5. Conceptual Design of DeSOx System

A conceptual design of the DeSOx system was carried out based on the study result of the selection of the optimum DeSOx system for Melnik Power Station.

In Table 5-1 and 5-2, design conditions and planned performance of the FGD Units are shown respectively.

A general layout of the FGD Units is shown in Fig. 5-1.

In Fig. 5-2 and in Table 5-3, a flow diagram and specifications of major equipment of the FGD Units are shown respectively.

In Fig. 5-3 and Fig. 5-4, material balance for FGD Units for Part II and Part III are shown, respectively.

Outlines of major equipment are as follows:

(1) Absorber : Single tower, in-situ oxidation, spray tower method (General view of the absorber is shown in Fig. 5-5 and selection list of lining material including for the absorber is shown in Fig. 5-6.)

(2) Boost Up Fan (BUF) : Axial fan, fixed blade, "A" position (Between IDF and Gas/Gas Heater)

(3) Flue Gas Reheating System : It is installed for the purpose of preventing corrosion of stacks and flue gas ducts and of improving an effect of exhaust gas dispersion from stacks.

Regenerative rotating type Gas to Gas Heat Exchangers (GGH) which has good reliability and economic is selected for flue gas reheating system.

(4) By-product Treatment : Of all gypsum from Part II and Part III, 100,000 tons of gypsum is shipped to the gypsum board factory being planned to be built adjacent to the Power Station. The rest of gypsum is disposed.

(5) Electrical Equipment : Electrical equipment is powered by a newly installed DeSOx transformer which is connected with secondary 110 kV bus bar of the existing main transformer of Part II through a circuit breaker.

(6) Control Equipment : The latest model of digital controller is selected as the control equipment.

Major facilities which are necessary to be reconstructed, remodeled, removed or relocated due to DeSOx system installation are as follows.

(1) Flue Gas Common Ducts at Stack Inlet
(2) Inner Material of Stack for Acid Resistance Lining
(3) Material Warehouse and Coal Train Defreezing Tunnel
(4) Ash-slurry Transportation Piping and Hot-water Supply Piping

Table 5-1 Design Condition of FGD Units

	Item	Unit	Design Condition	
			Part II for 1 Unit	Part III
1.	Capacity of Power Plant	MW	110	500
2.	FGD Process	-	Wet-Limestone-Gypsum	Wet-Limestone-Gypsum
3.	Total Gas Flow Rate	m^3N/h, wet	521,000 (530,000)*	2,127,000 (2,300,000)*
	FGD Inlet Flue Gas Rate	"	417,000 (440,000)*	2,127,000 (2,300,000)*
4.	Inlet Flue Gas Temperature	°C	190	170
5.	Inlet Flue Gas Composition			
	H_2O	vol%	13.0	13.4
	O_2	vol%	8.0	7.5
	SO_2 (as O_2=6% & Dry base)	mg/m^3N, dry	4,840	4,840
	HF (")	mg/m^3N, dry	94.6	94.7
	HCl (")	mg/m^3N, dry	19.1	19.1
	SO_3 (")	mg/m^3N, dry	48.4	48.8
6.	SO_2 Removal Efficiency	%	70 (91)**	85
7.	Dust Concentration			
	Outlet of the Existing EP	mg/m^3N, dry	<100	
8.	Absorbent	-	Limestone	
	Purity	%	96% or more	
	Grain Size	ϕ mm	22.5 - 80	
9.	Gypsum		To be discarded	To be used as the material of gypsum board
10.	Outlet Flue Gas Temperature at the Inlet of the Stack	°C	100	
11.	Cl Concentration in Make-up Water	mg/ℓ	27	

* Flue gas flow rate in ( ) is the normal value.
** Figure in ( ) shows the value with consideration of the duct by-passing and GGH leakage.

Table 5-2 Design Performance of FGD Units

	Item	Unit	Design Performance	
			Part II for 1 Unit	Part III
1.	Capacity of Power Plant	MW	110	500
2.	Gas Flow Rate	m^3N/h, wet	417,000	2,127,000
3.	Inlet Gas Condition			
	Temperature	°C	190	170
	SO_2 (as O_2=6% & Dry base)	mg/m^3N	4,840	4,840
	*SO_3 (")	mg/m^3N	48.4	48.4
	Dust Load	mg/m^3N	100	100
4.	Outlet Gas Condition			
	Temperature	°C	100	100
	SO_2 (as O_2=6% & Dry base)	mg/m^3N	1,452	726
	SO_3 (")	mg/m^3N	24	24
	Dust Load	mg/m^3N, dry	40	40
5.	SO_2, Removal Efficiency	%	70	85
6.	Ca/S (Injected Ca/Treated S)	-	1.06	1.06
7.	Draft Loss of FGD Plant	mmAq	230	230
8.	Gypsum Slurry	t/h	4.27	22.73

Remarks: The value with the * mark is the assumption with 1% of the SO_3 conversion rate in the boiler (furnace), and it is necessary to measure the actual SO_3 concentration in flue gas at the definite design stage in order to consider the prevention measures from corrosion condition of the flue gas line (ie: inner surface of flue gas duct and GGH elements.)

Table 5-3 **Specification of Major Equipment for FGD System of Melnik Power Station**

(1/9)

Equipment	Specification
[Part II]	
II - 1 Absorbing System	
1) Absorber	
Number	1 x 4 Units
Type	Spray Tower
Dia. x Height	ϕ 8.0 m x H 22.5 m
Capacity	440,000 m^3N/h
2) Absorber Recirculation Pump	
Number	4 x 4 Units
Type	Centrifugal
Capacity	30 m^3/min
Head	20 m
Motor	145 kW
3) Absorber Bleed Pump	
Number	4 + 4 Stand-by
Type	Centrifugal
Capacity	0.55 m^3/min
Head	15 m
Motor	45 kW
4) Agitator for Absorber Recir. Tank	
Number	2 x 4 Units
Type	Horizontal Axial Propeller
Motor	30 kW
5) Oxidation Agitator on Absorber	
Number	3 x 4 Units
Type	Horizontal Axial Propeller
Motor	30 kW
6) Oxidation Air Blower (Common for 2 Units)	
Number	2 + 1 Stand-by
Type	Rotary Blower
Capacity	22 m^3/min
Head	0.6 kg/cm^3g
Motor	110 kW
7) Slurry Holding Tank (Common for 4 Units)	
Number	1
Type	Vertical Cylinder
Capacity	1,770 m^3
8) Slurry Holding Tank	
Transfer Pump (Common for 4 Units)	1 + 1 Stand-by
Number	Centrifugal
Capacity	13 m^3/min
Head	23 m
Motor	75 kW

Equipment	Specification
9) Absorber Area Drain Pit (Common for 2 Units)	
Number	1 x 2 Units
Type	Underground Concrete Pit
Capacity	22 m^3
10) Absorber Area Drain Pump (Common for 2 Units)	
Number	1 x 2 Units
Type	Centrifugal
Capacity	2.4 m^3/min
Head	20 m
Motor	15 kW
11) Emergency Head Tank	
Number	1 + 4 Units
Type	Vertical Cylinder
Capacity	5 m^3
II - 2 Gypsum Recovery System	
1) Centrifuge (Comon for 4 Units)	
Number	4 + 1 Stand-by
Capacity (as dry Gypsum)	1,200 kg/h/batch
Motor	160 kW
2) Centrifuge Filtrate Pit (Common for 4 Units)	
Number	1
Type	Vertical Cylinder
Capacity	88 m^3
3) Centrifuge Filtrate Pump (Common for 4 Units)	
Number	1 + 1 Stand-by
Type	Centrifugal
Capacity	2.7 m^3/min
Head	38 m
Motor	30 kW
4) Blow Down Tank (Common for 4 Units)	
Number	1
Type	Vertical Cylinder
Capacity	1.2 m^3
8) Blow Down Pump (Common for 4 Units)	
Number	1 + 1 Stand-by
Type	Centrifugal
Capacity	0.01 m^3/min
Head	20 m

Equipment	Specification
II-3 Draft System	
1) Boost Up Fan	
Number	1 x 4 Units
Type	Axial Flow
Capacity	13,700 m^3/min
Head	270 mmAq
Motor	700 kW
2) Flue Gas Reheating System	
Number	1 x 4 Units
Type	Rotary Regenerative type Gas to Gas Heat Exchanger
Capacity	5.0 x 10^6 Kcal/h
Motor	5 kW
3) Bypass Damper	
Number	1 x 4 Units
Type	Multi Louver
Material	Corten
4) Inlet Isolation Damper	
Number	1 x 4 Units
Type	Multi Louver
Material	Carbon Steel
5) Outlet Isolation Damper	
Number	1 x 4 Units
Type	Multi Louver
Material	Corten
II - 4 Auxiliary System	
1) Make-up Water Pump (Common for 4 Units)	
Number	1 + 1 Stand-by
Type	Centrifugal
Capacity	2.3 m^3/min
Head	20 m
Motor	15 kW
2) Air Compressor (Common for 2 Units)	2 + 1 Stand-by
Number	Reciprocating
Type	50 m^3_N/H
Capacity	7 kg/cm^2g
Pressure	90 kW
Motor	

Equipment	Specification
[Part III]	
III - 1 Absorbing System	
1) Absorber	
Number	1
Type	Spray Tower
Dia. x Height	ϕ 18.1 m x H 24.8 m
Capacity	2,300,000m^3N/h
2) Absorber Recirculation Pump	
Number	8
Type	Centrifugal
Capacity	74 m^3/min
Head	21 m
Motor	390 kW
3) Absorber Bleed Pum	
Number	1 + 1 Stand-by
Type	Centrifugal
Capacity	2.9 m^3/min
Head	28 m
Motor	37 kW
4) Agitator for Absorber Recir. Tank	
Number	6
Type	Horizontal Axial Propeller
Motor	30 kW
5) Oxidation Agitator on Absorber	
Number	8
Type	Horizontal Axial Propeller
Motor	30 kW
6) Oxidation Air Blower	
Number	1 + 1 Stand-by
Type	Rotary Blower
Capacity	220 m^3/min
Head	0.6 kg/cm^3g
Motor	310 kW
7) Slurry Holding Tank	
Number	1
Type	Vertical Cylinder
Capacity	2,200 m^3
8) Slurry Holding Tank Transfer Pump	
Number	1
Type	Centrifugal
Capacity	4.3 m^3/min
Head	23 m
Motor	30 kW

Equipment	Specification
9) Absorber Area Drain Pit	
Number	1
Type	Underground Concrete Pit
Capacity	100 m^3
10) Absorber Area Drain Pit Pump	
Number	1
Type	Centrifugal
Capacity	5.5 m^3/min
Head	20 m
Motor	55 kW
11) Emergency Head Tank	
Number	1
Type	Vertical Cylinder
Capacity	22 m^3
III - 2 Gypsum Recovery System	
1) Centrifuge	
Number	5 + 1 Stand-by
Capacity (as dry Gypsum)	1,200 kg/h/batch
Motor	160 kW
2) Centrifuge Filtrate Pit	
Number	1
Type	Vertical Cylinder
Capacity	147 m^3
3) Centrifuge Filtrate Pump	
Number	1 + 1 Stand-by
Type	Centrifugal
Capacity	4.9 m^3/min
Head	38 m
Motor	55 kW
4) Blow Down Tank	
Number	1
Type	Vertical Cylinder
Capacity	1.2 m^3
8) Blow Down Pump	
Number	1 + 1 Stand-by
Type	Centrifugal
Capacity	0.1 m^3/min
Head	20 m

Equipment	Specification
III - 3 Draft System	
1) Boost Up Fan	
Number	2
Type	Axial Flow
Capacity	34,200 m^3N/h
Head	290 mmAq
Motor	1,570 kW
2) Flue gas Reheating System	
Number	2
Type	Rotary Regenerative type Gas to Gas Heat Exchanger
Capacity	17.3 x 10^6 kcal/h
Motor	22 kW
3) Bypass Damper	
Number	1
Type	Multi Louver
Material	Corten
4) Inlet Isolation Damper	
Number	2
Type	Multi Louver
Material	Carbon Steel
5) Outlet Isolation Damper	
Number	2
Type	Multi Louver
Material	Corten
III - 4 Auxiliary	
1) Make-up Water Pump	
Number	1 + 1 Stand-by
Type	Centrifugal
Capacity	2.3 m^3/min
Head	20 m
Motor	15 kW
2) Air Compressor	
Number	1 + 1 Stand-by
Type	Reciprocating
Capacity	150 m^3N/h
Pressure	7 kg/cm^3g
Motor	170 kW

Equipment	Specification
[Common for Parts II and III]	
C - 1 Limestone Preparation System	
1) Limestone Siro	
Number	1
Type	Vertical Cylinder
Capacity	200 m^3
2) Limestone Crusher	
Number	1 + 1 Stand-by
Type	Hammer Type
Capacity	24.0 t/h
Motor	130 kW
3) Crushed Limestone Siro	
Number	2
Type	Vertical Cylinder
Capacity (for Par II/Part III)	78 m^3/90 m^3
4) Limestone Mill	
Number	2 + 1 Stand-by
Type	Wet type Ball Mill
Capacity	13.7 t/h
Motor	550 kW
5) Limestone Slurry Tank	
Number	2
Type	Vertical Cylinder
Capacity (for Part II/Part III)	190 m^3/320 m^3
6) Limestone Feeder	
Number	2
Capacity (for Part II/Part III)	10.3 t/h / 13.7 t/h
7) Limestone Feeder	
Number	1
Type	Belt type
Capacity (for Part II/Part III)	10.3 t/h / 13.7 t/h
8) Limestone Slurry Pump	
Number	2
Type	Submerged
Capacity (for Part II/Part III)	0. $3m^3$/min / 1.5 m^3/min
Head	26 m
9) Dump pit	
Number	1
Type	Underground Concrete Pit
Capacity	380 m^3
10) Limestone Storage Yard	
Number	1
Capacity	30 m x 25 m

Equipment	Specification
C - 2 Gypsum Recovery System	
1) Gypsum Storage Silo	
Number	2 Units
Type	Vertical Cylinder
Capacity	ϕ 17.0 m x H 25 m (3,000 tons)
2) Gypsum Conveyor (from Centrifuge to Gypsum Storage Silo)	
Number	4
Type	Belt type
Capacity	108 t/h
3) Reclimer (Inside the Silo)	
Number	2
Type	Screw type
Capacity	500 t/h
4) Gypsum Conveyor (for Discharge)	
Number	2
Type	Belt type
Capacity	450 t/h
C - 3 Auxiliary System	
1) Make-up Water Tank	
Number	1
Type	Vertical Cylinder
Capacity	280 m^3
C - 4 Waste Water Treatment System	
1) Waste Water Storage Pit	
Number	1
Type	Concrete Basin
Capacity	300 m^3
2) Adjustment Coagulation Pit	
Number	1
Type	Concrete Basin
Capacity	9 m^3
3) Sedimentation Pit	
Number	1
Type	Concrete Basin
Capacity	60 m^3
4) Neutralization Pit	
Number	1
Type	Concrete Basin
Capacity	10 m^3
5) Sludge Thickner	
Number	1
Capacity	0.4 m^3/h

Equipment	Specification
C - 5 Electrical System	
1) FGD Transformer (110 kV Incoming)	
Number	2 Units
Capacity of Windings	5 Tap
Rated Voltage	110 kV / 6 kV
Capacity	35 MVA
2) Disconnecting Switch	
Number	25 sets
Rated Voltage	110 kV
3) Switchgears	
Rated Voltage (M/C / P/C / MCC)	7.2 / 0.415 / 0.415 kV
4) Battery	
Number	5 sets
Rated Voltage	0.1 kV
Capacity	500 AH / 10 A
5) Charger	
Number	5 sets
Type	Thyristor Rectifier
Capacity	50 kVA
C - 6 Control & Instrumentation	
1) Control Desk	
Number	5
Type	Steel Plate Desk Type
CRT (Cathode Ray Tube)	1 CRT for each Desk
2) Controller	
Type	Self-standing Steel Plated Digital Controller
3) Relay Panels	
Type	Self-standing Steel Plated Hard-wired Type
4) CVCF (Constant Voltage Constant Frequency)	
Number	5
Type	Thyristor Inverter Type
Capacity	25 kVA

X=-800

X=-700

X=-600

X=-500

CONVEYOR

DUMP PIT

LIMESTONE STORAGE YARD

LIMESTONE SILO

CRUSHER

CRUSHED LIMESTONE SILO

MILL

LIMESTONE SLURRY TANK

GYPSUM STORAGE SILO

GYPSUM STORAGE SILO

GYPSUM DEWATERING BUILDING

LIMESTONE MILLING BUILD.

Y=±0

Y=-100

Y=-200

SLURRY HOLDING TANK

BUF

GGH

ABSORBER

GGH

BUF

WASTE WATER TREATMENT

OXYGEN STORAGE HOUSE

FLUE DUCT

STACK

SLAG CRUSH STATION

OXID. BLOWER

AIR COMPRESSOR

GYPSUM SLURRY TANK

ABSORBER

ABSORBER

GGH

GGH

BUF

BUF

CONTROL & ELECTRICAL EQUIPMENT ROOM

FGD TRANSFORMER

UNIT NO.10

UNIT NO.9

UNIT NO.11

MELNIK III

(500MW x 1 unit)

MELNIK

(110MW

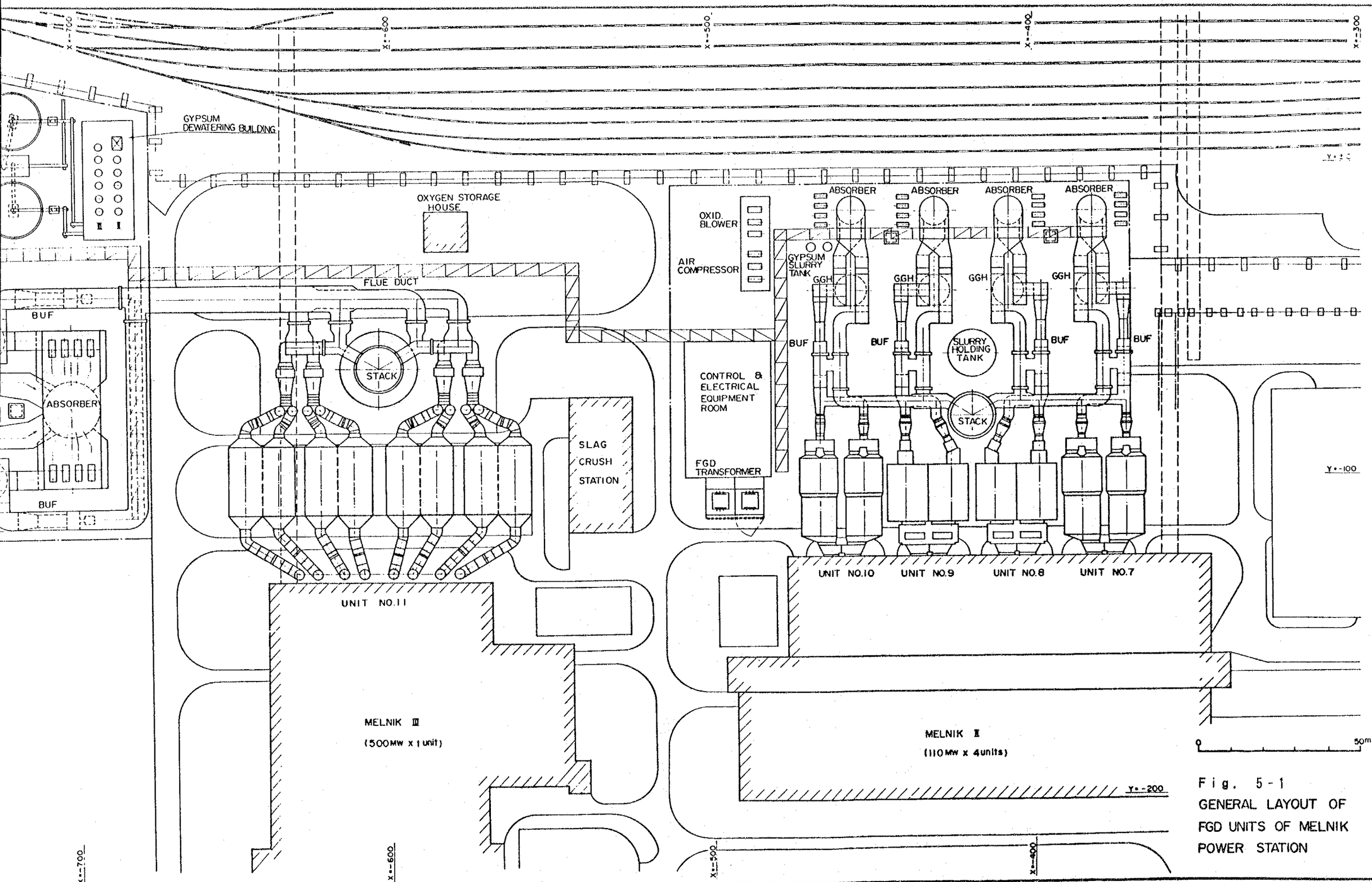


Fig. 5-1
GENERAL LAYOUT OF FGD UNITS OF MELNIK POWER STATION

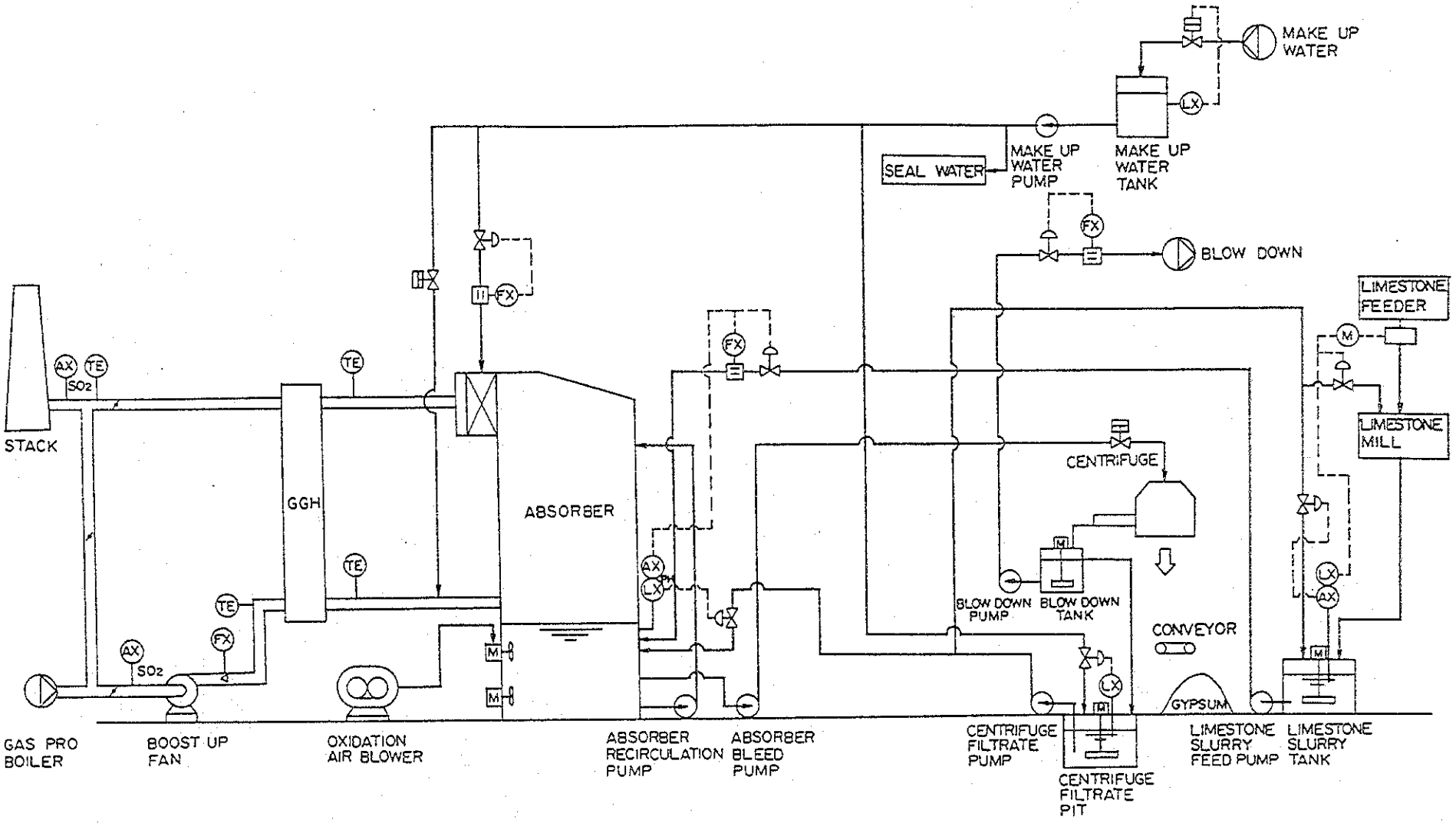
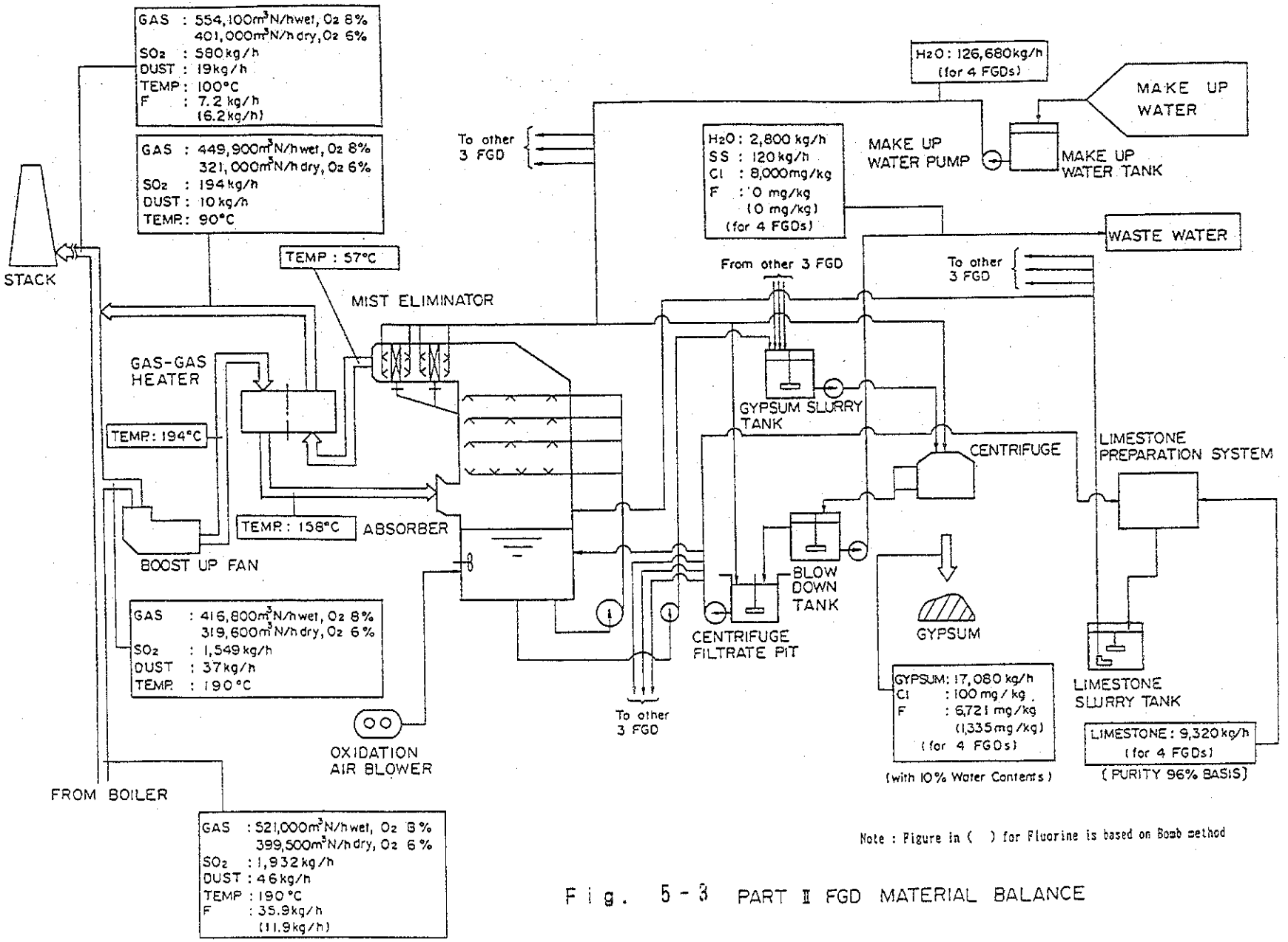
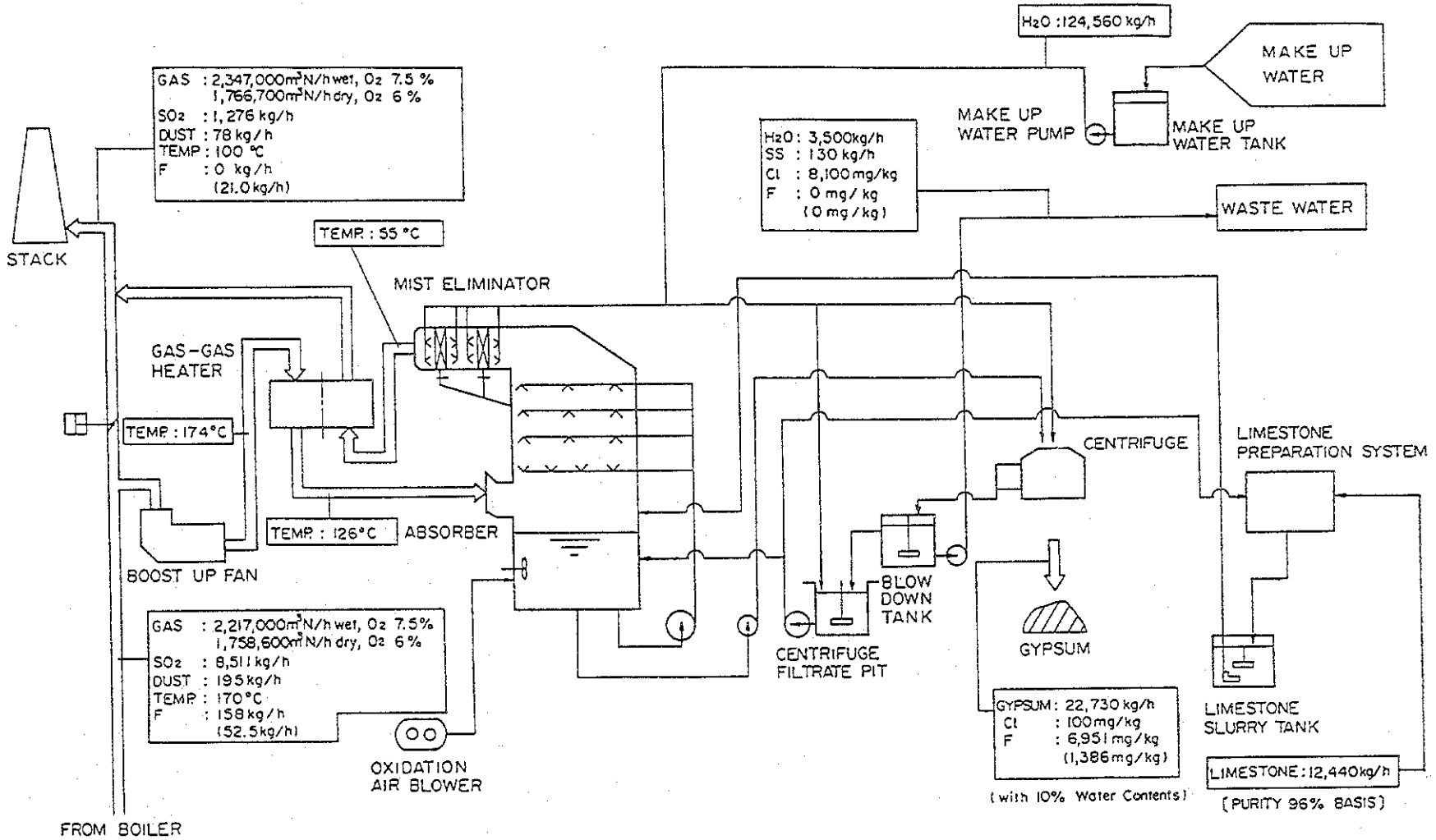


Fig. 5-2 FLOW DIAGRAM OF FGD PLANT



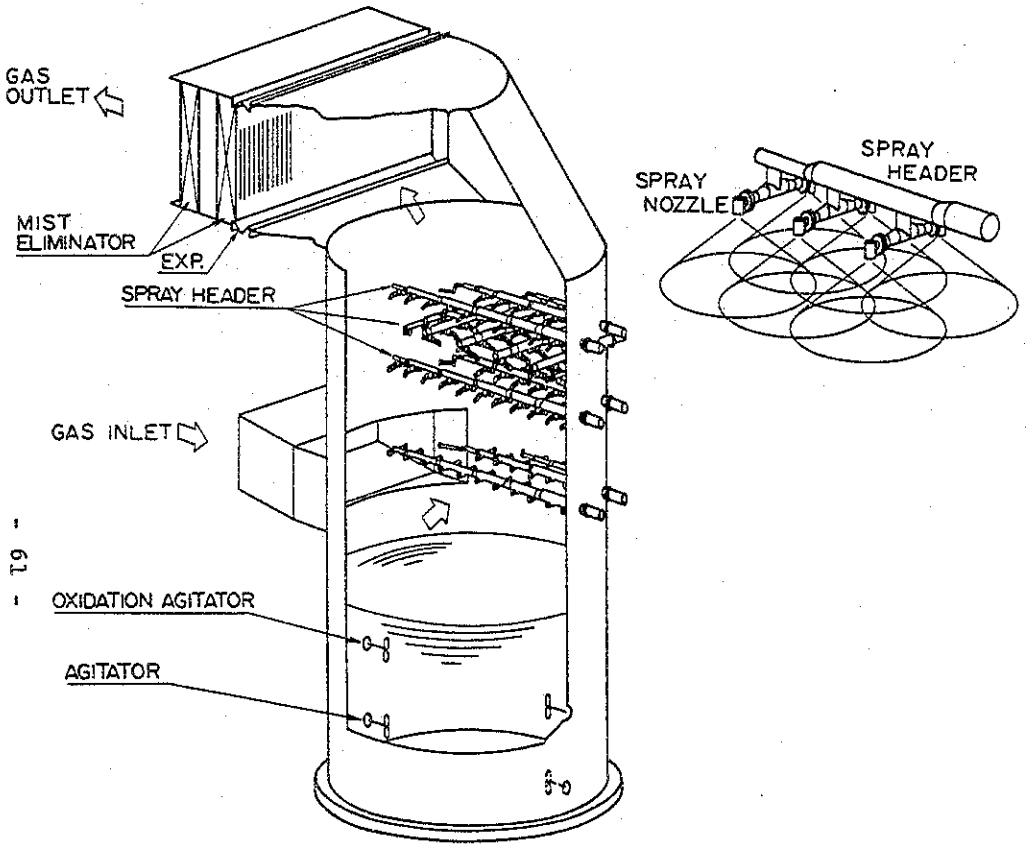
Note : Figure in ( ) for Fluorine is based on Bomb method

Fig. 5-3 PART II FGD MATERIAL BALANCE

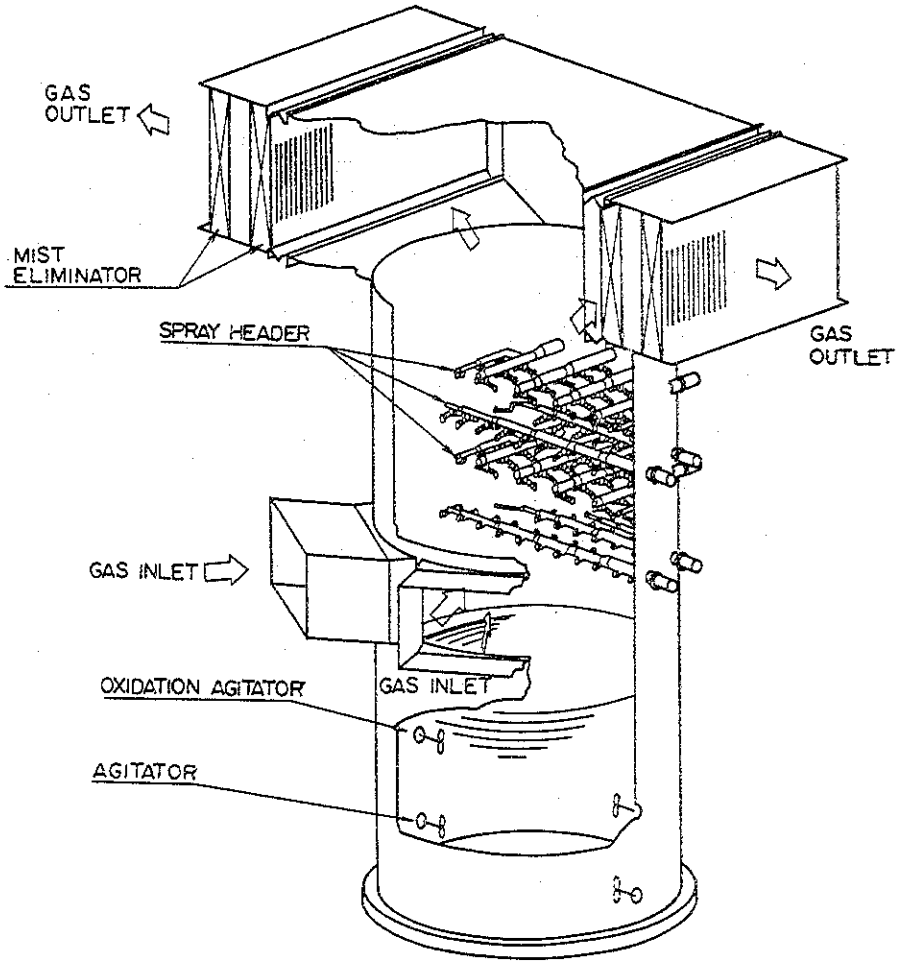


Note : Figure in ( ) for Fluorine is based on Bomb method

Fig. 5-4 PART III FGD MATERIAL BALANCE

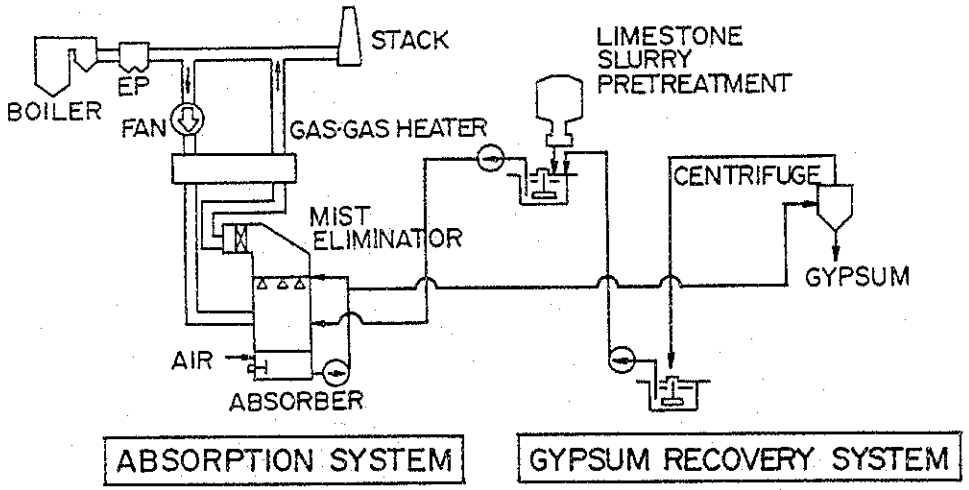


PART Ⅱ



PART Ⅲ

Fig. 5-5 ABSORBER BIRD'S EYE VIEW



FLOW SHEET

NO.	PORTION	LINING MATERIAL
1.	FLUE	
	• GGH ~ ABSORBER INLET	HEAT RESISTANT GLASS
	• ABSORBER OUTLET ~ GGH INLET	GLASS FLAKE RESIN
2.	ABSORBER	
	• GAS INLET TANK UPPER ZONE	HEAT RESISTANT GLASS FLAKE RESIN
	• SPRAY ZONE	INNER PIPE: GLASS FLAKE RESIN TOWER CASING: STAINLESS LINING
	• MIST ELIMINATOR	GLASS FLAKE RESIN
3.	TANK	GLASS FLAKE RESIN
4.	PIT	RESIN MORTAR
5.	SLURRY PIPING	FRP PIPE OR STAINLESS STEEL

Fig. 5-6 LINING MATERIAL FOR FGD SYSTEM

6. Project Implementation Programme

The project implementation programme and construction schedule were studied based on the conceptual design of the optimum DeSOx system.

The study result shows following implementation programme in order to start the commercial operation of FGDs of Part III and Units Nos. 9 and 10 of Part II on October 1, 1996.

As for Units Nos. 7 and 8 of Part II, the start of operation of FGDs is planned to be just two years after the start of other FGDs. Because the power plants are shutdown for their retrofit for cogeneration till October, 1998.

		Part III and Units Nos. 9 and 10 of Part II	Units Nos. 7 and 8 of Part II
(1)	Completion of the Feasibility Study	End of Dec. 1992	Same as left
(2)	Preparation of Financial Source	End of Jan. 1993	Same as left
(3)	Selection of Consultant	End of Mar. 1993	Same as left
(4)	Detailed Design and Preparation of Tender Documents	End of Nov. 1993	Same as left
(5)	Completion of Tender Evaluation	End of Apr. 1994	Same as left
(6)	Contract Award	End of Apr. 1994	Same as left
(7)	Commencement of Civil Work	Beginning of Sep. 1994	Beginning of Sep. 1996
(8)	Erection Start	Beginning of May 1995	Beginning of May 1997
(9)	Trial Operation Start	Beginning of Aug. 1996	Beginning of Aug. 1998
(10)	Taking Over	End of Sep. 1996	End of Sep. 1998
(11)	Commercial Operation Start	1st of Oct. 1996	1st of Oct. 1998

A planned schedule for construction of FGDs are shown in table 6-1, 6-2 (1) and 6-2 (2).

Table 6-1 Schedule of Project Inprementation for DeSOx Installation of Melnik P.S.

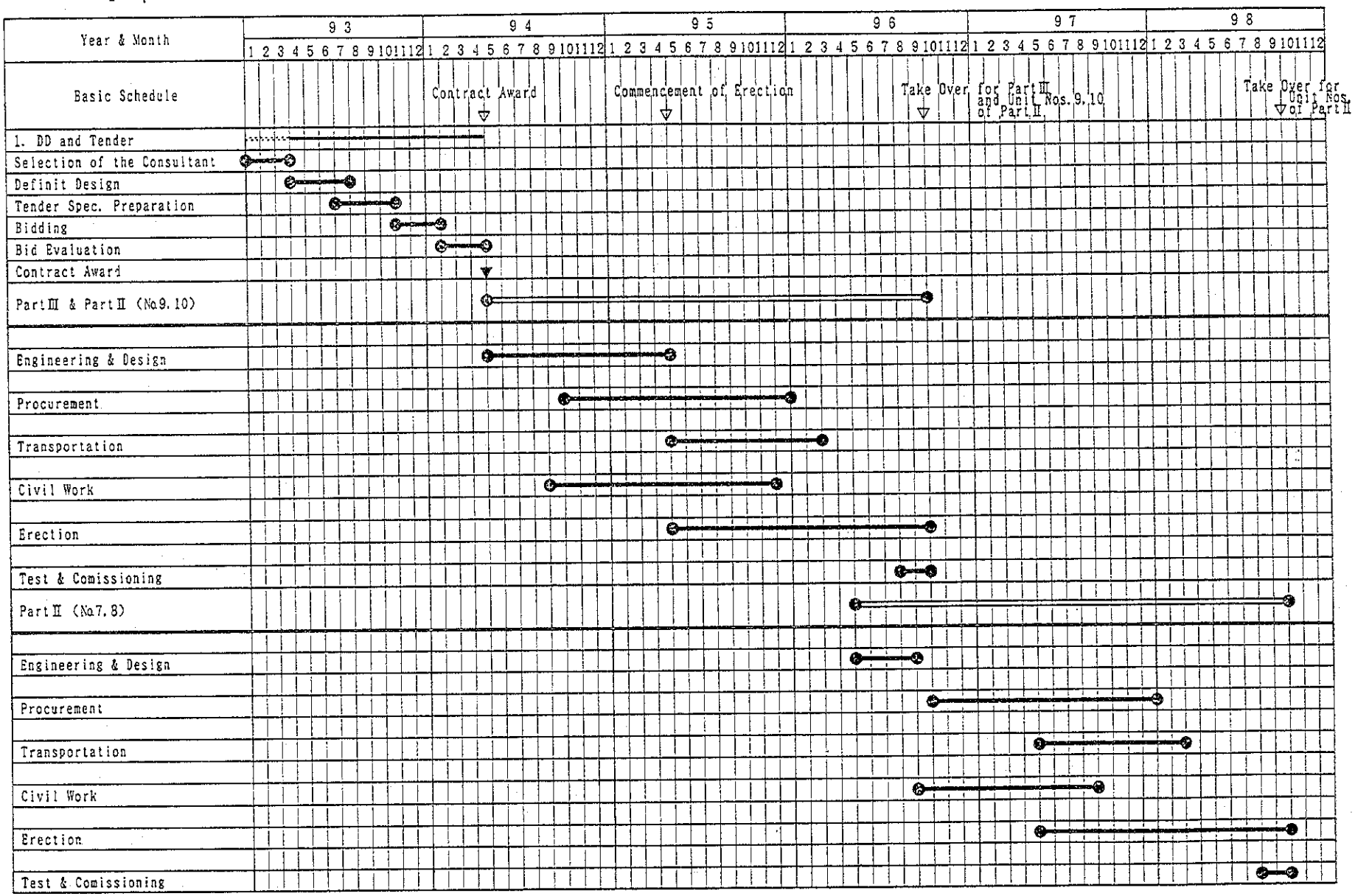


Table 6-2(1) Unit No.11 FGD Plant and Common Facility Construction Schedule

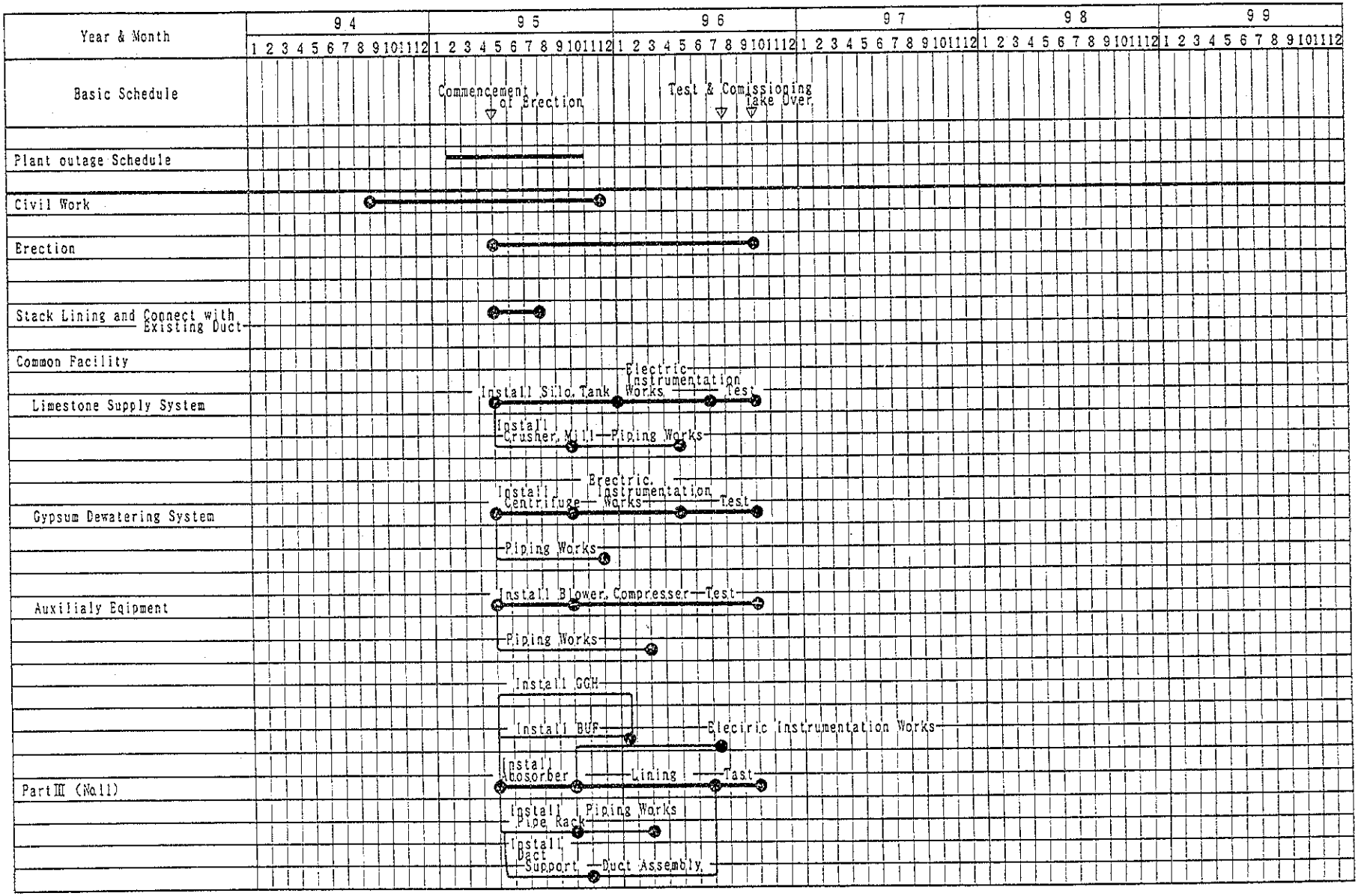
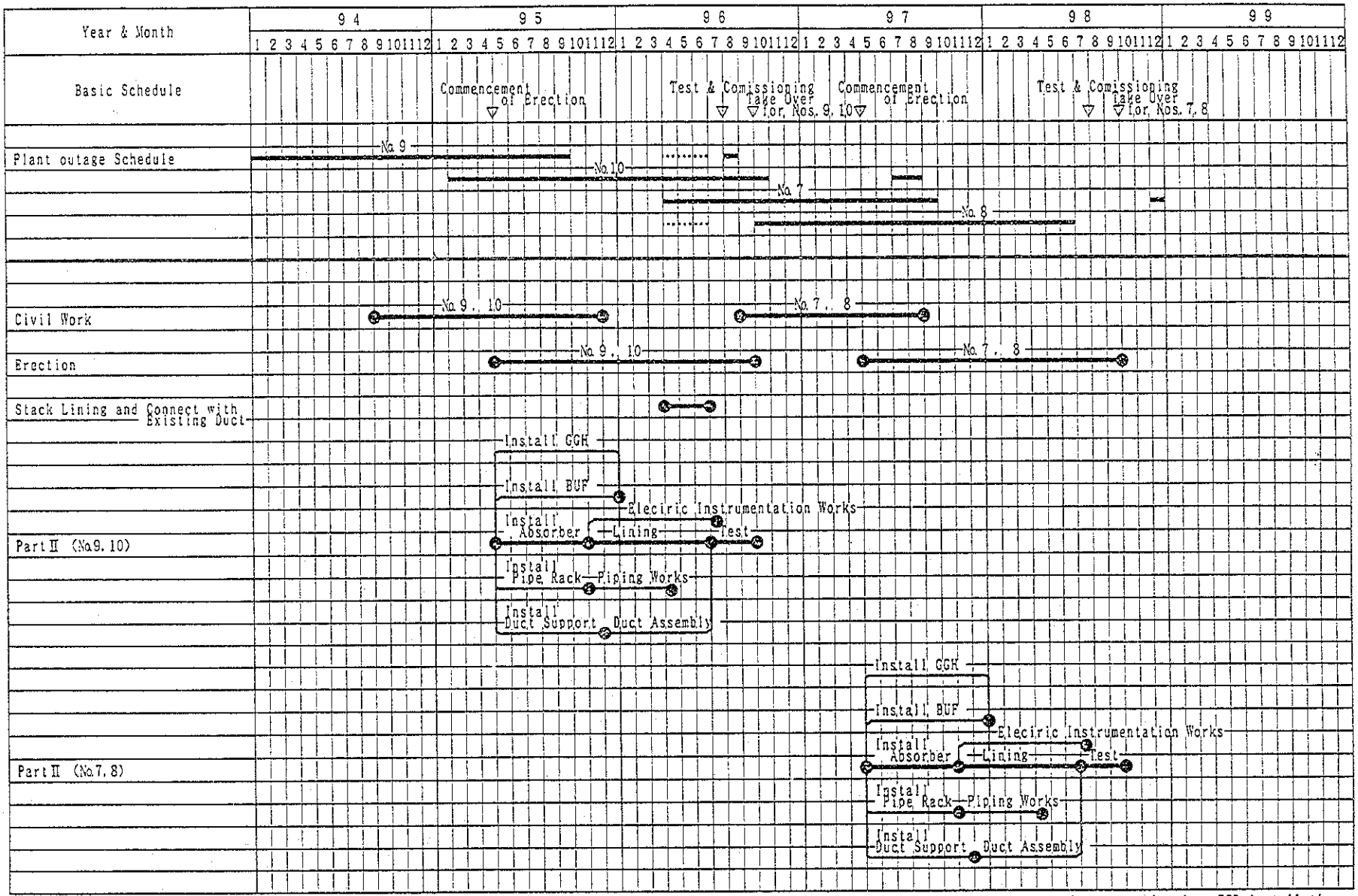


Table 6-2(2) Units Nos. 7, 8 and Units Nos. 9, 10 Construction Schedule



Note : Dotted line described in the plant outage schedule means required outage related to FGD installation.

7. Construction Cost and O&M Cost

An estimated amount of construction cost of 500 MW class FGD unit with deSOx efficiency of 85% for Part III and 4 x 110 MW class FGD units with deSOx efficiency of 70% (with the capacity of 80% flue gas treatment and deSOx efficiency of 87.5%) for Part II are shown below respectively.

Part II : 114,978,000 US$ (equivalent to 261.3 US$/kW)
Part III : 115,574,000 US$ (equivalent to 231.1 US$/kW)

Costs are estimated as of July 1st 1992.

(1) Estimated Construction Cost

[Part II]

	x 10^3 kčs	x 10^3 US$
(1) DeSOx System and Associated Equipment	1,865,455	67,151
(2) Transportation	55,921	2,013
(3) Construction	187,209	6,739
(4) Civil Work	318,164	11,453
(5) Modification of Existing Facilities	140,317	5,051
(6) Spare Parts	37,364	1,345
(7) Start-up and Commissioning	38,003	1,368
(8) Import Tax	134,955	4,858
[Direct Construction Cost] (1)~(8)	[2,777,388]	[99,978]
(9) Engineering Fee [5% of Direct Const. Cost]	138,900	5,000
(10) Contingency [5% of Direct Const. Cost]	138,900	5,000
(11) Administration fee [5% of Direct Const. Cost]	138,900	5,000
[Total Construction Cost] (1)~(11)	[3,194,088]	[114,978]
[Construction Cost per kW]	[7,259 kčs/kW]	[261.3 US$/kW]

[Part III]

	x 10^3 kčs	x 10^3 US$
(1) DeSOx System and Associated Equipment	1,949,239	70,167
(2) Transportation	58,505	2,106
(3) Construction	195,627	7,042
(4) Civil Work	360,890	12,991
(5) Modification of Existing Facilities	15,112	544
(6) Spare Parts	39,086	1,407
(7) Start-up and Commissioning	39,725	1,430
(8) Import Tax	133,677	4,812
[Direct Construction Cost] (1)~(8)	[2,791,861]	[100,499]
(9) Engineering Fee [5% of Direct Const. Cost]	139,595	5,025
(10) Contingency [5% of Direct Const. Cost]	139,595	5,025
(11) Administration fee [5% of Direct Const. Cost]	139,595	5,025
[Total Construction Cost] (1)~(11)	[3,210,646]	[115,574]
[Construction Cost per kW]	[6,421 kčs/kW]	[231.1 US$/kW]

(2) Annual O&M Cost

[Part II]

	x 10^3 kčs	US$
a. Utilities Cost	24,711,000	889,525
b. Labor Cost	2,275,000	81,893
c. Maintenance Cost	95,823,000	3,449,352
d. By-products Treatment Cost	9,175,000	330,274
[Total]	[131,984,000]	[4,751,044]

[Part III]

	x 10^3 kčs	US$
a. Utilities Cost	22,186,000	798,632
b. Labor Cost	1,553,000	55,904
c. Maintenance Cost	96,319,000	3,467,207
[Total]	[120,058,000]	[4,321,743]

8. Operation and Maintenance

(1) Methods of Operation

The FGD is started and stopped linked usually with start and stop of its power plant. The FGD system is started in the sequence of the absorbing system, the drafting system and the gypsum processing system. The FGD system is stopped, on the other hand, in the sequence of the drafting system, absorbing system and the gypsum processing system.

Fig. 8-1 shows starting and stopping timings of the unit to unit FGD system. The FGD Units are started system by system sequentially by operating on the CRT of the Control Desk. The starting flow chart is shown in Fig. 8-2.

The FGD Units are stopped system by system, from the Control Room, sequentially by operating on the CRT as in the case of starting. A stop mode is either a short-term stop mode or a long-term stop mode.

A flow chart of the short-term stop mode is shown in Fig. 8-3.

(2) Performance Management

It is desirable to practice performance management in routine operations. One way to do so is to prepare and keep operation log sheet having items necessary for judging operating conditions including performance items.

(3) Maintenance Procedures

In addition to keeping monitoring the operating condition in the Control Room, it is desirable to patrol, at each shift, the field to check for equipment troubles. For patrolling, it is desirable to prepare a check sheet considering the route of equipment inspection, inspection frequency, points of inspection, points of special observation, etc., and patrol the field according to the check sheet.

The FGD must be stopped once a year for scheduled inspection. In the FGD, especially, gypsum sedimentation and clogging possibly occur in the tower, tanks, pumps and pipings, and it is necessary to remove and clear such sedimentation and clogging in addition to overhauling of each equipment.

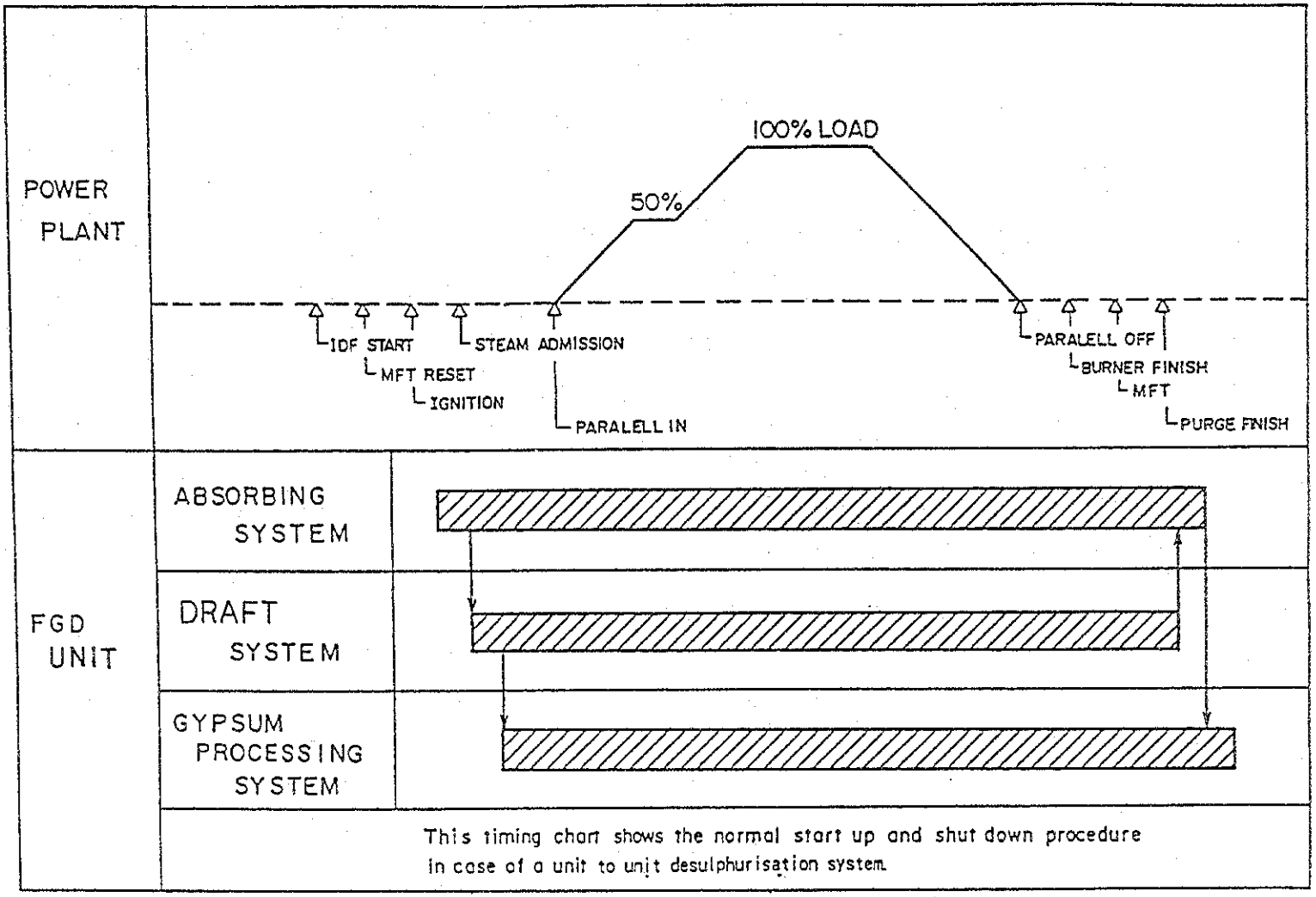


Fig. 8-1 FGD UNIT START UP SHUT DOWN TIMING CHART

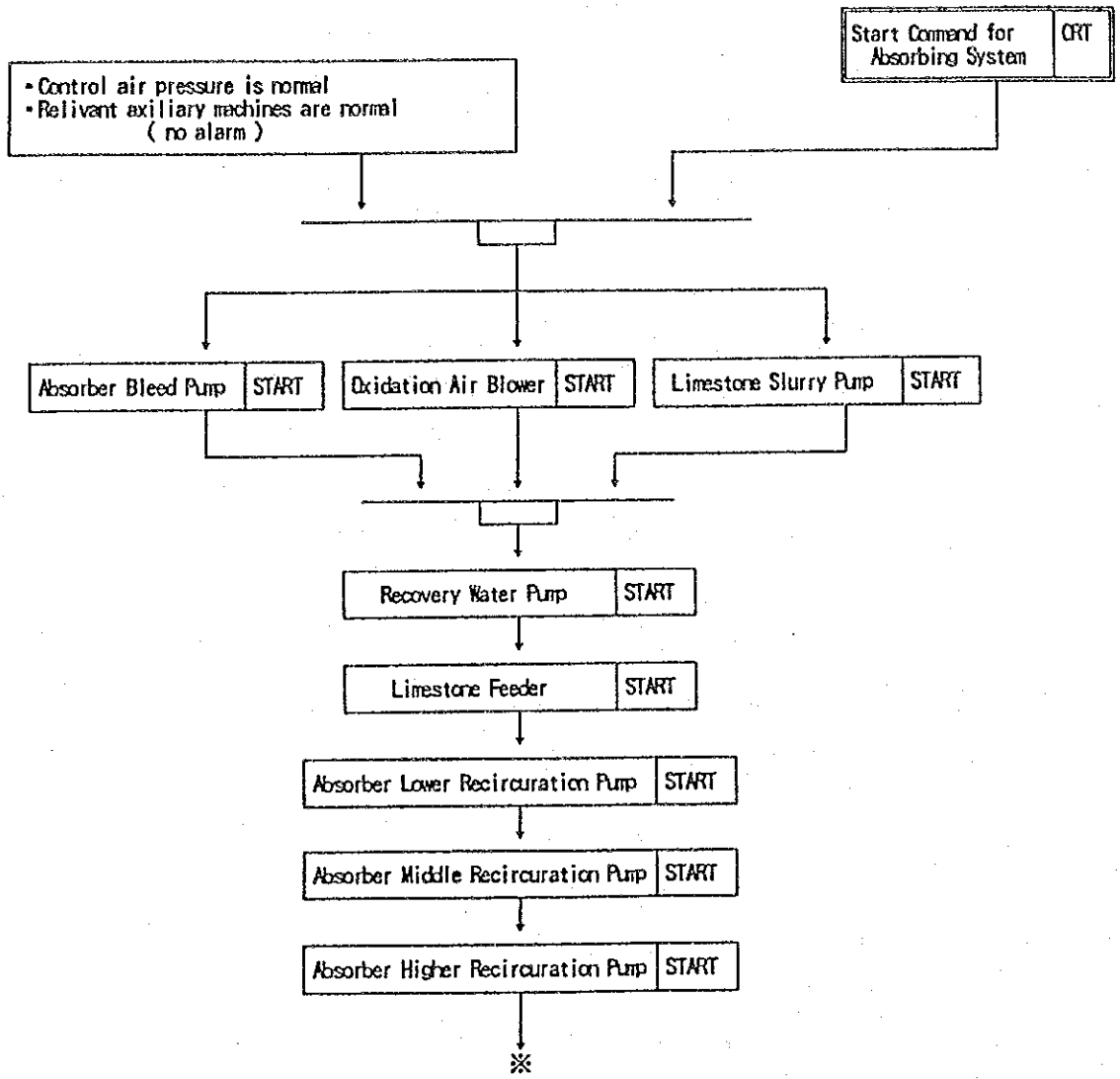
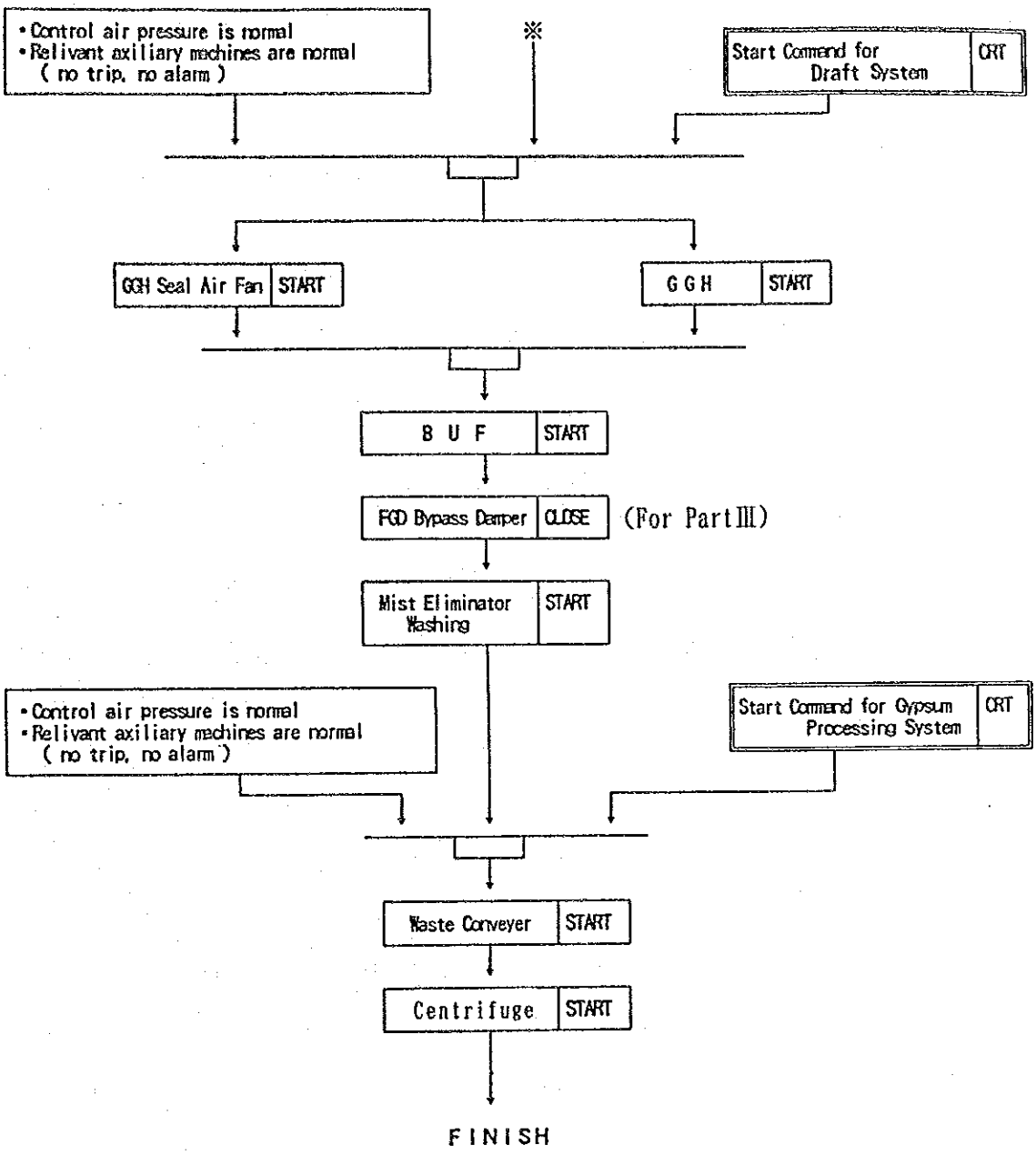


Fig. 8-2 FLOW CHART OF START UP PROCEDURE (1/2)



FLOW CHART OF START UP PROCEDURE (2/2)

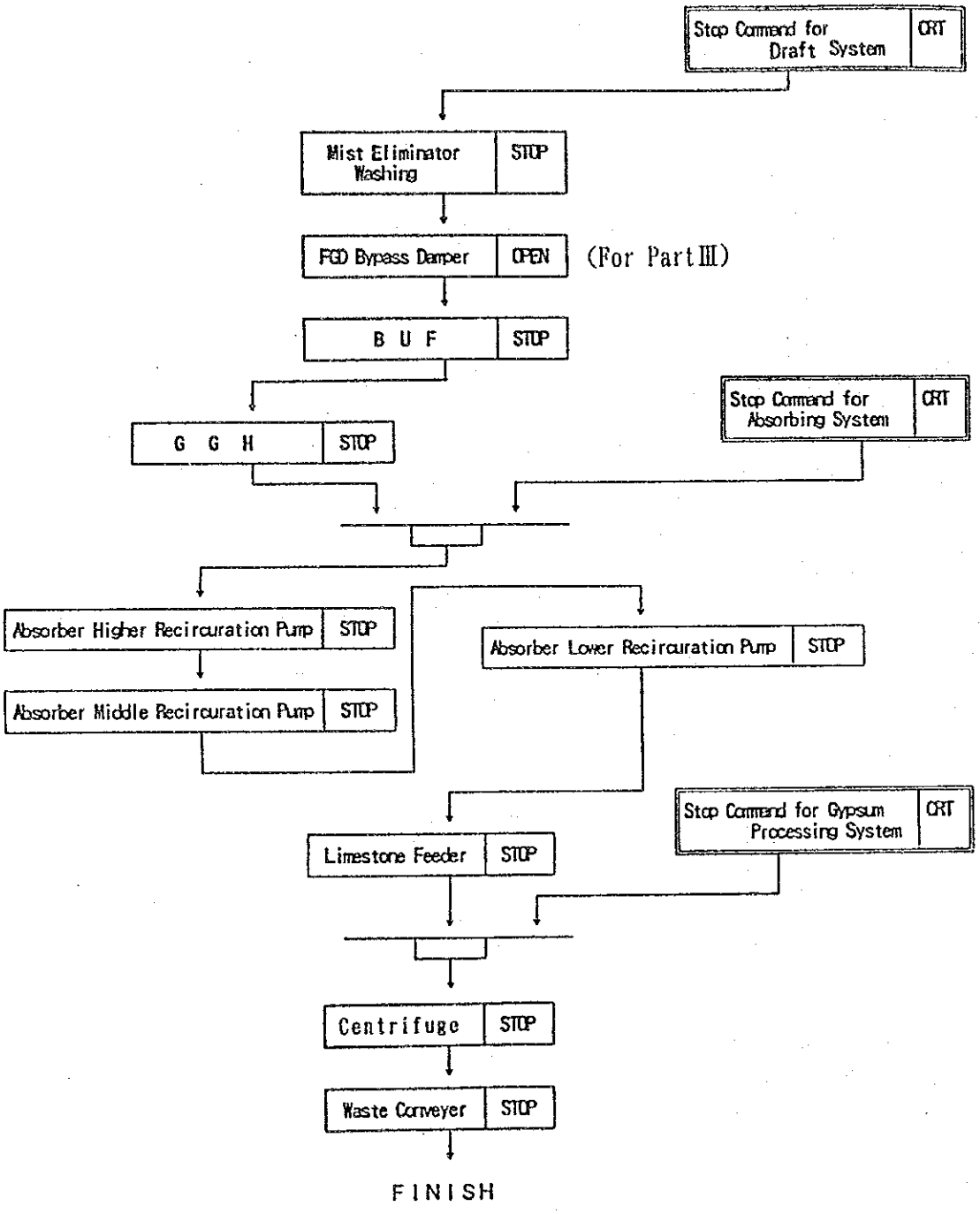


Fig. 8-3 FLOW CHART OF SHUT DOWN PROCEDURE
(SHORT TERM STOP MODE)

9. Analysis and Evaluation on Socio-economic Impact

(1) Annual cost in each year was calculated from the total construction cost including interest during construction based on the construction cost in Chapter 7.

Total construction cost is shown in Table 9-1 and Table 9-2.

Tariff is calculated based on the annual cost. As a result of this calculation, 0.28 to 0.36 kčs/kWh (at maximum for Part II) and 0.26 to 0.32 kčs/kWh (at maximum for Part III) additional burden in tariff are estimated. Increase in tariff enabling to recover this burden is strongly recommended. Tariff trend in each year are shown in Table 9-3 to 9-6. (With 1992 July cost .. Inflation is disregarded)

(2) For the economic evaluation, reconstruction of natural gas firing boilers is chosen, since it is the least expensive and can meet the regulation of "the New Clean Air Act".

The flow of benefit and cost of the evaluation is shown in Table 9-7. EIRR (Economic Internal Rate of Return), Excess benefit (B-C) and Benefit-Cost ratio (B/C) are as follows.

EIRR	39.54%
B-C	23,322.426 x 10^6 kčs
B/C	4,929

Judging from the study results mentioned above, this project is much superior to the reconstruction of the natural gas firing boilers in terms of cost.

This superiority is maintained until social discount rate which reflects opportunity cost of capital reaches 39.54%.

(3) Evaluation on Socio-economic Impact

a. During reconstruction of Japanese economy after World War II, investment for environmental protection accounted for 3% of total investment of private companies. At that time the position of environmental protection was not clearly specified in the legislation for environmental protection and no governmental agency in charge of environmental issue did not exist.

In the prime of economic high rate growth, around 1970, environmental issue became the nationwide problem. Many environmental acts were enacted and the Environmental Agency was established in 1971. Environmental administration was strengthened in this way.

As in the field of electric utility legislations were systematized, technology on flue gas treatment was introduced. DeSOx system for coal fired thermal power stations was started at the Takasago Thermal Power Station as a pioneer and at the almost all coal fired thermal power stations and high sulphur oil fired thermal power stations, total 68 units 23,450 kW so far, DeSOx systems were installed.

b. Macro economic method for socio-economical evaluation on introduction of environmental protection has not been fully developed. However,

- At the Tokyo Conference of Roma Club in 1982, Prof. Dr. Yoichi Kaya, University of Tokyo, presented a estimation, based on rough assumptions, that damage amounted to 6,000 Milliard Yen (45 Milliard US dollars) in comparison with that the cost for SOx removal amounted 480 Milliard Yen (4 Milliard US dollars) and

- Environmental White Paper for FY 1977 stipulated that there was hardly no adverse effect on macro economies although countermeasures for environmental protection were carried out from 1965 to 1975.

Those had affirmative effect that real rate of economic growth was raised by 0.9%.

- Other nations have had similar experiences. As the OECD says, "The effect of anti-pollution investments on GNP ranges from 'neutral' to 'negligible'" (See "The State of the Environment", OECD; 1991).

c. Following are analysis on introduction of DeSOx system in Czechoslovak power plants based on above analyses.

- Economic extension and increase in employment attributable to increase in investment.

- Absorbable effect on electricity tariff

- Increase in export

Czechoslovakia is already industrialized. In this project, local procurement shall be extended as much as possible so that technology can be absorbed aggressively. As a consequence, Czechoslovakia will be able to export DeSOx equipments to neighbor countries by taking advantage of its comparatively cheap labor cost and such technology.

Table 9 - 1 Total Construction Cost [Part II]

(1,000 US$)

Interest for Foreign Loan / Interest for Local Loan		5.0%			8.0%		
		Local Portion	Foreign Portion	Total	Local Portion	Foreign Portion	Total
10.0%	C.C.	70,264	44,714	114,978	70,264	44,714	114,978
	I.D.C.	12,955.39	4,294.84	17,250.23	12,955.39	7,047.25	20,002.64
	Total	83,219.39	49,008.84	132,228.23	83,219.39	51,761.25	134,980.64
15.0%	C.C.	70,264	44,714	114,978	70,264	44,714	114,978
	I.D.C.	20,156.08	4,294.84	24,450.92	20,156.08	7,047.25	27,203.33
	Total	90,420.08	49,008.84	139,428.92	90,420.08	51,761.25	142,181.33

Note:

C.C. : Construction Cost
I.D.C. : Interest during Construction

Table 9 -2 Total Construction Cost [Part III]

(1,000 US$)

Interest for Local Loan		Interest for Foreign Loan: 5.0%			Interest for Foreign Loan: 8.0%		
		Local Portion	Foreign Portion	Total	Local Portion	Foreign Portion	Total
10.0%	C.C.	70,313	45,261	115,574	70,313	45,261	115,574
	I.D.C.	9,295.38	3,176.78	12,472.16	9,295.38	5,144.80	14,440.18
	Total	79,608.38	48,437.78	128,046.16	79,608.38	50,405.80	130,014.18
15.0%	C.C.	70,313	45,261	115,574	70,313	45,261	115,574
	I.D.C.	14,164.55	3,176.78	17,341.33	14,164.55	5,144.80	19,309.35
	Total	84,477.55	48,437.78	132,915.33	84,477.55	50,405.80	134,883.35

Note:

C.C. : Construction Cost
I.D.C. : Interest during Construction

Table 9-3 Calculation of Tariff

[Part II、Case of Maximum Construction Cost]

(USD 1000)

Year after Completion 0&10	Depreciation	Interest	Utility Cost	Personnel Cost	Repair Cost	Disposal Cost	Total	Tariff (Yen/KWh)	Tariff (KCS/KWh)	Tariff (c/KWh)
1	5572.622	5943.578	444.763	40.947	1750.54	165.137	13917.585	0.40	0.05	0.31
2	5572.622	5283.180	444.763	40.947	1750.54	165.137	13257.188	0.38	0.03	0.30
3	11374.506	10885.916	889.525	81.893	3449.34	330.274	27011.454	1.55	0.33	1.21
4	11374.506	13440.464	889.525	81.893	3449.34	330.274	29566.003	1.70	0.36	1.32
5	11374.506	11854.113	889.525	81.893	3449.34	330.274	27979.651	1.61	0.34	1.25
6	11374.506	10267.762	889.525	81.893	3449.34	330.274	26393.300	1.52	0.32	1.18
7	11374.506	8681.411	889.525	81.893	3449.34	330.274	24806.949	1.43	0.30	1.11
8	11374.506	7095.060	889.525	81.893	3449.34	330.274	23220.598	1.34	0.28	1.04
9	11374.506	5508.708	889.525	81.893	3449.34	330.274	21634.247	1.24	0.26	0.97
10	11374.506	3922.357	889.525	81.893	3449.34	330.274	20047.895	1.15	0.24	0.90
11	11374.506	2996.404	889.525	81.893	3449.34	330.274	19121.942	1.10	0.23	0.86
12	11374.506	2070.450	889.525	81.893	3449.34	330.274	18195.988	1.05	0.22	0.81
13	8588.195	1840.400	889.525	81.893	3449.34	330.274	15179.627	0.87	0.18	0.68
14	5801.885	1610.350	889.525	81.893	3449.34	330.274	12163.266	0.70	0.15	0.54
15	2900.942	1380.300	889.525	81.893	3449.34	330.274	9032.274	0.52	0.11	0.40
16	0.000	1150.250	889.525	81.893	3449.34	330.274	5901.282	0.34	0.07	0.26
17	0.000	920.200	889.525	81.893	3449.34	330.274	5671.232	0.33	0.07	0.25
18	0.000	690.150	889.525	81.893	3449.34	330.274	5441.182	0.31	0.07	0.24
19	0.000	460.100	889.525	81.893	3449.34	330.274	5211.132	0.30	0.06	0.23
20	0.000	230.050	889.525	81.893	3449.34	330.274	4981.082	0.29	0.06	0.22
21	0.000	0.000	889.525	81.893	3449.34	330.274	4751.032	0.27	0.06	0.21
22	0.000	0.000	889.525	81.893	3449.34	330.274	4751.032	0.27	0.06	0.21
23	0.000	0.000	889.525	81.893	3449.34	330.274	4751.032	0.27	0.06	0.21
24	0.000	0.000	889.525	81.893	3449.34	330.274	4751.032	0.27	0.06	0.21
25	0.000	0.000	889.525	81.893	3449.34	330.274	4751.032	0.27	0.06	0.21
26	0.000	0.000	444.763	40.947	1698.30	165.137	2349.646	0.07	0.01	0.05
27	0.000	0.000	444.763	40.947	1698.30	165.137	2349.646	0.07	0.01	0.05

Annual Operation Hour	5081
Annual Load Factor	58
Auxirialy Loss	
Annual Net Generation(KWh)	2235640000

Table 9-4 Calculation of Tariff

[Part II、Case of Minimum Construction Cost]

(USD 1000)

Year after Completion 9&10	Depreciation	Interest	Utility Cost	Personnel Cost	Repair Cost	Disposal Cost	Total	Tariff (Yen/KWh)	Tariff (KCS/KWh)	Tariff (c/KWh)
1	5251.146	3702.110	444.763	40.947	1750.54	165.137	11354.642	0.33	0.07	0.25
2	5251.146	3290.765	444.763	40.947	1750.54	165.137	10943.297	0.31	0.07	0.24
3	10578.259	6667.054	889.525	81.893	3449.34	330.274	21996.345	1.27	0.27	0.98
4	10578.259	8149.167	889.525	81.893	3449.34	330.274	23478.457	1.35	0.28	1.05
5	10578.259	7180.837	889.525	81.893	3449.34	330.274	22510.128	1.30	0.27	1.01
6	10578.259	6212.507	889.525	81.893	3449.34	330.274	21541.798	1.24	0.26	0.96
7	10578.259	5244.178	889.525	81.893	3449.34	330.274	20573.469	1.18	0.25	0.92
8	10578.259	4275.848	889.525	81.893	3449.34	330.274	19605.139	1.13	0.24	0.88
9	10578.259	3307.519	889.525	81.893	3449.34	330.274	18636.809	1.07	0.23	0.83
10	10578.259	2339.189	889.525	81.893	3449.34	330.274	17668.480	1.02	0.21	0.79
11	10578.259	1782.295	889.525	81.893	3449.34	330.274	17111.496	0.98	0.21	0.77
12	10578.259	1225.221	889.525	81.893	3449.34	330.274	16554.512	0.95	0.20	0.74
13	7952.686	1039.085	889.525	81.893	3449.34	330.274	13792.803	0.79	0.17	0.62
14	5327.113	952.950	889.525	81.893	3449.34	330.274	11031.094	0.63	0.13	0.49
15	2663.556	816.814	889.525	81.893	3449.34	330.274	8231.402	0.47	0.10	0.37
16	0.000	680.678	889.525	81.893	3449.34	330.274	5431.710	0.31	0.07	0.24
17	0.000	544.543	889.525	81.893	3449.34	330.274	5295.575	0.30	0.06	0.24
18	0.000	408.407	889.525	81.893	3449.34	330.274	5159.439	0.30	0.06	0.23
19	0.000	272.271	889.525	81.893	3449.34	330.274	5023.303	0.29	0.06	0.22
20	0.000	136.136	889.525	81.893	3449.34	330.274	4887.168	0.28	0.06	0.22
21	0.000	0.000	889.525	81.893	3449.34	330.274	4751.032	0.27	0.06	0.21
22	0.000	0.000	889.525	81.893	3449.34	330.274	4751.032	0.27	0.06	0.21
23	0.000	0.000	889.525	81.893	3449.34	330.274	4751.032	0.27	0.06	0.21
24	0.000	0.000	889.525	81.893	3449.34	330.274	4751.032	0.27	0.06	0.21
25	0.000	0.000	889.525	81.893	3449.34	330.274	4751.032	0.27	0.06	0.21
26	0.000	0.000	444.763	40.947	1698.80	165.137	2349.646	0.07	0.01	0.05
27	0.000	0.000	444.763	40.947	1698.80	165.137	2349.646	0.07	0.01	0.05

Annual Operation Hour	5081
Annual Load Factor	58
Auxirialy Loss	
Annual Net Generation(KWh)	2225640000

Table 9-5 Calculation of Tariff

[Part III, Case of Maximum Construction Cost]

(USD 1000)

Year after Completion	Depreciation	Interest	Utility Cost	Personnel Cost	Repair Cost	Fuel Cost	Total	Tariff (Yen/KWh)	Tariff (KCS/KWh)	Tariff (c/KWh)
1	10790.669	11404.470	798.632	55.904	3467.22	0.000	26516.894	1.53	0.32	1.19
2	10790.669	10137.306	798.632	55.904	3467.22	0.000	25249.731	1.45	0.31	1.13
3	10790.669	8870.143	798.632	55.904	3467.22	0.000	23982.568	1.38	0.29	1.07
4	10790.669	11411.418	798.632	55.904	3467.22	0.000	26523.843	1.53	0.32	1.19
5	10790.669	9920.229	798.632	55.904	3467.22	0.000	25032.654	1.44	0.30	1.12
6	10790.669	8429.040	798.632	55.904	3467.22	0.000	23541.465	1.36	0.28	1.05
7	10790.669	6937.851	798.632	55.904	3467.22	0.000	22050.276	1.27	0.27	0.99
8	10790.669	5446.662	798.632	55.904	3467.22	0.000	20559.087	1.19	0.25	0.92
9	10790.669	3955.473	798.632	55.904	3467.22	0.000	19067.897	1.10	0.23	0.85
10	10790.669	2464.284	798.632	55.904	3467.22	0.000	17576.708	1.01	0.21	0.79
11	10790.669	2240.258	798.632	55.904	3467.22	0.000	17352.683	1.00	0.21	0.78
12	10790.669	2016.232	798.632	55.904	3467.22	0.000	17128.657	0.99	0.21	0.77
13	5395.334	1792.206	798.632	55.904	3467.22	0.000	11509.297	0.66	0.14	0.52
14	0.000	1568.181	798.632	55.904	3467.22	0.000	5889.937	0.34	0.07	0.26
15	0.000	1344.155	798.632	55.904	3467.22	0.000	5665.911	0.33	0.07	0.25
16	0.000	1120.129	798.632	55.904	3467.22	0.000	5441.885	0.31	0.07	0.24
17	0.000	896.103	798.632	55.904	3467.22	0.000	5217.859	0.30	0.06	0.23
18	0.000	672.077	798.632	55.904	3467.22	0.000	4993.833	0.29	0.06	0.22
19	0.000	448.052	798.632	55.904	3467.22	0.000	4769.808	0.27	0.06	0.21
20	0.000	224.026	798.632	55.904	3467.22	0.000	4545.782	0.26	0.05	0.20
21	0.000	0.000	798.632	55.904	3467.22	0.000	4321.756	0.25	0.05	0.19
22	0.000	0.000	798.632	55.904	3467.22	0.000	4321.756	0.25	0.05	0.19
23	0.000	0.000	798.632	55.904	3467.22	0.000	4321.756	0.25	0.05	0.19
24	0.000	0.000	798.632	55.904	3467.22	0.000	4321.756	0.25	0.05	0.19
25	0.000	0.000	798.632	55.904	3467.22	0.000	4321.756	0.25	0.05	0.19

Annual Operation Hour	4468
Annual Load Factor	51
Auxiriary Lors	
Annual Net Generation(KWh)	2234000000

Depreciation	Straight Method
Residual Value	0
Term (Year)	12.5
Total Value	134883.357

Table 9-6 Calculation of Tariff

[Part III、Case of Minimum Construction Cost]

(USD 1000)

Year after Completion	Depreciation	Interest	Utility Cost	Personnel Cost	Repair Cost	Fuel Cost	Total	Tariff (Yen/KWh)	Tariff (KCS/KWh)	Tariff (c/KWh)
1	10243.692	7164.754	798.632	55.904	3467.22	0.000	21730.202	1.25	0.26	0.97
2	10243.692	6868.670	798.632	55.904	3467.22	0.000	20934.119	1.21	0.25	0.94
3	10243.692	5572.587	798.632	55.904	3467.22	0.000	20138.035	1.16	0.24	0.90
4	10243.692	7063.842	798.632	55.904	3467.22	0.000	21629.291	1.25	0.26	0.97
5	10243.692	6133.209	798.632	55.904	3467.22	0.000	20698.657	1.19	0.25	0.93
6	10243.692	5202.576	798.632	55.904	3467.22	0.000	19768.024	1.14	0.24	0.88
7	10243.692	4271.943	798.632	55.904	3467.22	0.000	18837.391	1.08	0.23	0.84
8	10243.692	3341.309	798.632	55.904	3467.22	0.000	17906.758	1.03	0.22	0.80
9	10243.692	2410.676	798.632	55.904	3467.22	0.000	16975.125	0.98	0.21	0.76
10	10243.692	1480.043	798.632	55.904	3467.22	0.000	16045.492	0.92	0.19	0.72
11	10243.692	1345.494	798.632	55.904	3467.22	0.000	15910.942	0.92	0.19	0.71
12	10243.692	1210.944	798.632	55.904	3467.22	0.000	15776.393	0.91	0.19	0.71
13	5121.846	1076.395	798.632	55.904	3467.22	0.000	10519.997	0.61	0.13	0.47
14	0.000	941.846	798.632	55.904	3467.22	0.000	5263.602	0.30	0.06	0.24
15	0.000	807.296	798.632	55.904	3467.22	0.000	5129.052	0.30	0.06	0.23
16	0.000	672.747	798.632	55.904	3467.22	0.000	4994.503	0.29	0.06	0.22
17	0.000	538.198	798.632	55.904	3467.22	0.000	4859.954	0.28	0.06	0.22
18	0.000	403.648	798.632	55.904	3467.22	0.000	4725.404	0.27	0.06	0.21
19	0.000	269.099	798.632	55.904	3467.22	0.000	4590.855	0.26	0.06	0.21
20	0.000	134.549	798.632	55.904	3467.22	0.000	4456.305	0.26	0.05	0.20
21	0.000	0.000	798.632	55.904	3467.22	0.000	4321.756	0.25	0.05	0.19
22	0.000	0.000	798.632	55.904	3467.22	0.000	4321.756	0.25	0.05	0.19
23	0.000	0.000	798.632	55.904	3467.22	0.000	4321.756	0.25	0.05	0.19
24	0.000	0.000	798.632	55.904	3467.22	0.000	4321.756	0.25	0.05	0.19
25	0.000	0.000	798.632	55.904	3467.22	0.000	4321.756	0.25	0.05	0.19

Annual Operation Hour	4468
Annual Load Factor	51
Auxiriary Loss	
Annual Net Generation(KWh)	2234000000

Depreciation	Straight Method
Residual Value	0
Term (Year)	12.5
Total Value	128046.155

Table 9 - 7 Economic Evaluation

(Million Kcs)

	Costs					Benefits					
No. Year	Investmnet	Coal Cost	O&M Cost	Total Cost	Total Cost (N.P.V.)	Investment	O&M Cost	Fuel Cost	Total Benefit	Total Benefit (N.P.V.)	Benefits-Costs
1	150.531			150.531	136.846	15.317			15.317	13.924	-135.215
2	2436.346			2436.346	2013.509	247.898			247.898	204.874	-2108.448
3	1966.689			1966.689	1477.602	200.110			200.110	150.346	-1766.579
4	675.132			675.132	461.124	68.695			68.695	46.919	-606.437
5	645.778	0.000	65.992	711.770	441.953	65.708	-7.068	1361.060	1419.700	881.522	707.930
6	146.768	0.000	65.992	212.760	120.097	14.934	-7.068	1361.060	1368.926	772.723	1156.166
7		0.000	252.042	252.042	129.337		-30.532	5365.600	5335.068	2737.733	5083.026
8		0.000	252.042	252.042	117.579		-30.532	5365.600	5335.068	2488.849	5083.026
9		0.000	252.042	252.042	106.890		-30.532	5365.600	5335.068	2262.590	5083.026
10		0.000	252.042	252.042	97.173		-30.532	5365.600	5335.068	2056.900	5083.026
11		0.000	252.042	252.042	88.339		-30.532	5365.600	5335.068	1869.909	5083.026
12		0.000	252.042	252.042	80.308		-30.532	5365.600	5335.068	1699.917	5083.026
13		0.000	252.042	252.042	73.008		-30.532	5365.600	5335.068	1545.379	5083.026
14		0.000	252.042	252.042	66.371		-30.532	5365.600	5335.068	1404.890	5083.026
15		0.000	252.042	252.042	60.337		-30.532	5365.600	5335.068	1277.173	5083.026
16		0.000	252.042	252.042	54.852		-30.532	5365.600	5335.068	1161.066	5083.026
17		0.000	252.042	252.042	49.865		-30.532	5365.600	5335.068	1055.515	5083.026
18		0.000	252.042	252.042	45.332		-30.532	5365.600	5335.068	959.559	5083.026
19		0.000	252.042	252.042	41.211		-30.532	5365.600	5335.068	872.326	5083.026
20		0.000	252.042	252.042	37.464		-30.532	5365.600	5335.068	793.024	5083.026
21		0.000	252.042	252.042	34.059		-30.532	5365.600	5335.068	720.931	5083.026
22		0.000	252.042	252.042	30.962		-30.532	5365.600	5335.068	655.392	5083.026
23		0.000	252.042	252.042	28.148		-30.532	5365.600	5335.068	595.811	5083.026
24		0.000	252.042	252.042	25.589		-30.532	5365.600	5335.068	541.646	5083.026
25		0.000	252.042	252.042	23.262		-30.532	5365.600	5335.068	492.405	5083.026
26		0.000	252.042	252.042	21.148		-30.532	5365.600	5335.068	447.641	5083.026
27		0.000	252.042	252.042	19.225		-30.532	5365.600	5335.068	406.947	5083.026
28		0.000	252.042	252.042	17.477		-30.532	5365.600	5335.068	369.951	5083.026
29		0.000	252.042	252.042	15.889		-30.532	5365.600	5335.068	336.320	5083.026
30		0.000	186.050	186.050	10.662		-23.464	4004.540	3981.076	228.150	3795.026
31		0.000	186.050	186.050	9.693		-23.464	4004.540	3981.076	207.409	3795.026
Total	6021.243	0.000	6301.050	12322.293	5935.313	612.660	-760.301	134140.000	133992.358	28257.739	121667.065

Discount Rate 10.00%

Benefit 612.66

EDR 39.54%

B-C(Discount Rate=10%) 23322.426

B/C(Discount Rate=10%) 4.933

10. Recommendation

(1) Arrangement of Scheme for Local Portion Investment : Improvement of Domestic Financial Market etc.

It has been studied that the Project be implemented as much as possible inside Czechoslovakia for the least cost and giving good influence on Czechoslovak economy as well as taking into account current level of Czechoslovak technology. Consequently, although our Study has satisfied this requirement, there remains some problems in connection with the financing on the local portion of the Project.

As the present scheme loans on the basis of the Official Development Assistance in every countries as well as loans from organization for international aid such as the World Bank have limitation for credit line for local portion of projects. Therefore, a certain part of investment for local portion shall be funded from domestic financial market. However, since Czechoslovak private financial market is still unmatured, it is difficult to fund from the market at this stage. Therefore, the following schemes for financing on the local portion will be thought necessary to make the Project implement as scheduled.

a. Study the possibility of lowering the financing cost by using part of its own capital for environmental measures and building nuclear power plants.

b. Application of a governmental financing entity

If expansion of the activity of private banking system, which is operated on the basis of saving of the national, will not be expected soon, application of a governmental financing entity (if no such an organization, urgent establishment is necessary) shall be studied. Since environmental project is expected to generate effective demand of Czechoslovak national economy, application of the governmental financing entity will be thought very useful.

(2) Arrangement of the Electricity Tariff System

Unless credit incurred from this Project is duly borne by consumers in electricity tariff, it will increase national financial deficit and make inflation worse. Rise of electricity tariff by the implementation of the Project will be estimated at about only 0.03 kčs/MWh at maximum on the basis of total electricity sales of CEZ. This will not be cause of national financial deficit or inflation, if the cost increase caused from the FGD Units installation of Melnik Power Station can be distributed in total electricity consumption all over the country.

Therefore, it shall be materialized that environmental cost including the investment cost be duly included in a new electricity tariff system, revision of which is under way from the basis of the subsidized by the government to the basis of actual cost.

(3) Treatment of Gypsum Generated as Byproduct

About 100,000 tons/year of gypsum generation equivalent to those from Part III FGD is planned to be recovered and used as the raw material for the Gypsum Board Factory to be installed adjacent to the power station.

On the other hand, about 78,000 tons/year of gypsum generation equivalent to those from Part II FGD is planned to be disposed as of fly ash.

The disposal cost, however, affects economy of the total operation cost greatly. Therefore, it is recommended to make continuous effort to develop the extent of gypsum marketability for future.