	□	○		⊙				⊙				○-1, ⊙-3, □-1: 5 cases	○-1, ⊙-3, □-1: 5 cases
	B	(Under construction)																										
Feed water pump	A				○				-●-			◎		○-1, ◎-1, -●--1: 3 cases	○		⊙			⊙ -●-							○-1, ⊙-2, -●--1: 4 cases	○-9, ◎-3, △-2, -●--3, -●--1, ⊙-2, -1: 20 cases
	B		○				-●-				◎			○-1, ◎-1, -●--1: 3 cases		○			○		△						○-2, △-1: 3 cases	
	C					◎			○					○-1, ◎-1: 2 cases			○				△						○-1, △-1: 2 cases	
	D				○				-●-					○-1, -●--1: 2 cases		○	Suspended due to damage of motor by lack of lubricant										○-1: 1 case	
Total														○-18, □-3, ⊙-2, ◎-6, ◪-10, △-3, -●--3: 45 cases													○-21, □-3, -●--1, ◎-3, ※-3, ⊙-7, △-4, -●--3: 45 cases	○-39, △-7, ※-3, ◎-9, □-6, -●--6, ⊙-9, ◪-10, -●--1: 90 cases

(Legend)
○ : Replacement of ground sleeve
◎ : Replacement of bearing
△ : Replacement of impeller
□ : Replacement of balance disc
◪ : Casing repaired by build-up welding
※ : Casing repalced
-●- : Shaft replaced (Bent shaft)

(Note: Obtained from the 4th Thermal Power Station)

Table 4-2-20-(2) Monthly Operating Record of Ash Slurry Pumps at the 4th Thermal Power Station (1990)

	Months / Pumps	1	2	3	4	5	6	7	8	9	10	11	12	Total
Slurry pit No. 1	1	263	289	347	445	109	508	408	73	109	469	365	350	3,735
	2	240	317	243	78	358	49	108	189	461	108	188	290	2,629
	3	241	146	163	625	278	206	243	526	297	189	216	107	3,237
	Total	744	752	753	1,148	745	763	759	788	867	766	769	747	
Slurry pit No. 2	4	-	218	263	325	298	208	104	239	275	463	166	160	2,719
	5	-	409	238	109	194	263	416	408	246	208	529	220	3,240
	6	-	124	188	244	252	216	132	120	229	32	-	288	1,825
	Total	-	651	689	678	744	687	652	767	750	703	695	668	

(Note) . If the total number of operating hours a month is 720 or above, it is indicated that at least one of the pumps is in operation (in a normal condition).
. Obtained from the 4th Thermal Power Station in October, 1991

(c) Valves

a) Valves used for ash No. 1 slurry pump

3 inlet valves and 10 outlet valves are installed, and it is now necessary to replace 10 outlet valves with new ones.

Since the water level of the slurry pit is controlled by the outlet valves of the ash slurry pump, lower portion of valve disks and seats have been worn and should be replaced soon.

b) Valves used for ash No. 2 slurry pump

13 valves are installed.

Similar to ash No. 1 slurry pump, it seems necessary to replace outlet valves sooner or later. The number of valves expected to be replaced is 6.

c) Worn valves are repaired by welding at maintenance, and scale adhered valves by hammering scale away. When such repairs are repeated many times, the valves cannot maintain their original shop any more and become necessary to replace.

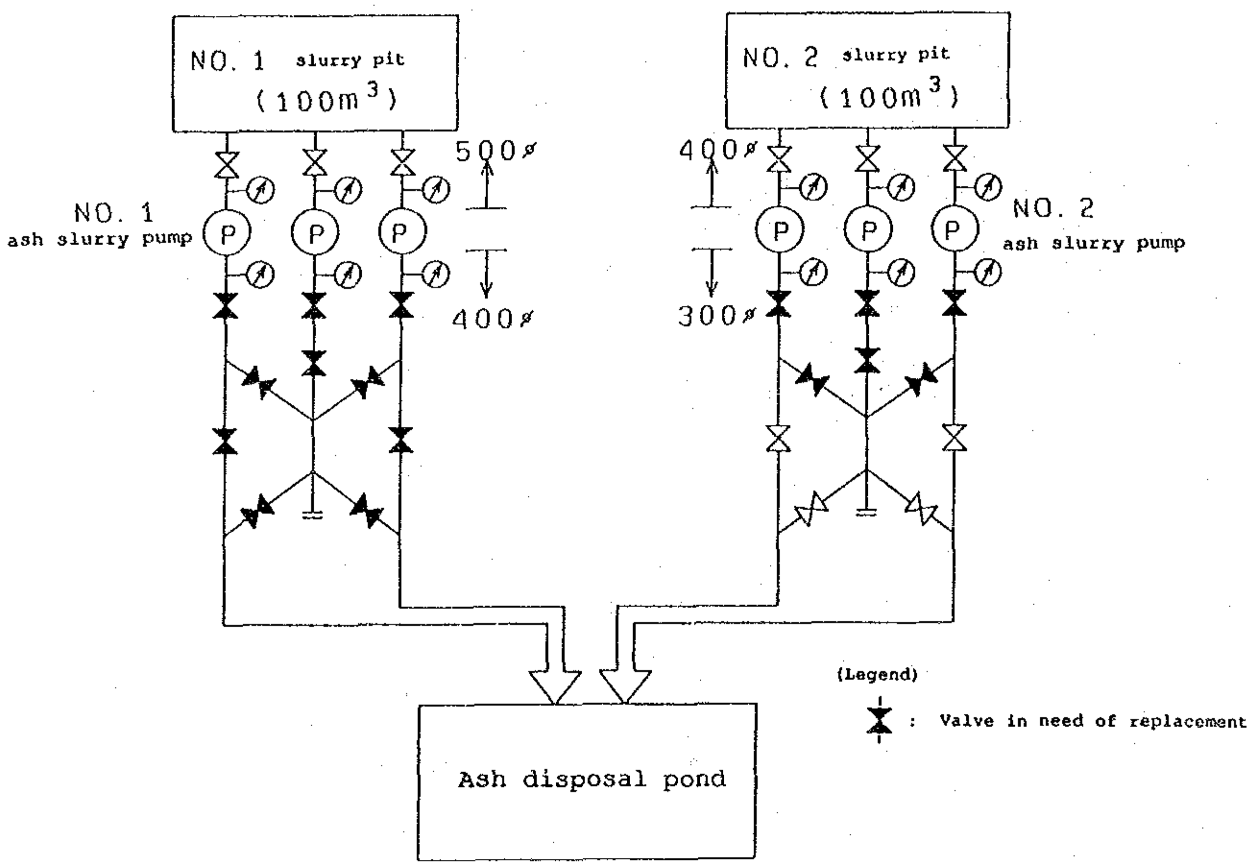


Fig. 4-2-10-(8) Layout of Slurry Valves at Ash Slurry Pumps

Table 4-2-21 (1) Analytic Results of Ash and Ash Treatment Water

Items		Unit	EP ash -1	EP ash -2	Scale inside ash slurry pipes	Analytic methods
Ash analysis	SiO_2	Waterfree %	63.2	71.6	2.68	JIS-M-8815
	Al_2O_3	Waterfree %	14.6	11.4	1.01	JIS-M-8815
	Fe_2O_3	Waterfree %	5.00	3.73	0.40	JIS-M-8815
	CaO	Waterfree %	6.71	3.28	< 0.01	JIS-M-8815
	$CaCO_3$	Waterfree %	0.07	0.21	93.7	JIS-M-8815
	$CaSO_4$	Waterfree %	0.24	0.05	1.12	JIS-M-8815
	MgO	Waterfree %	1.10	0.65	1.06	JIS-M-8815
	Na_2O	Waterfree %	0.65	1.11	0.07	JIS-M-8815
	K_2O	Waterfree %	2.67	4.37	0.06	JIS-M-8815
	TiO_2	Waterfree %	0.54	0.36	0.02	JIS-M-8815
	P_2O_5	Waterfree %	0.08	0.08	0.14	JIS-M-8815
	SO_3	Waterfree %	0.14	0.03	0.66	JIS-M-8815
	Cl	Waterfree %	0.035	0.049	0.015	Bomb method
Radioactivity (Micro-Sv/h)			0.07	0.07	-	Survey meter method

Table 4-2-21 (2) Analytic Results of Ash and Ash Treatment Water

Items		Unit	EP ash -1	EP ash -2	Scale inside ash slurry pipes	Analytic methods
Particle size	> 149 m	%	1.19	26.00	-	JIS-A-1204
	149-74 m	%	31.11	31.67	-	JIS-A-1204
	74-63 m	%	4.42	9.92	-	JIS-A-1204
	63-44 m	%	15.99	10.15	-	JIS-A-1204
	44-37 m	%	5.90	4.22	-	JIS-A-1204
	37-32 m	%	2.54	2.34	-	JIS-A-1204
	32-25 m	%	5.90	2.14	-	JIS-A-1204
	25-20 m	%	6.61	2.93	-	JIS-A-1204
	20-15 m	%	1.72	0.87	-	JIS-A-1204
	15-10 m	%	2.28	0.49	-	JIS-A-1204
	10- 8 m	%	3.60	1.61	-	JIS-A-1204
	8- 6 m	%	6.26	1.80	-	JIS-A-1204
	6- 4 m	%	6.41	2.34	-	JIS-A-1204
	4- 2 m	%	3.24	1.76	-	JIS-A-1204
	2- 1 m	%	1.82	1.13	-	JIS-A-1204
	1-0.5 m	%	0.52	0.41	-	JIS-A-1204
	< 0.5 m	%	0.19	0.22	-	JIS-A-1204
	True specific gravity	g/cm^3	2.22	2.34	-	JIS-Z-8807

m: micron

Table 4-2-21 (3) Analytic Results of Ash and Ash Treatment Water

Items		Unit	EP ash -1	EP ash -2	Scale inside ash slurry pipes	Analytic methods
Water quality	Names of samples	-	Slurry water for ash treatment	High-pressure water for ash treatment	-	
	SS	mg/l	23,000	5	-	JIS-K-0102
	Na	mg/l	41	81	-	JIS-K-0102
	Ca	mg/l	970	130	-	JIS-K-0102
	Cl	mg/l	48	61	-	JIS-K-0102

SS: Suspended Solid

* Radioactivity: Background value = Micro-Sv/h
* Sampled at the 4th Thermal Power Station in October, 1991 and analyzed in Japan

(d) Ash slurry pipes

Scale was removed from inside the ash slurry pipes used for Units No. 1 to 6 since scale adhering to the pipes caused high pressure loss, resulting in interference with the operation of the boilers. As shown in Table 4-2-21, scale contains 93.7% $CaCo^3$. Since scale forms as exothermic reaction, scale tends to form heavily inside the ash slurry pipes at some places whose temperature is changed by outside conditions.

Scale removal was executed as follows.

a) Execution period: from March to July, 1991

b) Execution range: 426 mm x 12t x about 3.2km/system x 2 systems (one spare system)

c) Execution method: Pipes are cut off at intervals of 8 m and scale is then removed by hammer, etc.

Since the ash slurry pipes (325 mm x 12t x about 3.7km/system x 2 systems) for Units No. 7 and 8 were installed in November, 1989, they have not been used for a long period of time and the quantity of scale is small, there is basically no problem with them at present.

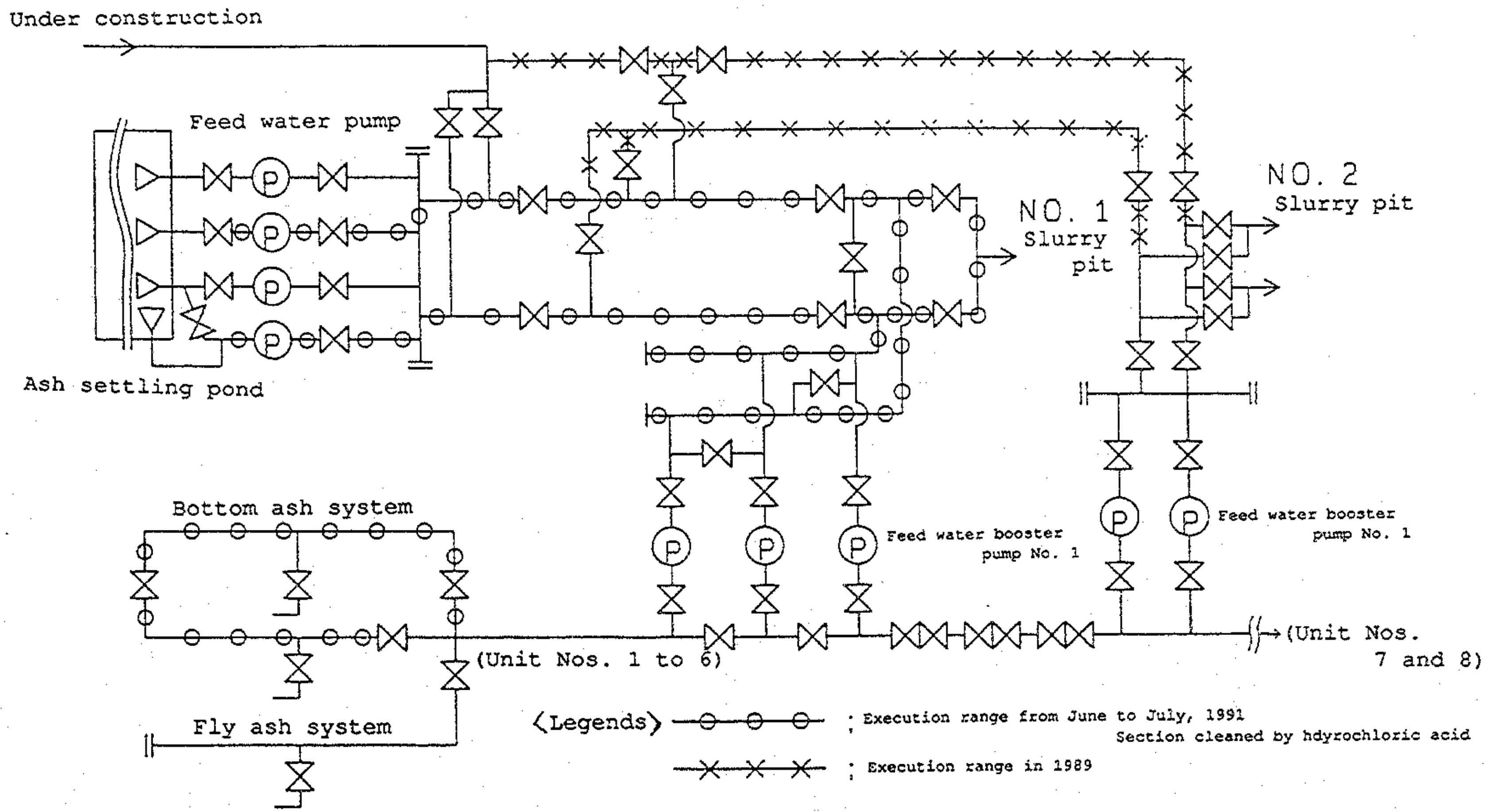
(e) Feed water pipes for ash treatment

a) Similar to the ash slurry pipes, scale adhering to the inside of the feed water pipes grew, decreased water pressure and interfered with the operation of the system. The pipes were finally cleaned by hydrochloric acid (imported from the ex-Soviet Union) from June to July, 1991. The effect of scale removal has achieved good results except some thin pipes such as ash slurry pipes' booster nozzle feed water pipes (Fig. 4-2-11 shows the execution range).

b) In order to prevent ash in large particle size from sinking inside the ash slurry pipe's booster line in the bottom ash line and to supply feed water while nozzles are cleaned, one spare line was installed in October, 1987. Therefore, there are two lines total at present.

The fly ash line consists of only one feed water line, and it is difficult to conduct the inspection of the line and to supply feed water while the line is cleaned. Another line should be installed.

Fig. 4-2-11 Implementation Scope of Cleaning the Feed Water Pipe for Ash Treatment with Hydrochloric Acid



(3) Pulverized coal feed systems

According to the record of troubles for all boilers at the 4th thermal power station, the biggest cause of troubles was the shutdown of boilers caused by the failure of pulverized coal feed systems and the second greatest cause of troubles was the shutdown of boilers caused by the trouble of boilers themselves. As shown in 4.2.3 of this chapter, these two main causes occupied almost all the trouble.

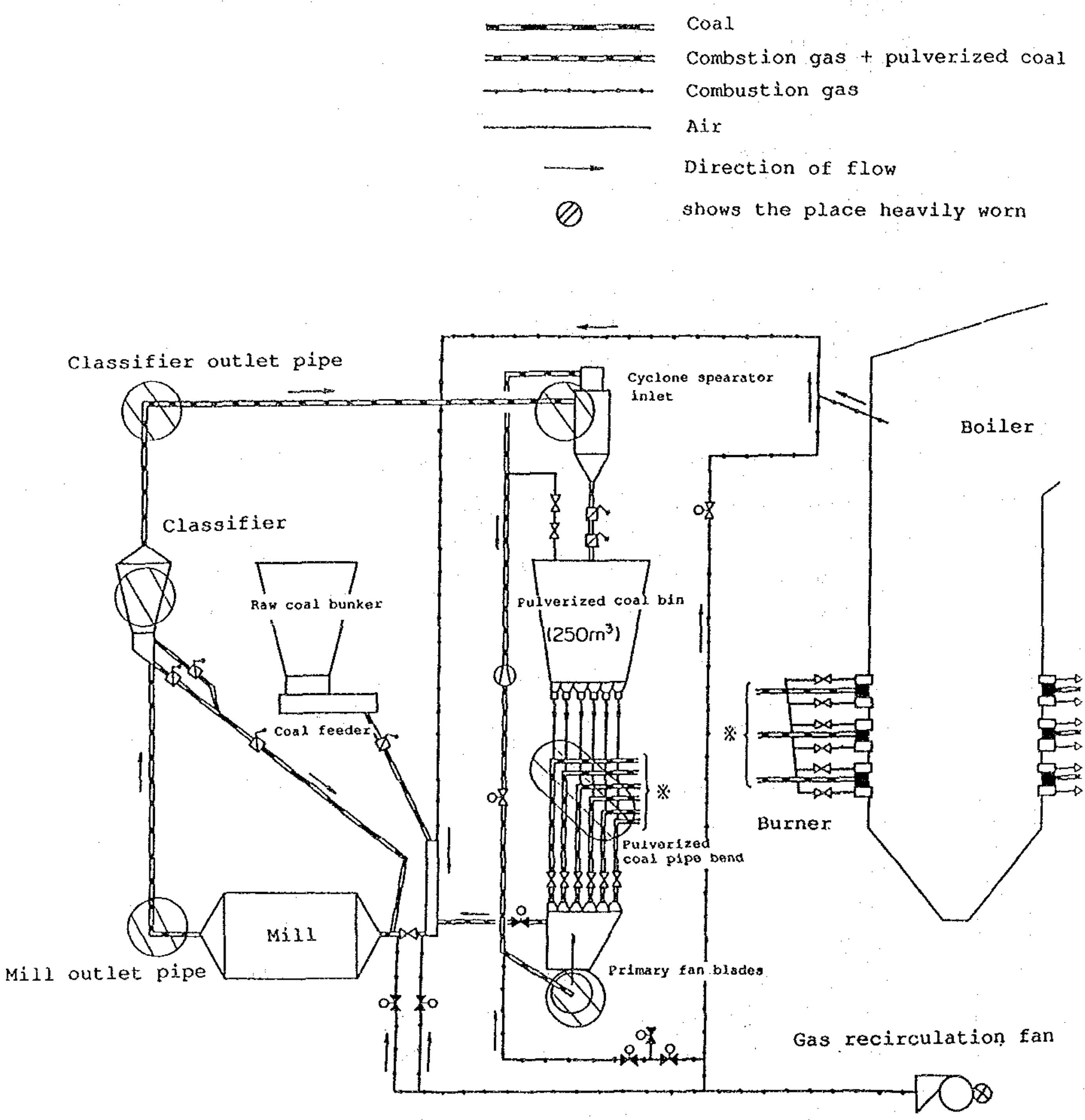
The leakage of pulverized coal was seen on investigation in October, 1991. According to maintenance people on the Mongolian side, 3 to 8 bends are in trouble with holes everyday.

Proper steel plates are generally welded to holes as repairs, and those parts are completely replaced with new ones when it is impossible to further weld them to those parts any more after being repeatedly done. Therefore, various kinds of repaired conditions are seen from the No. 1 boiler to the No. 7. Maintenance people have to much work. It is understandable that the Mongolian side wants to ask us to decrease these matters by all means.

Since there are two pulverized coal firing lines for each boiler at the 4th thermal power station, the boiler can be in operation while one line is repaired and the other line is in service. The trouble of them does not directly cause the shutdown of boilers so often, and it accounts for 4.2% of the total causes. But the frequency of repairs is abnormally high and it is necessary to decrease the frequency of repairs in a hurry by improving their wear resistance.

Pulverized coal feed systems are in all places damaged by wear. The places, which are heavily damaged by wear and the Mongolian side cannot afford to repair perfectly, are shown in Fig. 4-2-12. Their situation is explained below.

Fig. 4-2-12 Places of Heavy Wear in Pulverized Coal Feed System



1) Situation of repaired part

(a) Mill outlet pipe

The bend of the pipe with an angle of 30°, which is a first bend of pulverized coal pipe from the mill, is heavily worn out. According to the power station side, there has been no major trouble which caused the shutdown of the boilers, but the frequency of repairs is high. Each outlet pipe is repaired three times a week.

Fig. 4-2-13 shows the pictures of site conditions.

Photo-1 Mill Outlet Pipe (middle of the photo)

Photo-2 Interior of Mill Outlet Pipe, Part 1
A steel plate is welded to the hole.

Fig. 4-2-13 Photographs of Site Conditions

Photo-3 Interior of Mill Outlet Pipe, Part 2

Many steel plates are welded to the places damaged by wear in the No. 2 boiler.

(b) Classifiers

The classifier is entirely damaged by wear, and especially the inner cone, of which pulverized coal first runs against, is severely damaged by wear.

The number of repair cases in the past is shown in Table 4-2-22.

This table indicates the following characteristics.

a) The number of repair cases is increasing year by year.

b) The number of repair cases is not directly related to the total number of boiler operating hours. The number of repair cases differs depending on the boilers. It also differs depending on the situation of bends and is supposed to be related to the turbulent flow of pulverized coal.

c) There has been no major trouble which caused the shutdown of boilers in Units No. 2 to 7. However, in the boiler unit No. 1 the leakage of pulverized coal took place to cause the shutdown of the boiler 5 times a year.

d) In the No. 7 boiler, the total number of repair cases after the operation started, has already reached 10 within 2 years.

Table 4-2-22 Annual Average Number of Repair Cases on Classifiers

Unit number	1	2	3	4	5	6	7	Total	Average
Past 1 year	55	83	62	68	5	11	10	294	42
Past 3 years	50	43	72	63	29	3	-	260	37

(Note) Date of investigation: November 1991

Fig. 4-2-14 shows the pictures of classifiers' site conditions.

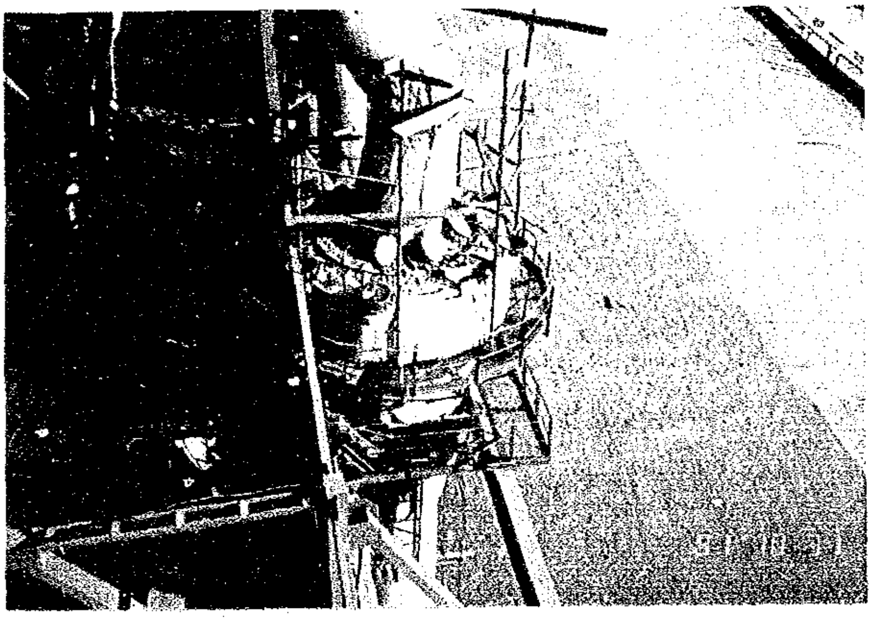


Photo-1 Classifier

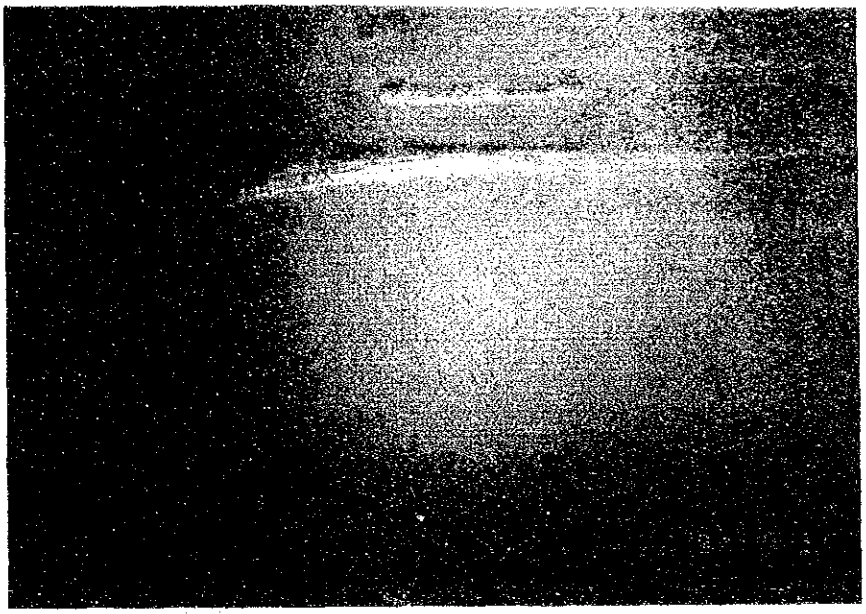


Photo-2 Interior Cone of Classifier

Fig. 4-2-14 Photographs of Site Conditions

(c) Classifier outlet pipe

The bend of the pipe with an angle of 50°, of which pulverized coal first runs against after coming from the classifier is severely damaged by wear. There have been no major trouble which caused the shutdown of boilers, but the frequency of repairs is high.

The number of repair cases in the past is shown in Table 4-2-23.

This table indicates the following characteristics.

a) The number of repair cases is increasing year by year.

b) The number of repair cases tends to increase along with the increase in the number of boilers' operating hours. The reason for this tendency is supposed to be that the flow of pulverized coal inside the pipe is similar to a laminar flow.

Table 4-2-23 Annual Average Number of Repair Cases on Classifiers Outlet Pipes

Unit number	1	2	3	4	5	6	7	Total	Average
Past 1 year	41	35	45	29	6	8	2	166	24
Past 3 years	22	17	19	33	10	12	-	113	16

(Note) Date of investigation: November 1991

Since this place is severely damaged by wear, its rehabilitation will be conducted in the near future by the power plant side.

Fig. 4-2-15 shows the classifier outlet pipe.

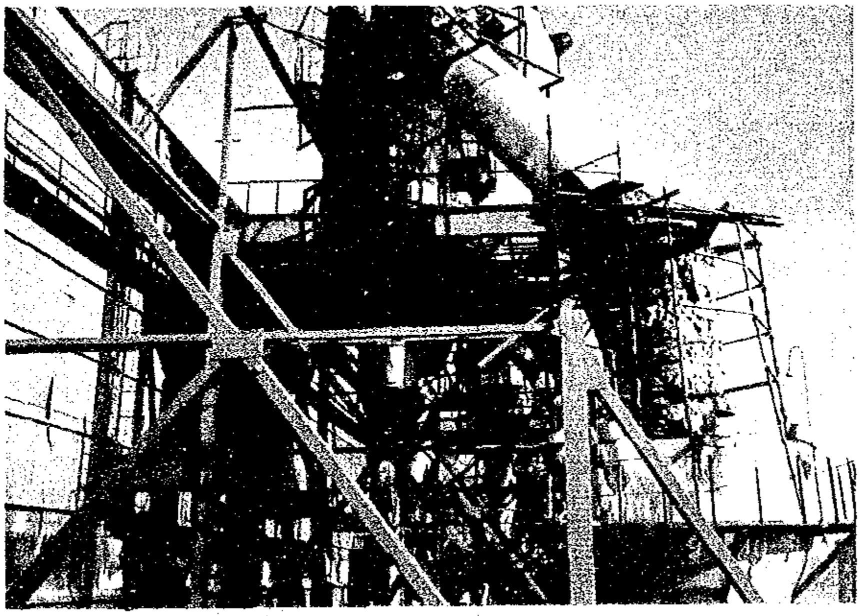


Fig. 4-2-15 Photographs of Site Conditions of Outlet Pipe of Classifier (right side of photo)

(d) Cyclone separator

The wall on the inlet side, in which pulverized coal first runs against, is severely damaged by wear. There has been no major trouble which caused the shut-down of boilers, but the frequency of repairs is high.

The number of repair cases in the past is shown in Table 4-2-24.

Table 4-2-24 Annual Average Number of Repair Cases on Cyclone Separators

Unit number	1	2	3	4	5	6	7	Total	Average
Past 1 year	36	23	56	76	10	12	8	221	32
Past 3 years	33	27	52	42	11	7	-	172	25

(Note) Date of investigation: November 1991

This table indicates the following characteristics.

a) The number of repair cases is increasing year by year.

b) The number of repair cases is not directly related to the number of boilers' operating hours. The reason for this tendency is supposed to be that the flow of pulverized coal inside the pipe is a turbulent flow in a way similar to classifiers.

Fig 4-2-13 shows the pictures of cyclone separators' site conditions.

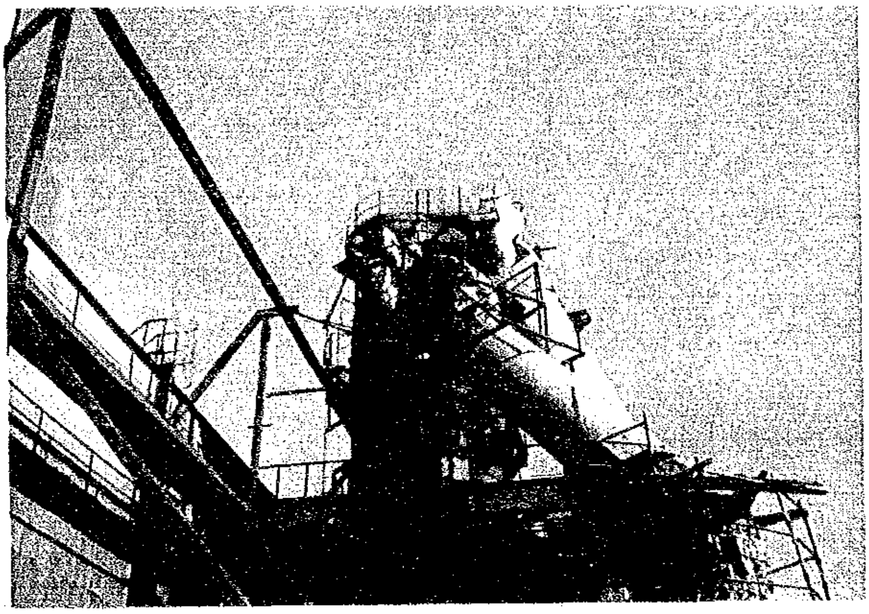


Photo-1 Entire Cyclone Separator (Inlet located in the middle of the photograph)

Fig. 4-2-16 Photographs of Site Conditions

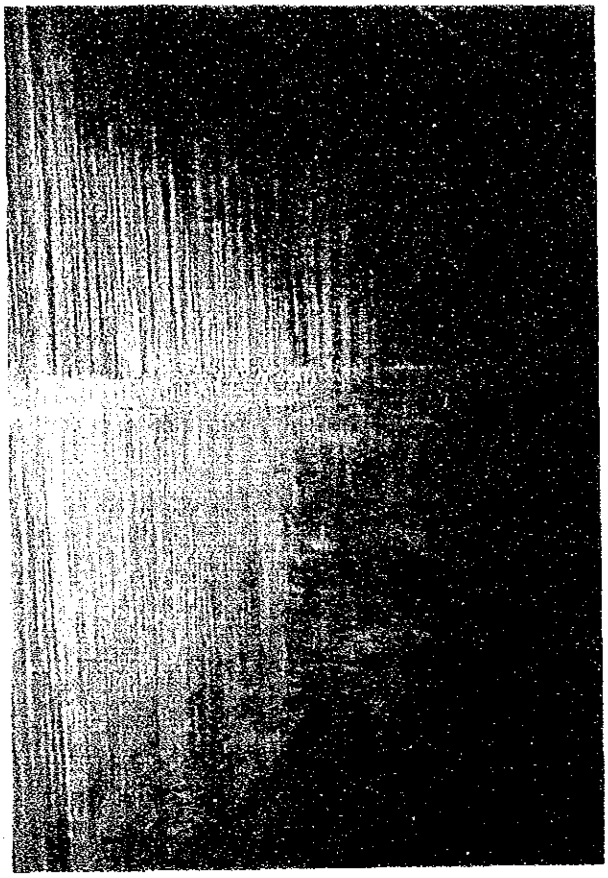


Photo-2 Interior of Cyclone Separator (Sidewall of Inlet)

(e) Pulverized coal pipe bend

The bend of the pipe is heavily damaged by wear. There has been no major trouble causing the shutdown of the boilers. However, as the total number of bends for each boiler is large, standing at 72 including 66 bends with an angle of 30' or more, the frequency of repairs is very high.

According to the Mongolian side, the order of repairs is as follows.

a) The shape of a bend is originally a pipe, and if a hole forms, it is covered with a steel plate. This is repeated.

b) After the above repair, if repeated often, the bend itself is replaced with a steel plate construction.

c) If this plate has a hole, the hole is covered with another steel plate.

Table 4-2-25 shows the number of repair cases in the past.

This table indicates the following characteristics.

a) The number of repair cases is increasing year by year.

b) The bends with an angle of more than 30° causes trouble with holes.

c) The number of repair cases differs depending on the boilers, and they are not increasing together with an increase in the number of boilers' operating hours. The flow of pulverized coal inside the pulverized coal pipe is supposed to be similar to a laminar flow. The number of bend repair cases increases when they are more severely damaged by wear depending on their direction of installation and the conditions of the inner bends.

Table 4-2-25 Annual Average Number of Repair Cases on Pulverized Coal Pipes' Bends

Unit number	1	2	3	4	5	6	7	Total	Average
Past 1 year	339	211	410	109	355	147	96	1,677	238
Past 3 years	333	272	318	184	256	63	-	1,426	204

(Note) Date of investigation: November 1991

Fig 4-2-16 shows the pictures of pulverized coal pipe bend's site conditions. They mainly show that the plate type bend has been covered with another steel plate for repairs.

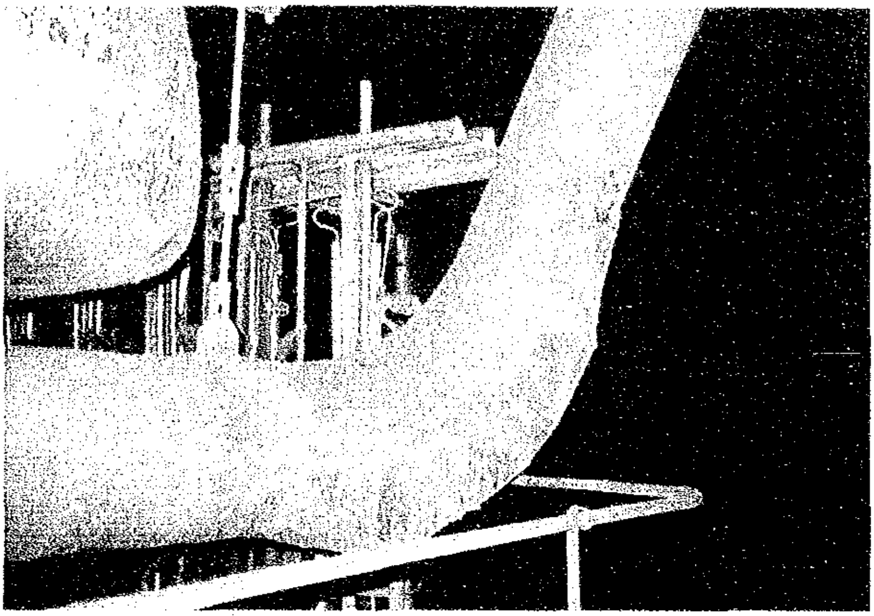


Photo-1 Pulverized Pipe Bend (Plate), Part 1

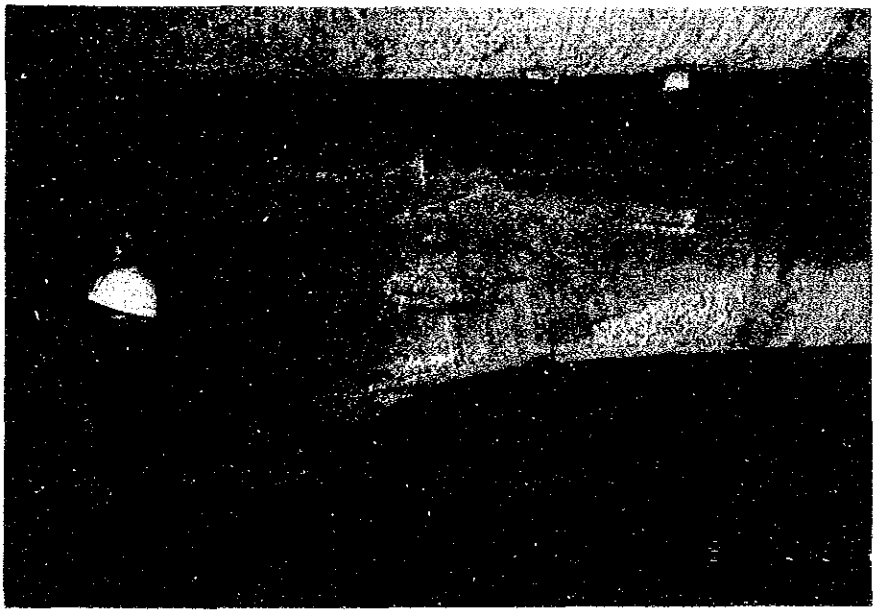


Photo-2 Pulverized Pipe Bend (Plate), Part 2
The bend (a pipe) is seen in the middle of the photo.

Fig. 4-2-17 Photographs of Site Conditions

Photo-3 Pulverized Pipe Bend (Plate), Part 3

(f) Primary fans

The situation of primary fan operation and maintenance is shown in Table 4-2-26.

Wear concentrates on the surface of blades, on which pulverized coal is severely sliding. Their surface is mainly repaired by welding.

Since there are 2 primary fan lines, there have been few cases which directly caused the shutdown of boilers. It is necessary to improve the wear resistance of the blades and to decrease the time of repairs.

This table indicates the following characteristics.

a) As for severely wearing blades, balance adjustment was often made 1.2 times a month as made in the