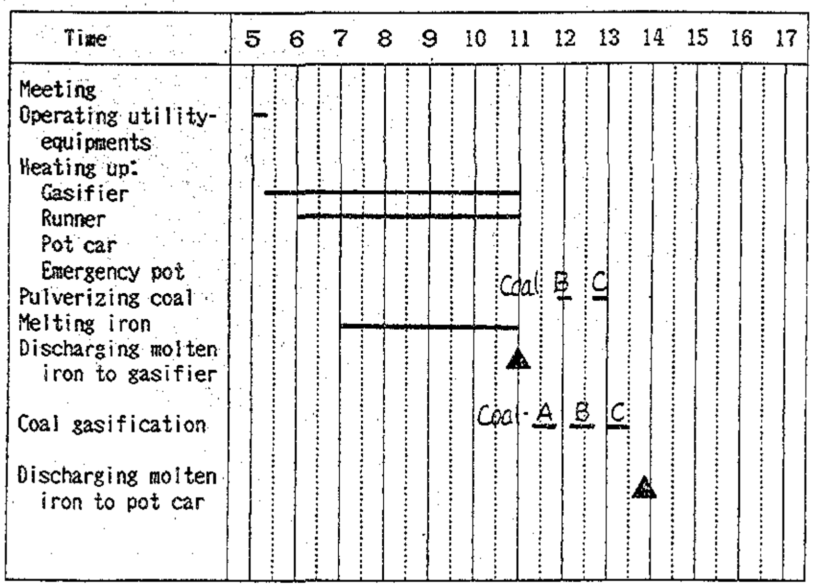
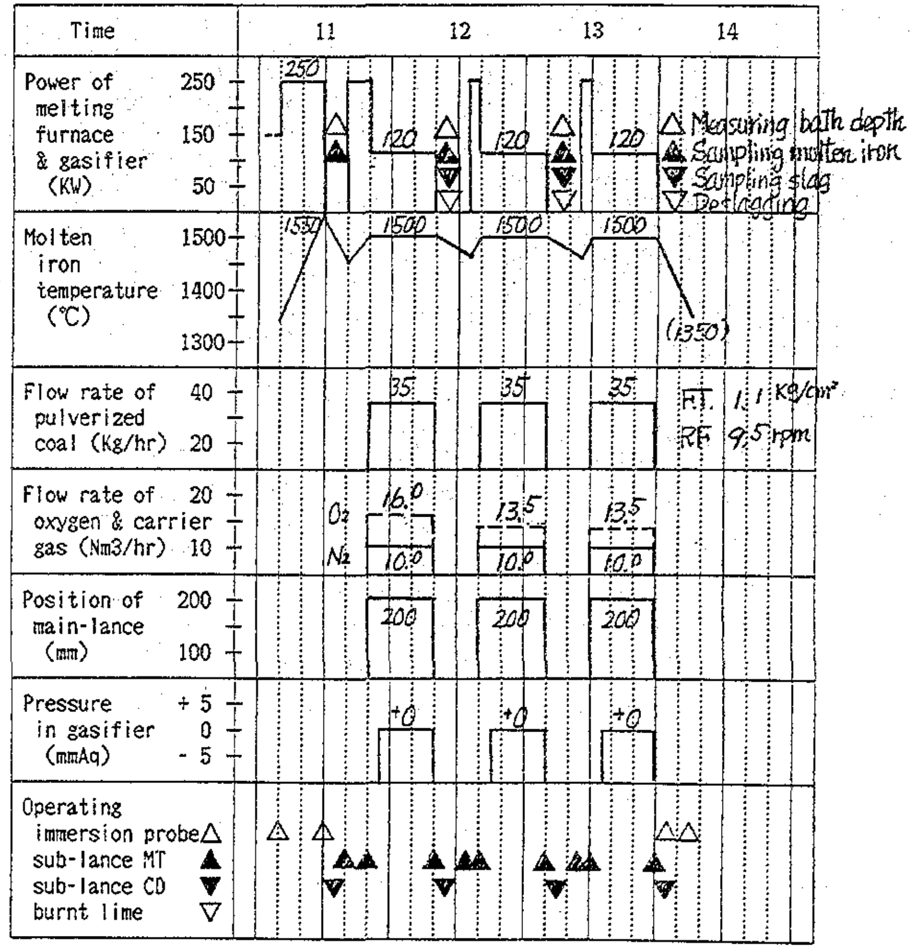
4.SCHEDULE



Time
5 6 7 8 9 10 11 12 13 14 15 16 17
Meeting
Operating utility-equipments
Heating up:
Gasifier
Runner
Pot car
Emergency pot
Pulverizing coal
Melting iron
Discharging molten iron to gasifier
Coal gasification
Discharging molten iron to pot car
Coal B C
Coal-A B C



Time
11 12 13 14
Power of melting furnace & gasifier (KW)
250 150 50
250
120
Measuring bath depth
Sampling molten iron
Sampling slag
Deslagging
Molten iron temperature (℃)
1500 1400 1300
1530
1500
(1350)
Flow rate of pulverized coal (Kg/hr)
40 20
35
F.T. 1.1 Kg/cm²
RF 9.5 rpm
Flow rate of oxygen & carrier gas (Nm3/hr)
20 10
O2
N2
16.0
13.5
10.0
Position of main-lance (mm)
200 100
200
Pressure in gasifier (mmAq)
+ 5 0 - 5
+0
Operating
immersion probe
sub-lance MT
sub-lance CD
burnt lime

RUN	17 TH COAL GASIFICATION TEST RUN	RUN No.	CG017

DATE	1987.11. 5 . (Thu.)

1.PURPOSE of RUN

1) INVESTIGATIONS of GASIFICATION-CHARACTERISTIC for CBA2, SJE2 and CBA1 coal.

2.COAL SAMPLE and OPERATION CONDITION

COAL SAMPLE—A

Sample number	CBA2				
Proximate analysis		Ultimate analysis		Ash components	
Ash	10.94 %	C	71.56 %	SiO2	%
V.M.	45.01 %	H	5.73 %	Al2O3	%
F.C.	44.05 %	N	1.16 %	CaO	%
	%	O	21.20 %	K2O	%
		S	0.35 %	Na2O	%

(DRY BASE) (D.A.F)

OPERATION CONDITION—A

Weight of molten iron	300	Kg
Flow rate of Oxygen	13.3	Nm3/hr
Flow rate of carrier gas	10.0	Nm3/hr
Flow rate of pulverized coal	35.0	Kg/hr
Position of main-lance over bath surface	200	mm
Molten iron temperature		
on discharge to gasifier	1550	℃
on coal gasification	1500	℃
on discharge to pot car	—	℃
Basicity of slag	1.5	
Weight of coal	—	wet Kg
Weight of burnt lime	0	Kg

COAL SAMPLE—B

Sample number	SJE2				
Proximate analysis		Ultimate analysis		Ash components	
Ash	2.68 %	C	70.41 %	SiO2	%
V.M.	50.15 %	H	5.48 %	Al2O3	%
F.C.	47.17 %	N	1.10 %	CaO	%
	%	O	22.84 %	K2O	%
		S	0.17 %	Na2O	%

(DRY BASE) (D.A.F.)

OPERATION CONDITION—B

Weight of molten iron	300	Kg
Flow rate of Oxygen	14.0	Nm3/hr
Flow rate of carrier gas	10.0	Nm3/hr
Flow rate of pulverized coal	35.0	Kg/hr
Position of main-lance over bath surface	200	mm
Molten iron temperature		
on discharge to gasifier	--	℃
on coal gasification	1500	℃
on discharge to pot car	—	℃
Basicity of slag	1.5	
Weight of coal	22	wet Kg
Weight of burnt lime	0	Kg

RUN		RUN No.	CG017

COAL SAMPLE—C

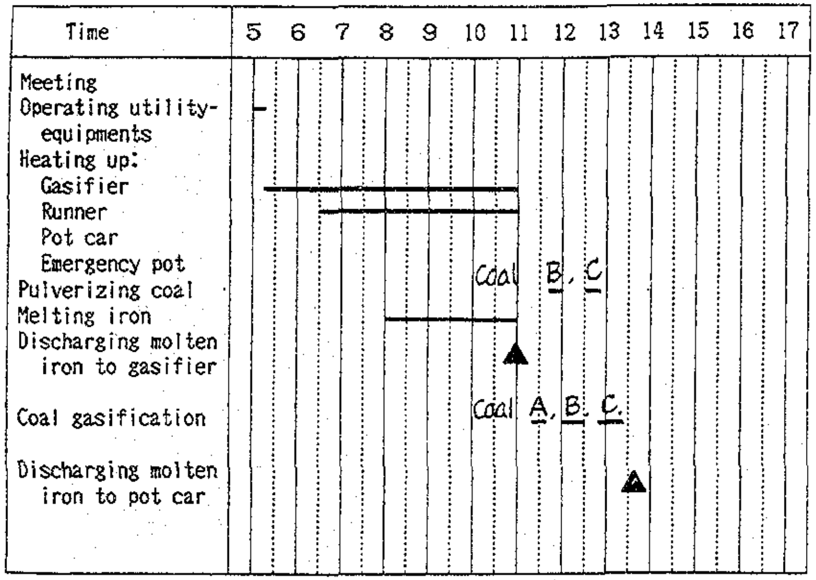
Sample number	CBA1				
Proximate analysis		Ultimate analysis		Ash components	
Ash	17.03 %	C	69.60 %	SiO2	%
V.M.	42.73 %	H	5.76 %	Al2O3	%
F.C.	40.24 %	N	1.12 %	CaO	%
	%	O	21.81 %	K2O	%
		S	1.71 %	Na2O	%

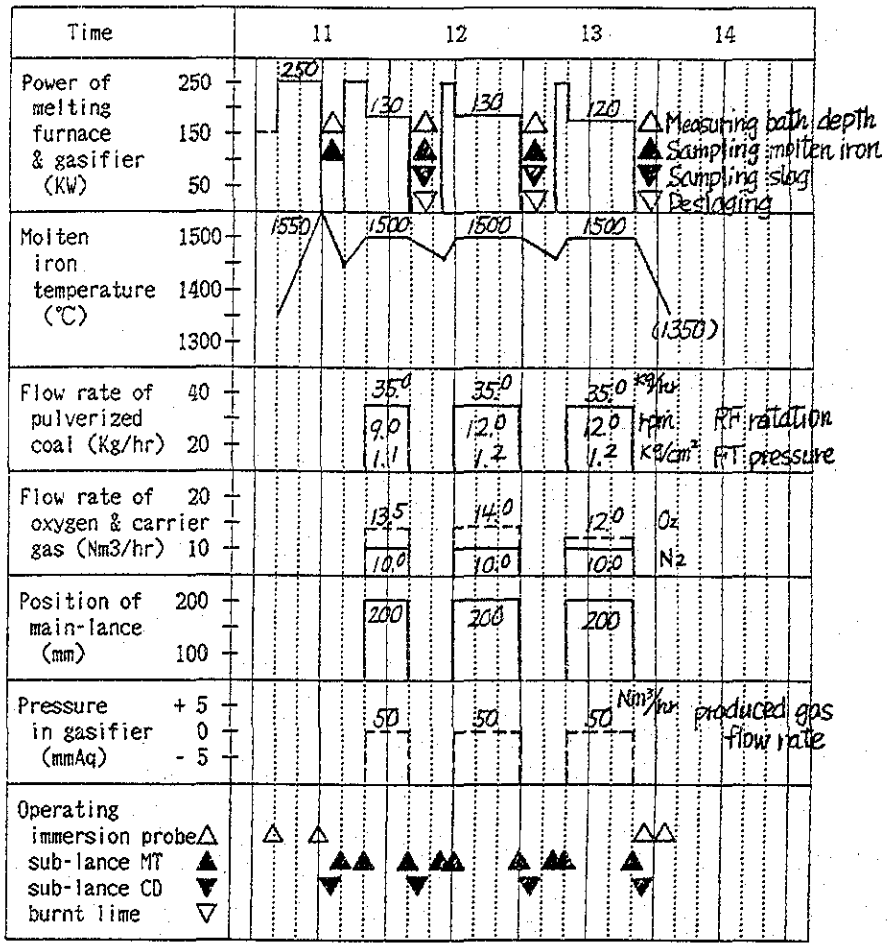
(DRY BASE) (D.A.F)

OPERATION CONDITION—C

Weight of molten iron	300	Kg
Flow rate of Oxygen	11.8	Nm3/hr
Flow rate of carrier gas	10.0	Nm3/hr
Flow rate of pulverized coal	35.0	Kg/hr
Position of main-lance over bath surface	200	mm
Molten iron temperature		
on discharge to gasifier	~~1550~~	℃
on coal gasification	1500	℃
on discharge to pot car	1350	℃
Basicity of slag	1.5	
Weight of coal	21.	wet Kg
Weight of burnt lime	0	Kg

4.SCHEDULE


Time
5 6 7 8 9 10 11 12 13 14 15 16 17
Meeting
Operating utility-equipments
Heating up:
Gasifier
Runner
Pot car
Emergency pot
Pulverizing coal
Melting iron
Discharging molten iron to gasifier
Coal gasification
Discharging molten iron to pot car
Coal B, C
Coal A, B, C


Time
11 12 13 14
Power of melting furnace & gasifier (KW)
250 150 50
250 130 130 120
Measuring bath depth
Sampling molten iron
Sampling slag
Deslaging
Molten iron temperature (℃)
1500 1400 1300
1550 1500 1500 1500 (1350)
Flow rate of pulverized coal (Kg/hr)
40 20
35.0 35.0 35.0 kg/hr
9.0 12.0 12.0 rpm RF rotation
1.1 1.2 1.2 Kg/cm² FT pressure
Flow rate of oxygen & carrier gas (Nm3/hr)
20 10
13.5 14.0 12.0 O2
10.0 10.0 10.0 N2
Position of main-lance (mm)
200 100
200 200 200
Pressure in gasifier (mmAq)
+ 5 0 - 5
50 50 50 Nm³/hr produced gas flow rate
Operating
immersion probe
sub-lance MT
sub-lance CD
burnt lime

RUN	18 TH COAL GASIFICATION TEST RUN	RUN No.	CG018

DATE	1987.11. 12 . (Thu.)

1. PURPOSE of RUN
   1) INVESTIGATIONS of GASIFICATION-CHARACTERISTIC for BJS and BUIIC1 coal.

2. COAL SAMPLE and OPERATION CONDITION

COAL SAMPLE—A

Sample number	BJS				
Proximate analysis		Ultimate analysis		Ash components	
Ash	4.24 %	C	68.52 %	SiO2	%
V.M.	49.97 %	H	5.68 %	Al2O3	%
F.C.	45.79 %	N	1.15 %	CaO	%
	%	O	24.13 %	K2O	%
		S	0.52 %	Na2O	%

(DRY BASE) (D.A.F)

OPERATION CONDITION—A

Weight of molten iron	300	Kg
Flow rate of Oxygen	13.3	Nm3/hr
Flow rate of carrier gas	10.0	Nm3/hr
Flow rate of pulverized coal	35.0	Kg/hr
Position of main-lance over bath surface	200	mm
Molten iron temperature		
on discharge to gasifier	1550	℃
on coal gasification	1500	℃
on discharge to pot car	—	℃
Basicity of slag	1.5	
Weight of coal	28	wet Kg
Weight of burnt lime	0	Kg

COAL SAMPLE—B

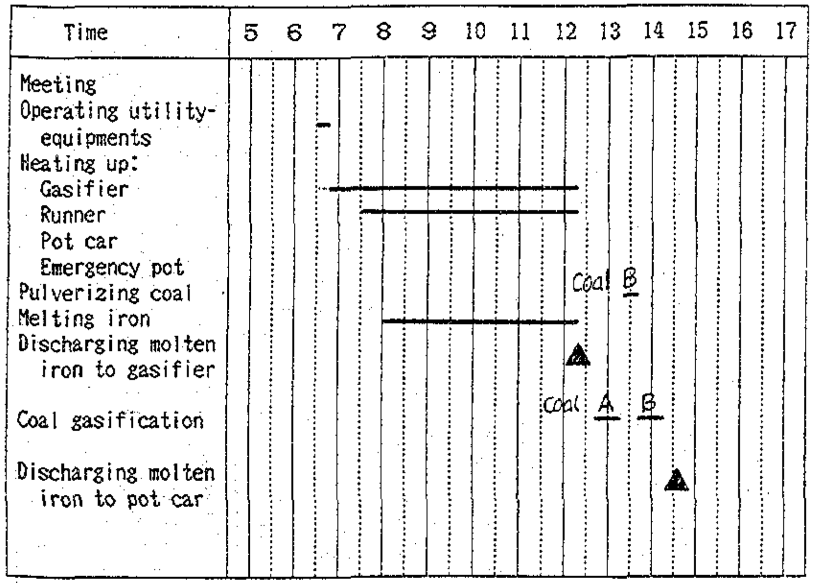
Sample number	BUIIC1				
Proximate analysis		Ultimate analysis		Ash components	
Ash	1.90 %	C	74.50 %	SiO2	%
V.M.	46.04 %	H	5.43 %	Al2O3	%
F.C.	52.06 %	N	1.36 %	CaO	%
	%	O	18.26 %	K2O	%
		S	0.45 %	Na2O	%

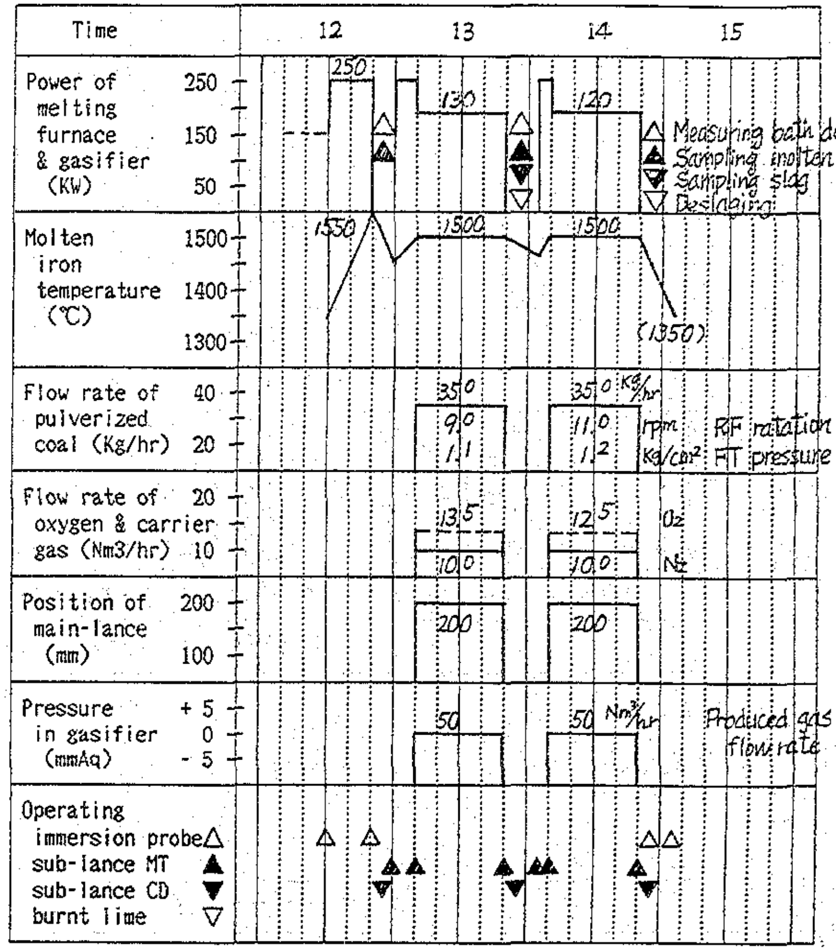
(DRY BASE) (D.A.F.)

OPERATION CONDITION—B

Weight of molten iron	300	Kg
Flow rate of Oxygen	12.6	Nm3/hr
Flow rate of carrier gas	10.0	Nm3/hr
Flow rate of pulverized coal	35.0	Kg/hr
Position of main-lance over bath surface	200	mm
Molten iron temperature		
on discharge to gasifier	--	℃
on coal gasification	1500	℃
on discharge to pot car	1350	℃
Basicity of slag	1.5	
Weight of coal	27.	wet Kg
Weight of burnt lime	0	Kg

4.SCHEDULE


Time
5 6 7 8 9 10 11 12 13 14 15 16 17
Meeting
Operating utility-equipments
Heating up:
Gasifier
Runner
Pot car
Emergency pot
Pulverizing coal
Melting iron
Discharging molten iron to gasifier
Coal gasification
Discharging molten iron to pot car
Coal B
Coal A
B


Time
12 13 14 15
Power of melting furnace & gasifier (KW)
250 150 50
250
130
120
Measuring bath depth
Sampling molten iron
Sampling slag
Deslaging
Molten iron temperature (℃)
1500 1400 1300
1550
1500
1500
(1350)
Flow rate of pulverized coal (Kg/hr)
40 20
350
9.0
1.1
350 Kg/hr
11.0
1.2
rpm RF rotation
Kg/cm² FT pressure
Flow rate of oxygen & carrier gas (Nm3/hr)
20 10
13.5
10.0
12.5
10.0
O2
N2
Position of main-lance (mm)
200 100
200
200
Pressure in gasifier (mmAq)
+ 5 0 - 5
50
50 Nm³/hr
Produced gas flow rate
Operating
immersion probe △
sub-lance MT ▲
sub-lance CD ▼
burnt lime ▽

RUN	19 TH COAL GASIFICATION TEST RUN	RUN No.	CG019

DATE	1987.11. 18 . (Wed.)

1.PURPOSE of RUN

1) INVESTIGATIONS of GASIFICATION-CHARACTERISTIC for BJS and BSIA1 coal

2.COAL SAMPLE and OPERATION CONDITION

COAL SAMPLE−A

Sample number	BJS				
Proximate analysis		Ultimate analysis		Ash components	
Ash	4.24 %	C	68.52 %	SiO2	%
V.M.	49.97 %	H	5.68 %	Al2O3	%
F.C.	45.79 %	N	1.15 %	CaO	%
	%	O	24.13 %	K2O	%
		S	0.52 %	Na2O	%

(DRY BASE) (D.A.F)

OPERATION CONDITION−A

Weight of molten iron	300	Kg
Flow rate of Oxygen		Nm3/hr
Flow rate of carrier gas	10.0	Nm3/hr
Flow rate of pulverized coal	35.0	Kg/hr
Position of main-lance over bath surface	200	mm
Molten iron temperature		
on discharge to gasifier	1550	℃
on coal gasification	1500	℃
on discharge to pot car	—	℃
Basicity of slag	1.5	
Weight of coal	22	wet Kg
Weight of burnt lime	0	Kg

COAL SAMPLE−B

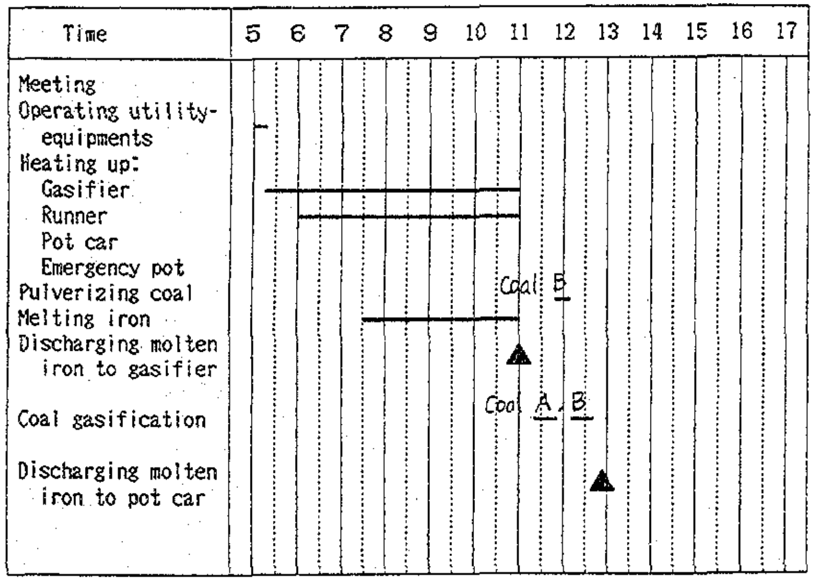
Sample number	BSIA1				
Proximate analysis		Ultimate analysis		Ash components	
Ash	4.29 %	C	73.13 %	SiO2	%
V.M.	46.63 %	H	5.72 %	Al2O3	%
F.C.	49.08 %	N	1.14 %	CaO	%
	%	O	19.30 %	K2O	%
		S	0.71 %	Na2O	%

(DRY BASE) (D.A.F.)

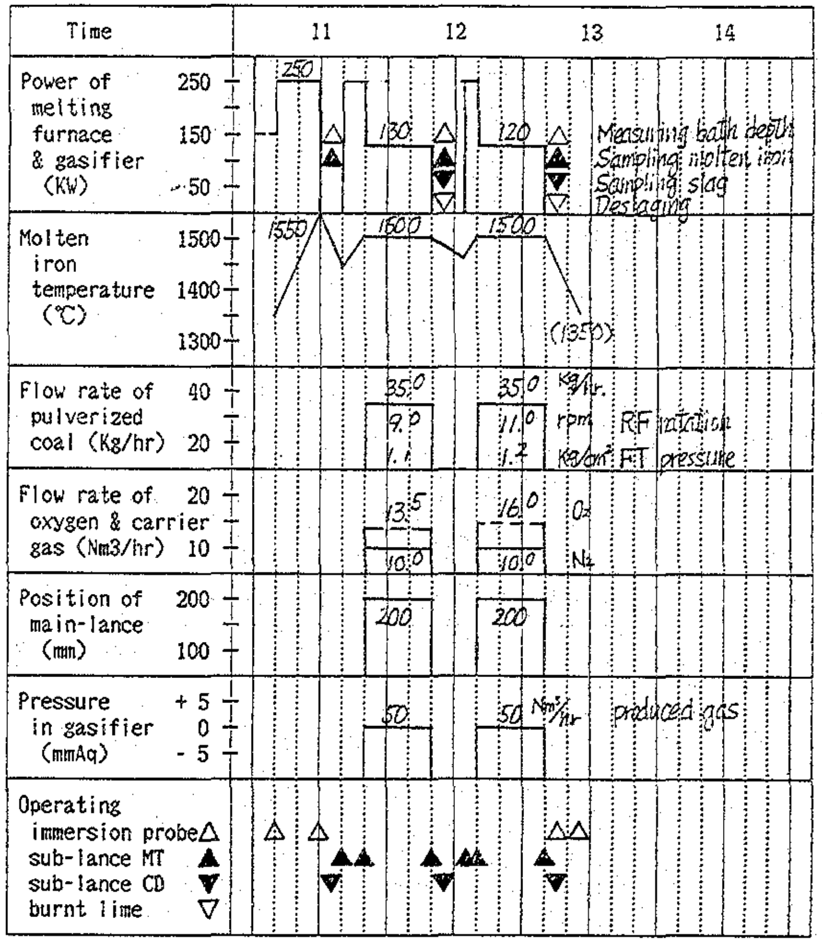
OPERATION CONDITION−B

Weight of molten iron	300	Kg
Flow rate of Oxygen	15.8	Nm3/hr
Flow rate of carrier gas	10.0	Nm3/hr
Flow rate of pulverized coal	35.0	Kg/hr
Position of main-lance over bath surface	200	mm
Molten iron temperature		
on discharge to gasifier	--	℃
on coal gasification	1500	℃
on discharge to pot car	1350	℃
Basicity of slag	1.5	
Weight of coal	21.	wet Kg
Weight of burnt lime	0	Kg

4.SCHEDULE



Time
5 6 7 8 9 10 11 12 13 14 15 16 17
Meeting
Operating utility-equipments
Heating up:
Gasifier
Runner
Pot car
Emergency pot
Pulverizing coal
Melting iron
Discharging molten iron to gasifier
Coal gasification
Discharging molten iron to pot car
Coal B
Coal A, B



Time
11 12 13 14
Power of melting furnace & gasifier (KW)
250
150
50
130
120
Measuring bath depth
Sampling molten iron
Sampling slag
Deslaging
Molten iron temperature (℃)
1500
1400
1300
1550
1600
(1350)
Flow rate of pulverized coal (Kg/hr)
40
20
35.0
9.0
1.1
11.0
1.2
Kg/hr.
rpm
Kg/cm²
RF rotation
FT pressure
Flow rate of oxygen & carrier gas (Nm3/hr)
13.5
10.0
16.0
O₂
N₂
Position of main-lance (mm)
200
100
Pressure in gasifier (mmAq)
+ 5
0
- 5
50
Nm³/hr
produced gas
Operating
immersion probe
sub-lance MT
sub-lance CD
burnt lime

26.Nov.87

RUN	TH COAL GASIFICATION TEST RUN	RUN No.	CG01 - 20	DATE	1987.10. - ( )

1.PURPOSE of RUN
1) INVESTIGATIONS of GASIFICATION-CHARACTERISTIC for

2.COAL SAMPLE and OPERATION CONDITION

COAL SAMPLE—A

Sample number BS4B					
Proximate analysis		Ultimate analysis		Ash components	
Ash	4.49 %	C	73.12 %	SiO2	%
V.M.	47.25 %	H	5.74 %	Al2O3	%
F.C.	48.26 %	N	1.13 %	CaO	%
	%	O	19.74 %	K2O	%
		S	0.27 %	Na2O	%

(DRY BASE) (D.A.F)

OPERATION CONDITION—A

Weight of molten iron	300	Kg
Flow rate of Oxygen	15.0	Nm3/hr
Flow rate of carrier gas	10.0	Nm3/hr
Flow rate of pulverized coal	35.0	Kg/hr
Position of main-lance over bath surface	200	mm
Molten iron temperature		
on discharge to gasifier	1550	℃
on coal gasification	1500	℃
on discharge to pot car	—	℃
Basicity of slag	1.5	
Weight of coal	20	wet Kg
Weight of burnt lime	0	Kg

COAL SAMPLE—B

Sample number B42B2					
Proximate analysis		Ultimate analysis		Ash components	
Ash 2.29		C	73.10 %	SiO2	%
V.M. 47.58		H	5.80 %	Al2O3	%
F.C. 50.13		N	1.25 %	CaO	%
		O	18.15 %	K2O	%
		S	1.70 %	Na2O	%

(DRY BASE) (D.A.F.)

OPERATION CONDITION—B

Weight of molten iron	300	Kg
Flow rate of Oxygen	15.7	Nm3/hr
Flow rate of carrier gas	10.0	Nm3/hr
Flow rate of pulverized coal	35.0	Kg/hr
Position of main-lance over bath surface	200	mm
Molten iron temperature		
on discharge to gasifier	--	℃
on coal gasification	1500	℃
on discharge to pot car	—	℃
Basicity of slag	1.5	
Weight of coal	20	wet Kg
Weight of burnt lime	0	Kg

DATE	1987.11.26 . (Thu.)

COAL SAMPLE-E

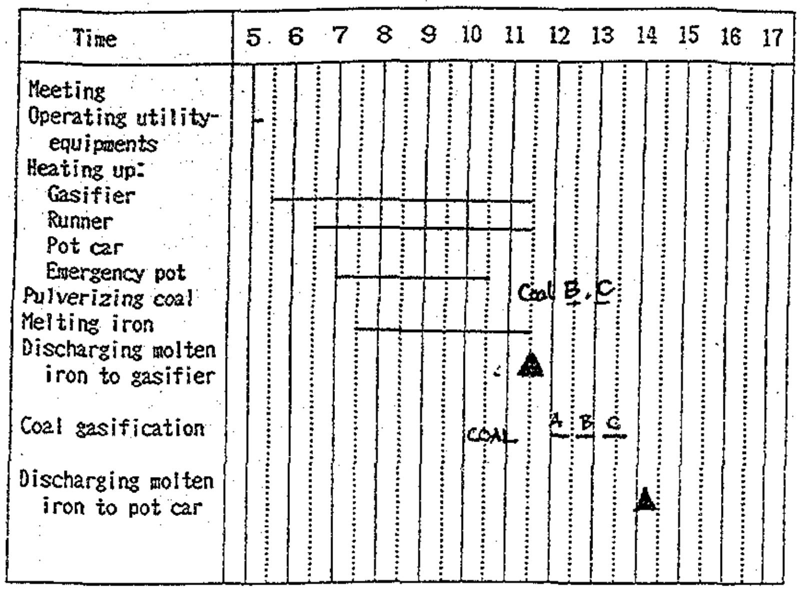
Sample number	BU2A1				
Proximate analysis		Ultimate analysis		Ash components	
Ash	7.06 %	C	76.73 %	SiO2	%
V.M.	44.92 %	H	5.97 %	Al2O3	%
F.C.	48.02 %	N	1.28 %	CaO	%
	%	O	15.43 %	K2O	%
	%	S	0.59 %	Na2O	%
					%

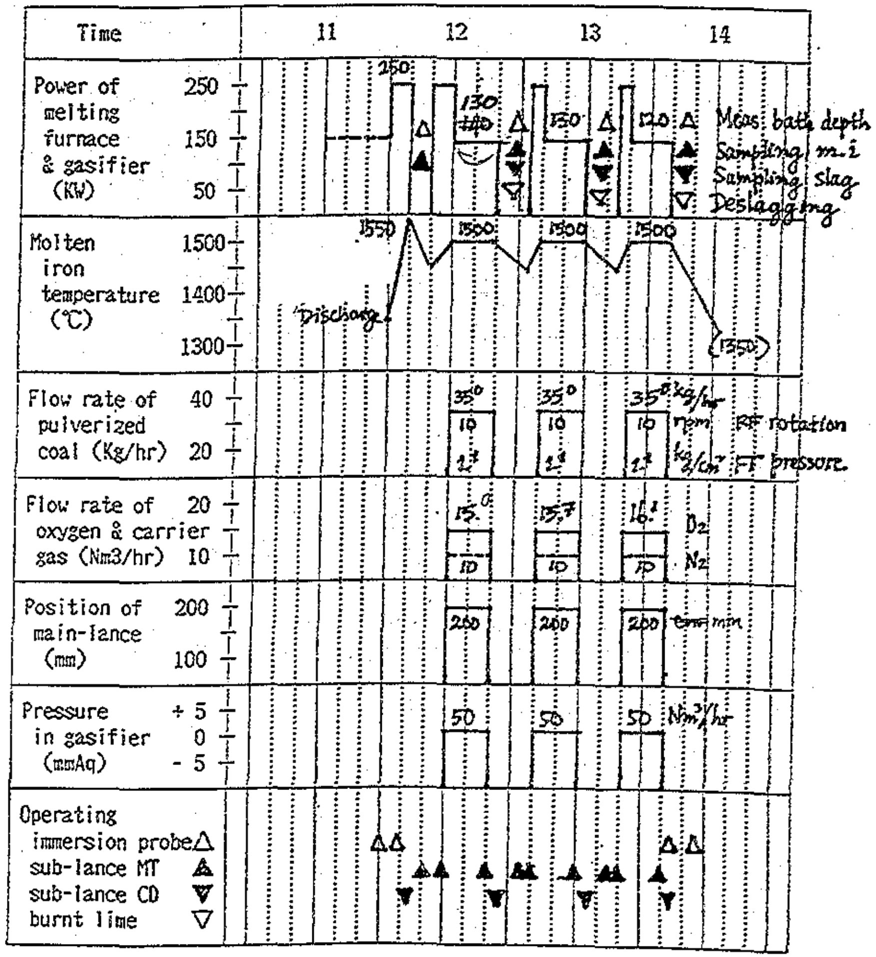
(DRY BASE) (D.A.F.)

OPERATION CONDITION—B

Weight of molten iron	300	Kg
Flow rate of Oxygen	16.1	Nm3/hr
Flow rate of carrier gas	10.0	Nm3/hr
Flow rate of pulverized coal	35.0	Kg/hr
Position of main-lance over bath surface	200	mm
Molten iron temperature		
on discharge to gasifier	--	℃
on coal gasification	1500	℃
on discharge to pot car	1350	℃
Basicity of slag	1.5	
Weight of coal	21	wet Kg
Weight of burnt lime	0	Kg

4.SCHEDULE


Time
5
6
7
8
9
10
11
12
13
14
15
16
17
Meeting
Operating utility-equipments
Heating up:
Gasifier
Runner
Pot car
Emergency pot
Pulverizing coal
Melting iron
Discharging molten iron to gasifier
Coal gasification
Discharging molten iron to pot car
Coal B.C
COAL
A B C


Time
11
12
13
14
Power of melting furnace & gasifier (KW)
250
150
50
Molten iron temperature (℃)
1500
1400
1300
Flow rate of pulverized coal (Kg/hr)
40
20
Flow rate of oxygen & carrier gas (Nm3/hr)
20
10
Position of main-lance (mm)
200
100
Pressure in gasifier (mmAq)
+ 5
0
- 5
Operating
immersion probe △
sub-lance MT ▲
sub-lance CD ▼
burnt lime ▽
Meas. bath depth
Sampling m.i
Sampling slag
Deslagging
Discharge
1550
1500
(1350)
RF rotation
FF pressure
O2
N2

RUN	TH COAL GASIFICATION TEST RUN	RUN No.	CG01 021

DATE	1987.12. 2 . ( )

1.PURPOSE of RUN
  1) INVESTIGATIONS of GASIFICATION-CHARACTERISTIC for BSIC1

2.COAL SAMPLE and OPERATION CONDITION

COAL SAMPLE—A

Sample number BSIC1					
Proximate analysis		Ultimate analysis		Ash components	
Ash	0.265 %	C 76.4	76.41 %	SiO2	%
V.M.	46.95 %	H	5.83 %	Al2O3	%
F.C.	50.40 %	N	1.40 %	CaO	%
	%	O	15.76 %	K2O	%
		S	0.60 %	Na2O	%
(DRY BASE)		(D.A.F)			

OPERATION CONDITION—A

Weight of molten iron	300	Kg
Flow rate of Oxygen	13.4	Nm3/hr
Flow rate of carrier gas	10.0	Nm3/hr
Flow rate of pulverized coal	35	Kg/hr
Position of main-lance over bath surface	200	mm
Molten iron temperature		
on discharge to gasifier	1550	℃
on coal gasification	1500	℃
on discharge to pot car		℃
Basicity of slag	1.5	
Weight of coal	20	wet Kg
Weight of burnt lime	0	Kg

COAL SAMPLE—B

Sample number BUIC1					
Proximate analysis		Ultimate analysis		Ash components	
Ash	1.90 %	C	74.50 %	SiO2	%
V.M.	46.04 %	H	5.43 %	Al2O3	%
F.C.	52.06 %	N	1.36 %	CaO	%
	%	O	18.26 %	K2O	%
		S	0.45 %	Na2O	%
(DRY BASE)		(D.A.F.)			

OPERATION CONDITION—B

Weight of molten iron	300	Kg
Flow rate of Oxygen	12.6	Nm3/hr
Flow rate of carrier gas	10.0	Nm3/hr
Flow rate of pulverized coal	35	Kg/hr
Position of main-lance over bath surface	200	mm
Molten iron temperature		
on discharge to gasifier	--	℃
on coal gasification	1500	℃
on discharge to pot car		℃
Basicity of slag	1.5	
Weight of coal	20	wet Kg
Weight of burnt lime	0	Kg

RUN	TH COAL GASIFICATION TEST RUN	RUN No.	CG021

DATE	1987.12.2 . ( )

1.PURPOSE of RUN
 1) INVESTIGATIONS of GASIFICATION-CHARACTERISTIC for

2.COAL SAMPLE and OPERATION CONDITION

COAL SAMPLE—A

Sample number					
Proximate analysis		Ultimate analysis		Ash components	
Ash	%	C	%	SiO2	%
V.M.	%	H	%	Al2O3	%
F.C.	%	N	%	CaO	%
	%	O	%	K2O	%
		S	%	Na2O	%

(DRY BASE) (D.A.F)

OPERATION CONDITION—A

Weight of molten iron	300	Kg
Flow rate of Oxygen		Nm3/hr
Flow rate of carrier gas	10.0	Nm3/hr
Flow rate of pulverized coal		Kg/hr
Position of main-lance over bath surface	200	mm
Molten iron temperature		
on discharge to gasifier	1550	℃
on coal gasification	1500	℃
on discharge to pot car		℃
Basicity of slag	1.5	
Weight of coal		wet Kg
Weight of burnt lime	0	Kg

COAL SAMPLE—C CBC

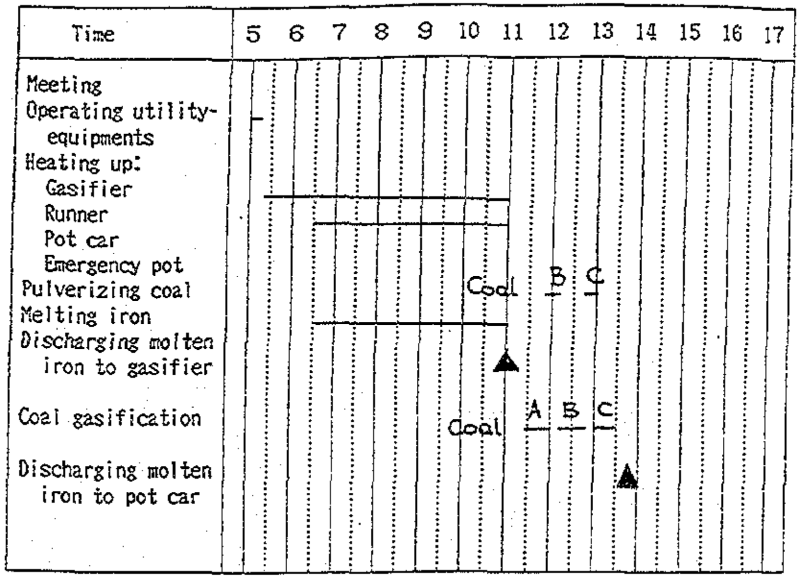
Sample number					
Proximate analysis		Ultimate analysis		Ash components	
Ash	6.15 %	C	72.22 %	SiO2	%
V.M.	47.08 %	H	5.88 %	Al2O3	%
F.C.	46.77 %	N	1.48 %	CaO	%
	%	O	20.05 %	K2O	%
		S	0.37 %	Na2O	%

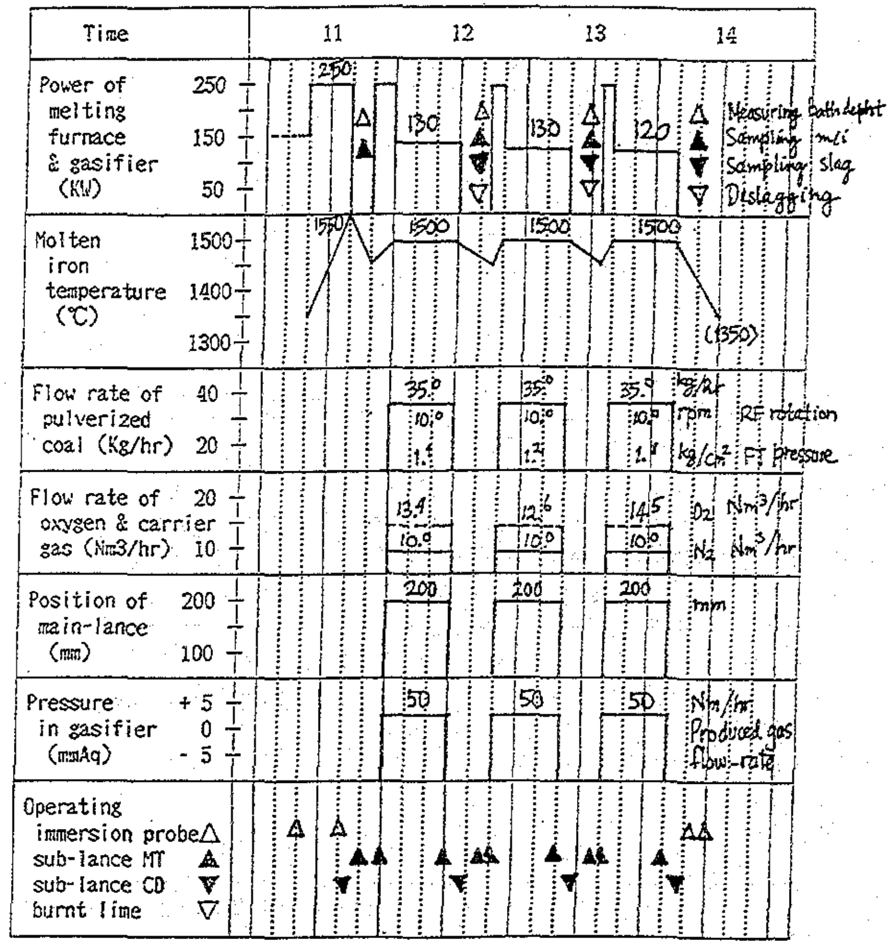
(DRY BASE) (D.A.F.)

OPERATION CONDITION—B

Weight of molten iron	300	Kg
Flow rate of Oxygen	14.5	Nm3/hr
Flow rate of carrier gas	10.0	Nm3/hr
Flow rate of pulverized coal	35	Kg/hr
Position of main-lance over bath surface	200	mm
Molten iron temperature		
on discharge to gasifier	--	℃
on coal gasification	1500	℃
on discharge to pot car	1350	℃
Basicity of slag	1.5	
Weight of coal	20	wet Kg
Weight of burnt lime	0	Kg

4.SCHEDULE

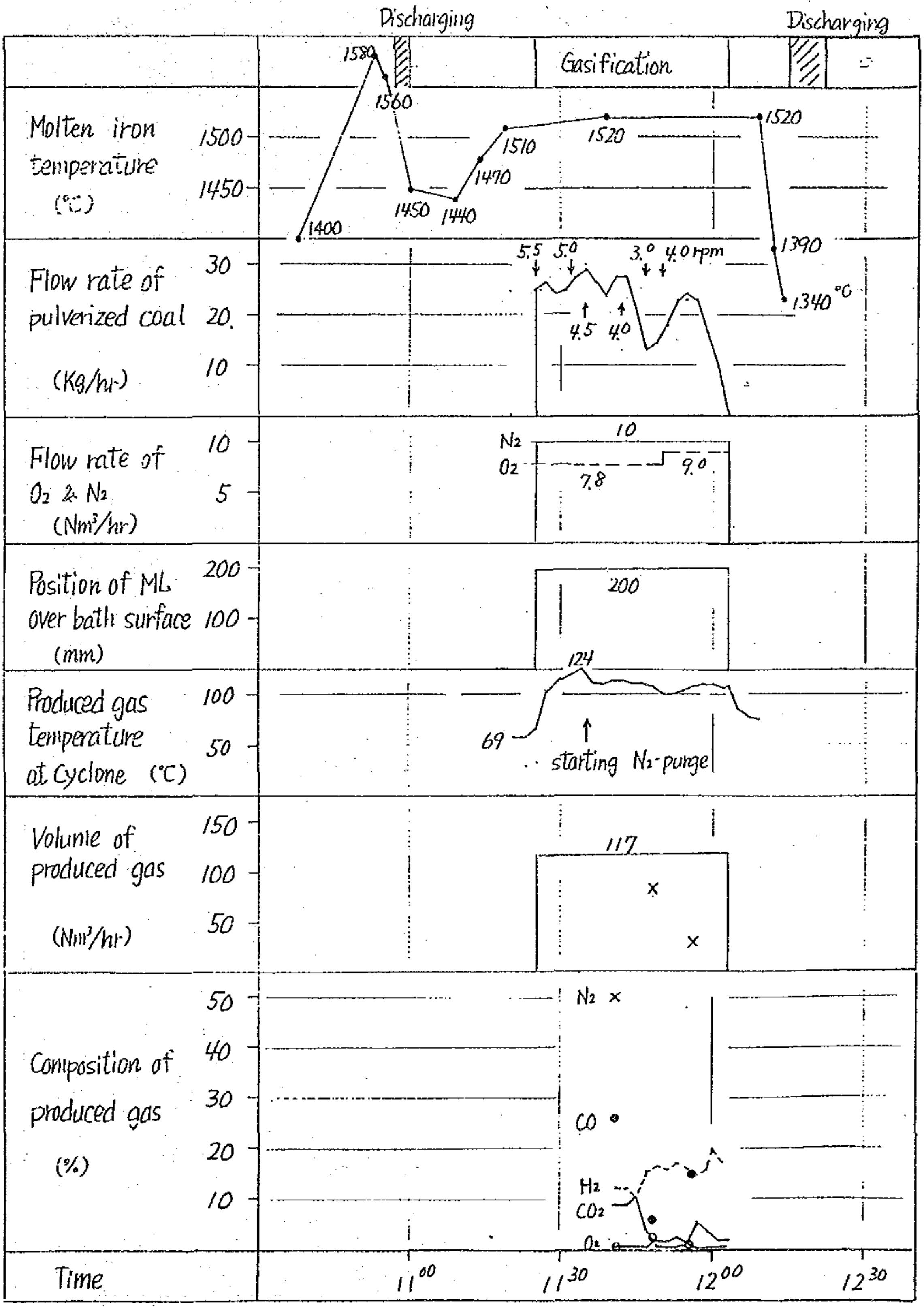

Time
5 6 7 8 9 10 11 12 13 14 15 16 17
Meeting
Operating utility-equipments
Heating up:
Gasifier
Runner
Pot car
Emergency pot
Pulverizing coal
Melting iron
Discharging molten iron to gasifier
Coal gasification
Discharging molten iron to pot car
Coal
B
C
A


Time
11 12 13 14
Power of melting furnace & gasifier (KW)
250
150
50
130
120
Measuring bath depth
Sampling m/i
Sampling slag
Dislagging
Molten iron temperature (℃)
1500
1400
1300
1550
(1350)
Flow rate of pulverized coal (Kg/hr)
40
20
35.0
10.0
kg/hr
rpm RF rotation
kg/cm² FT pressure
Flow rate of oxygen & carrier gas (Nm3/hr)
13.4
12.6
14.5
O2 Nm³/hr
N2 Nm³/hr
Position of main-lance (mm)
200
100
mm
Pressure in gasifier (mmAq)
+ 5
0
- 5
50
Nm/hr
Produced gas flow-rate
Operating
immersion probe △
sub-lance MT
sub-lance CD
burnt lime ▽

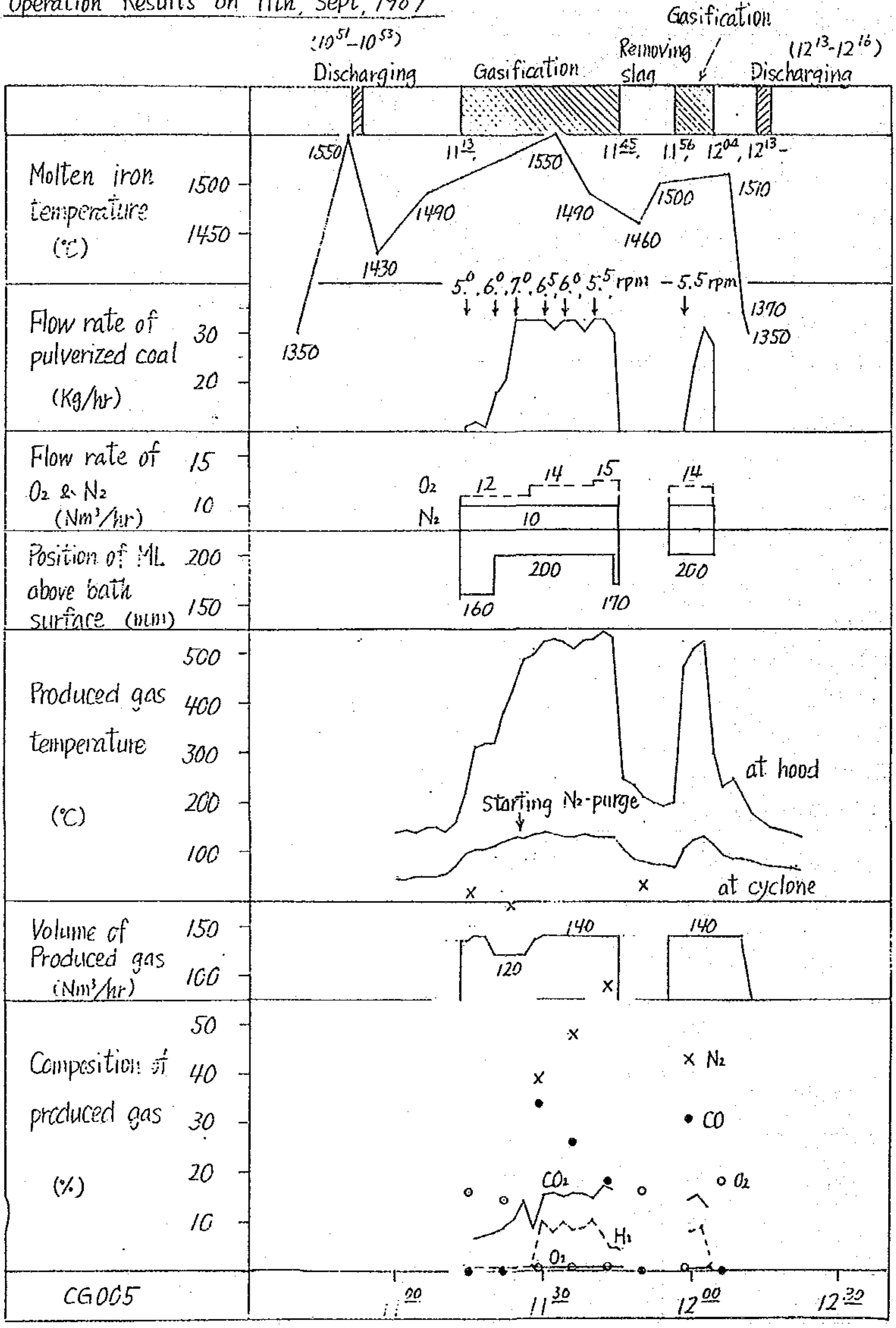
2. Test Results

Operation Result on 8th, Sept, 1987

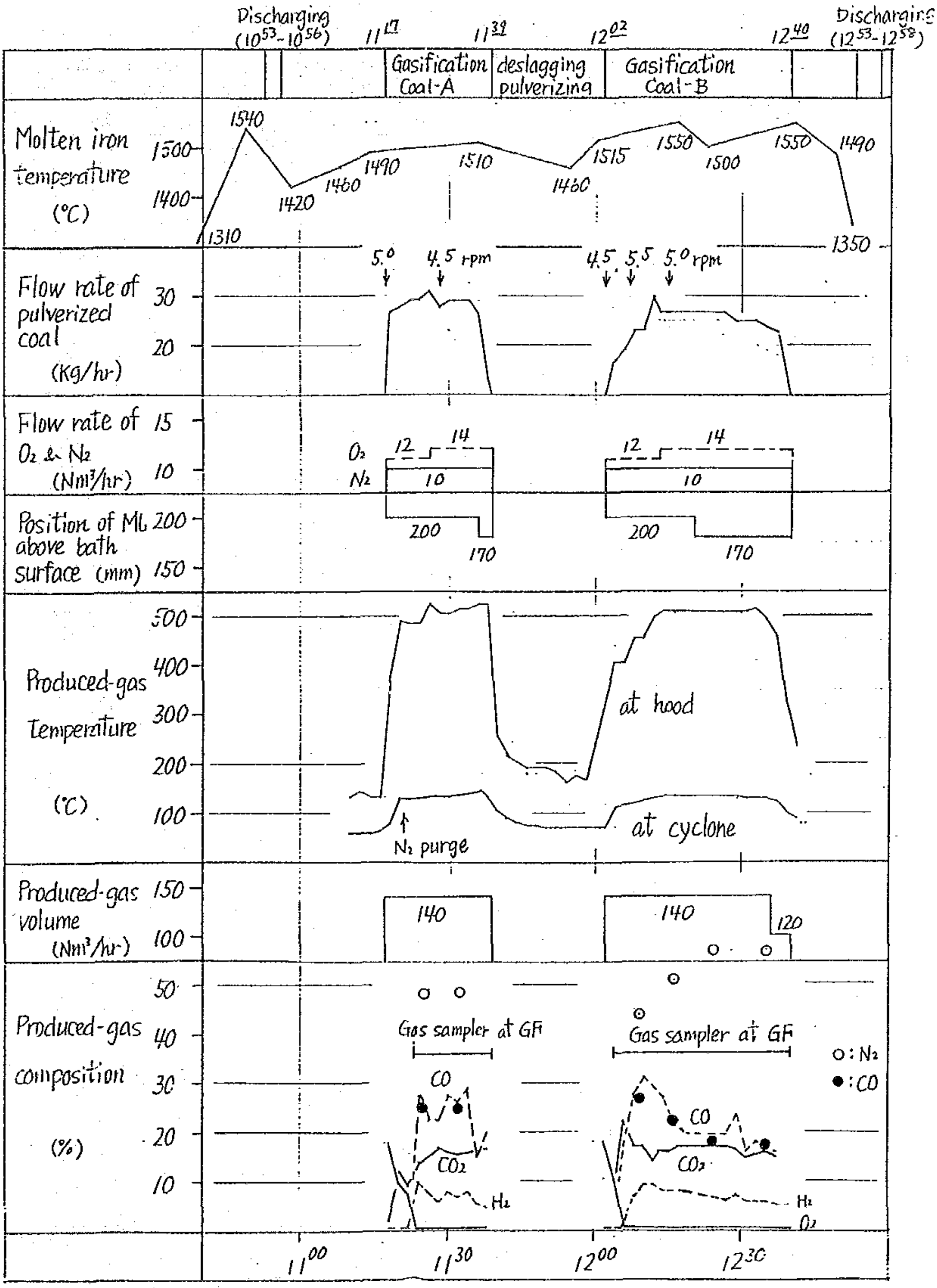
CG004



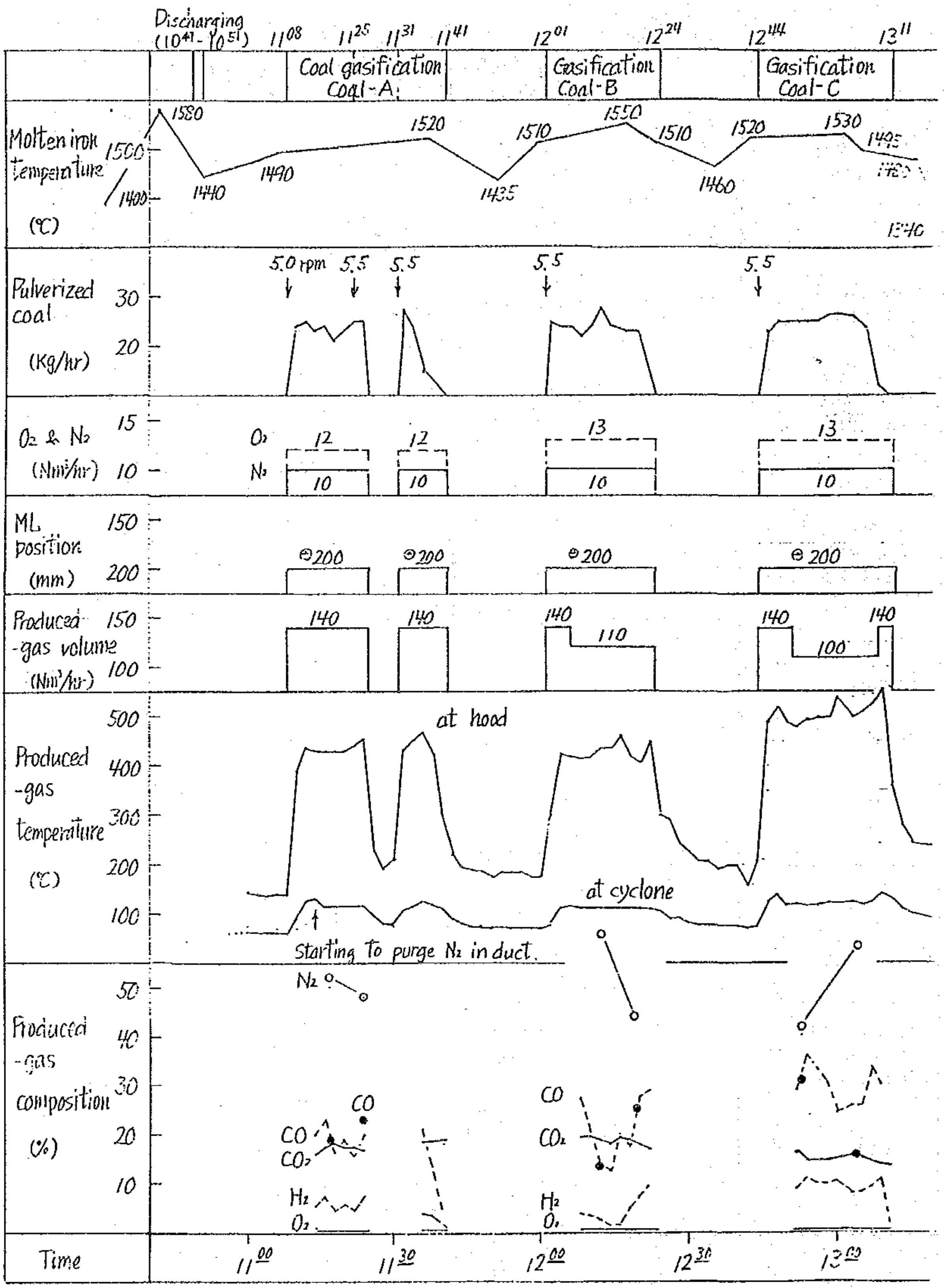
Operation Results on 11th, Sept, 1987



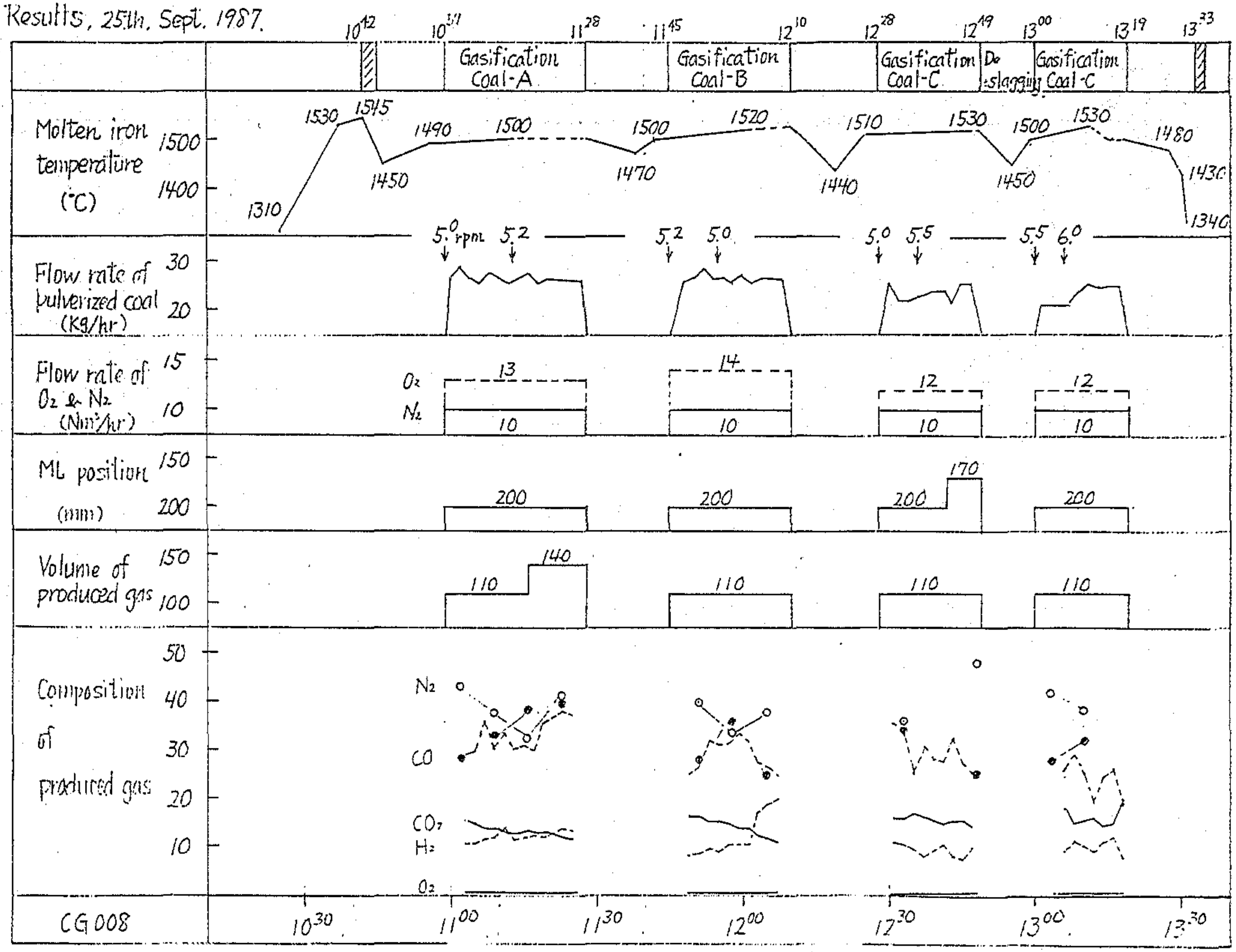
Operation Results on 16th, Sept. (CG006)



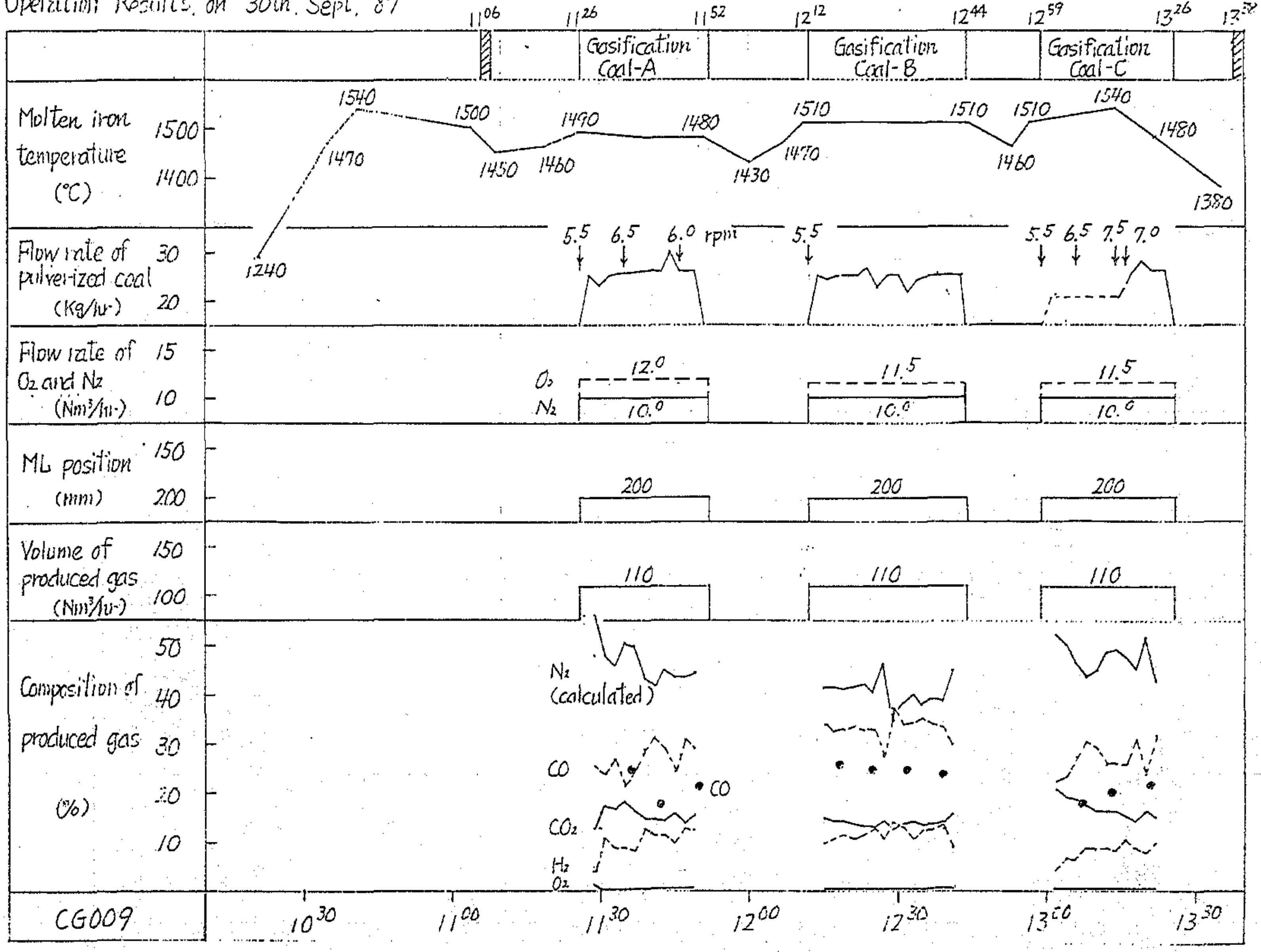
Operation Results on 22nd. Oct. (CG007)



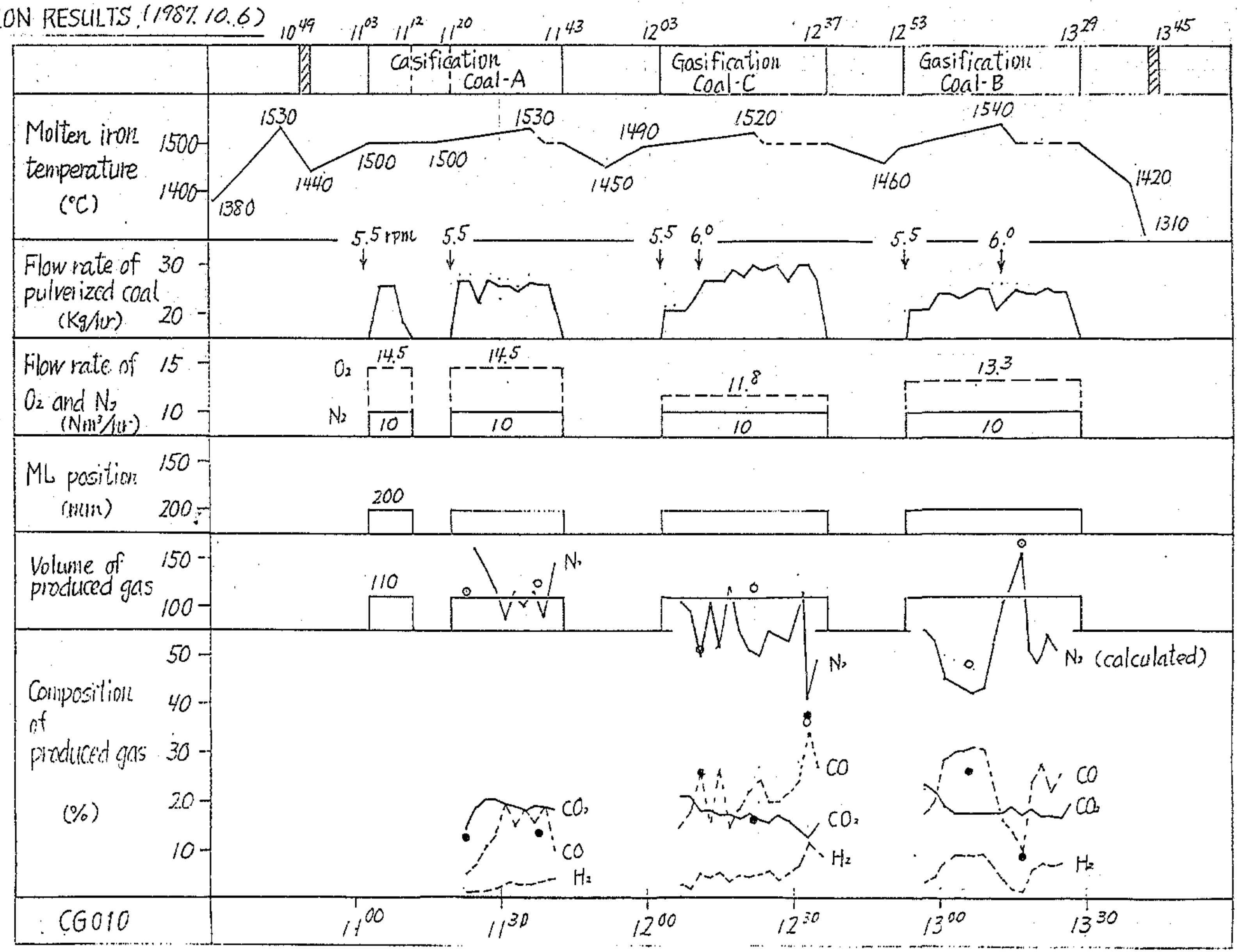
Operation Results, 25th. Sept. 1987.



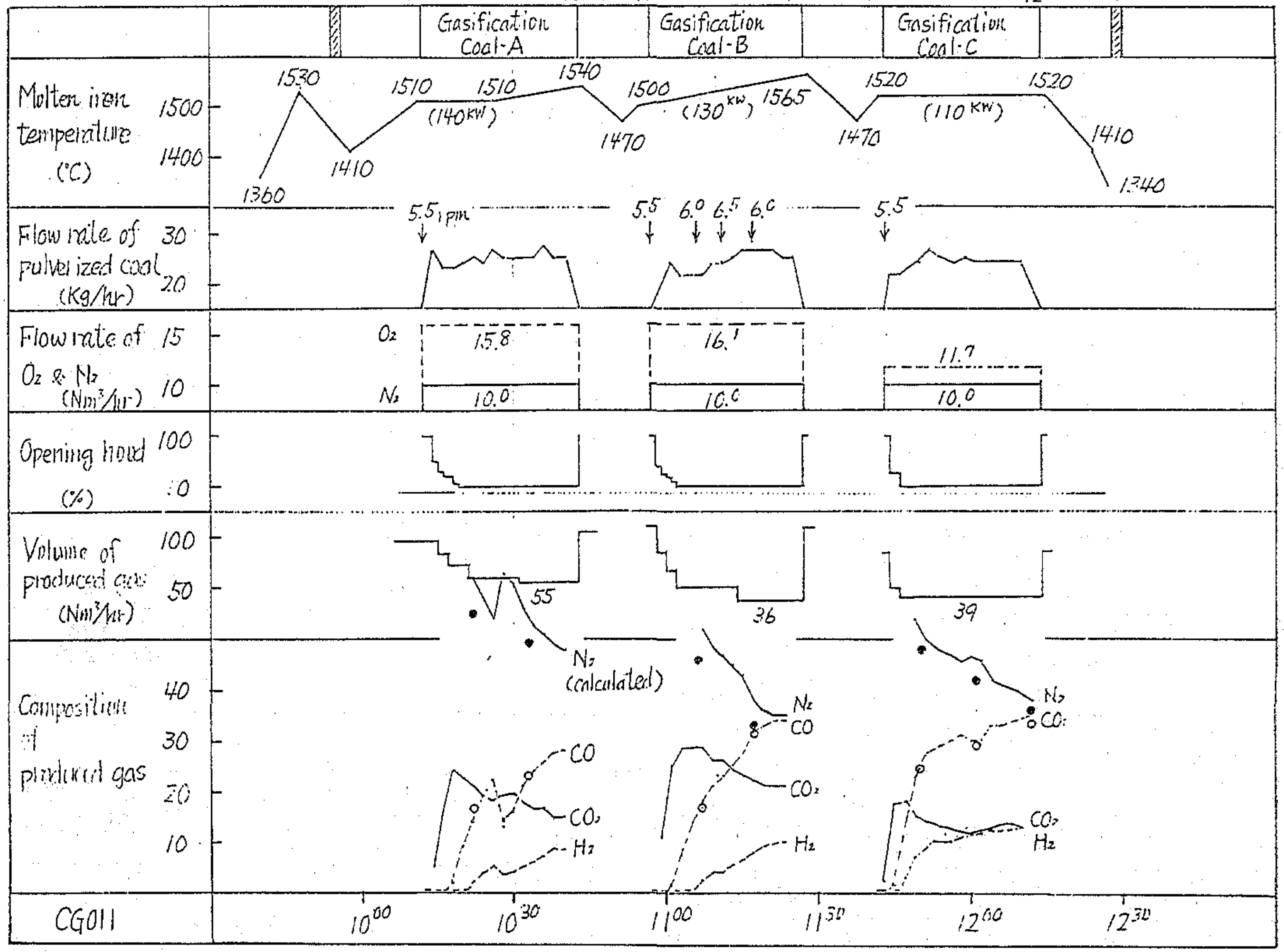
Operation Results on 30th. Sept. '87



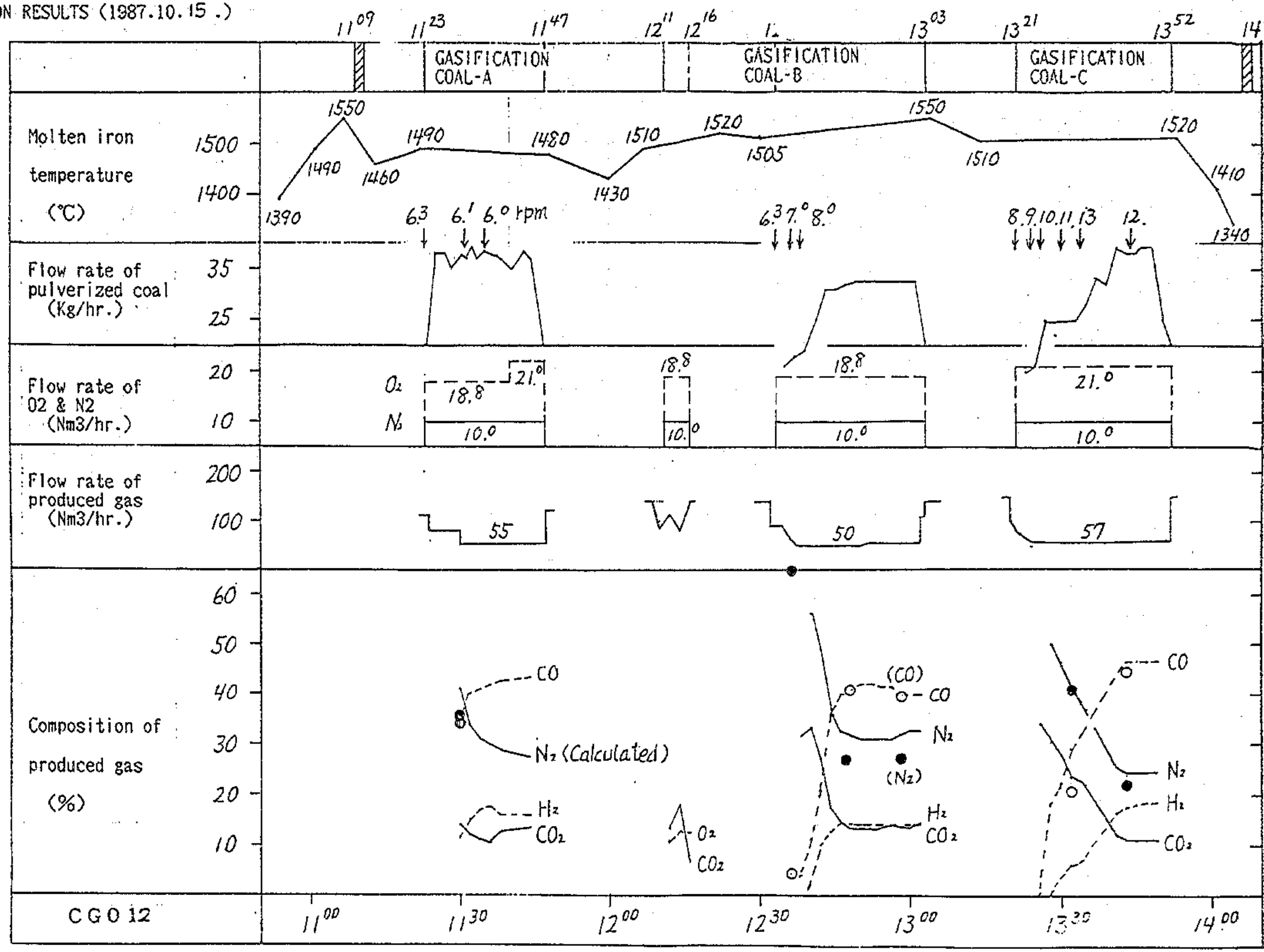
OPERATION RESULTS (1987.10.6)



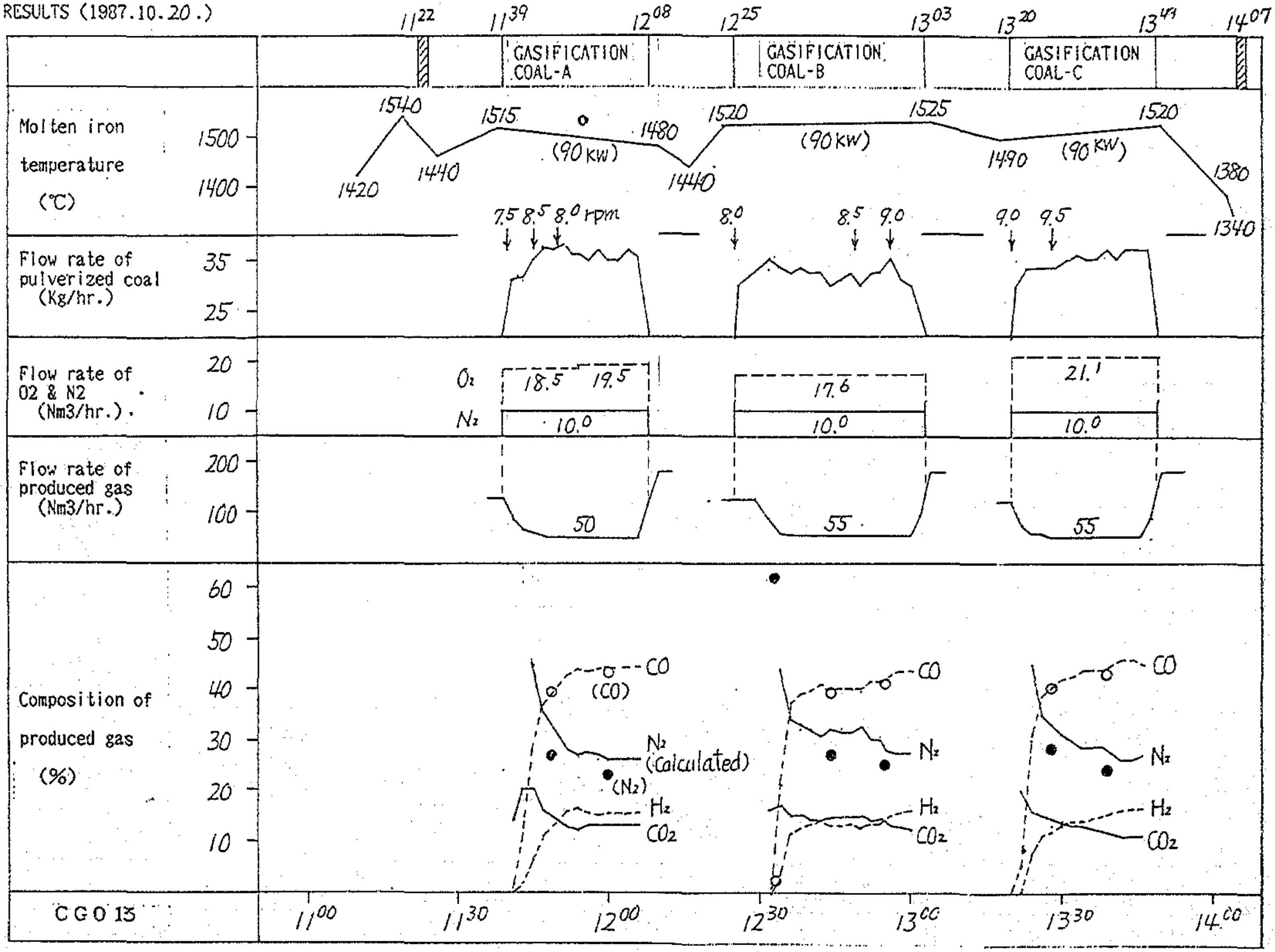
OPERATION RESULTS (1987.10.9)



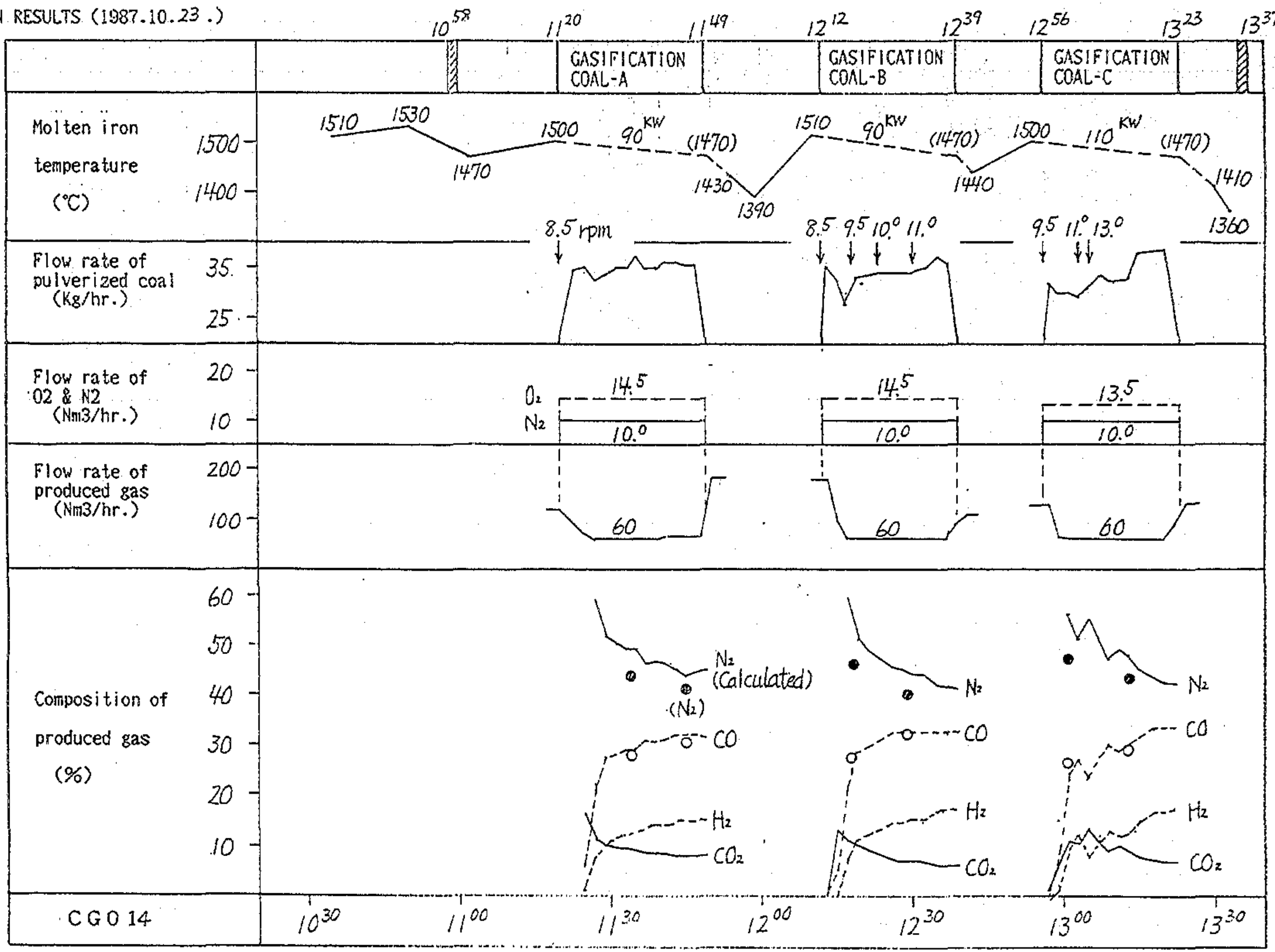
OPERATION RESULTS (1987.10.15 .)



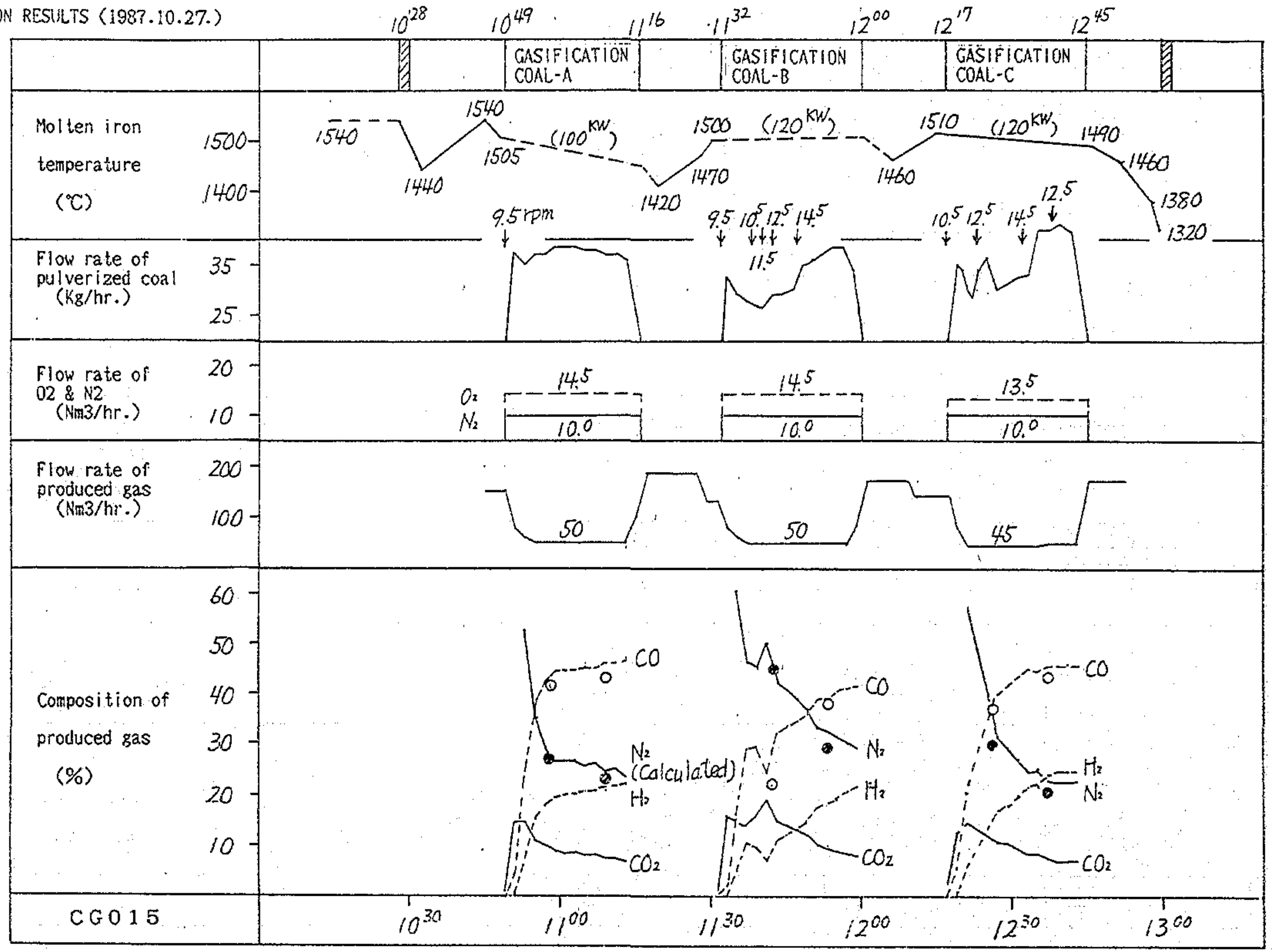
OPERATION RESULTS (1987.10.20.)



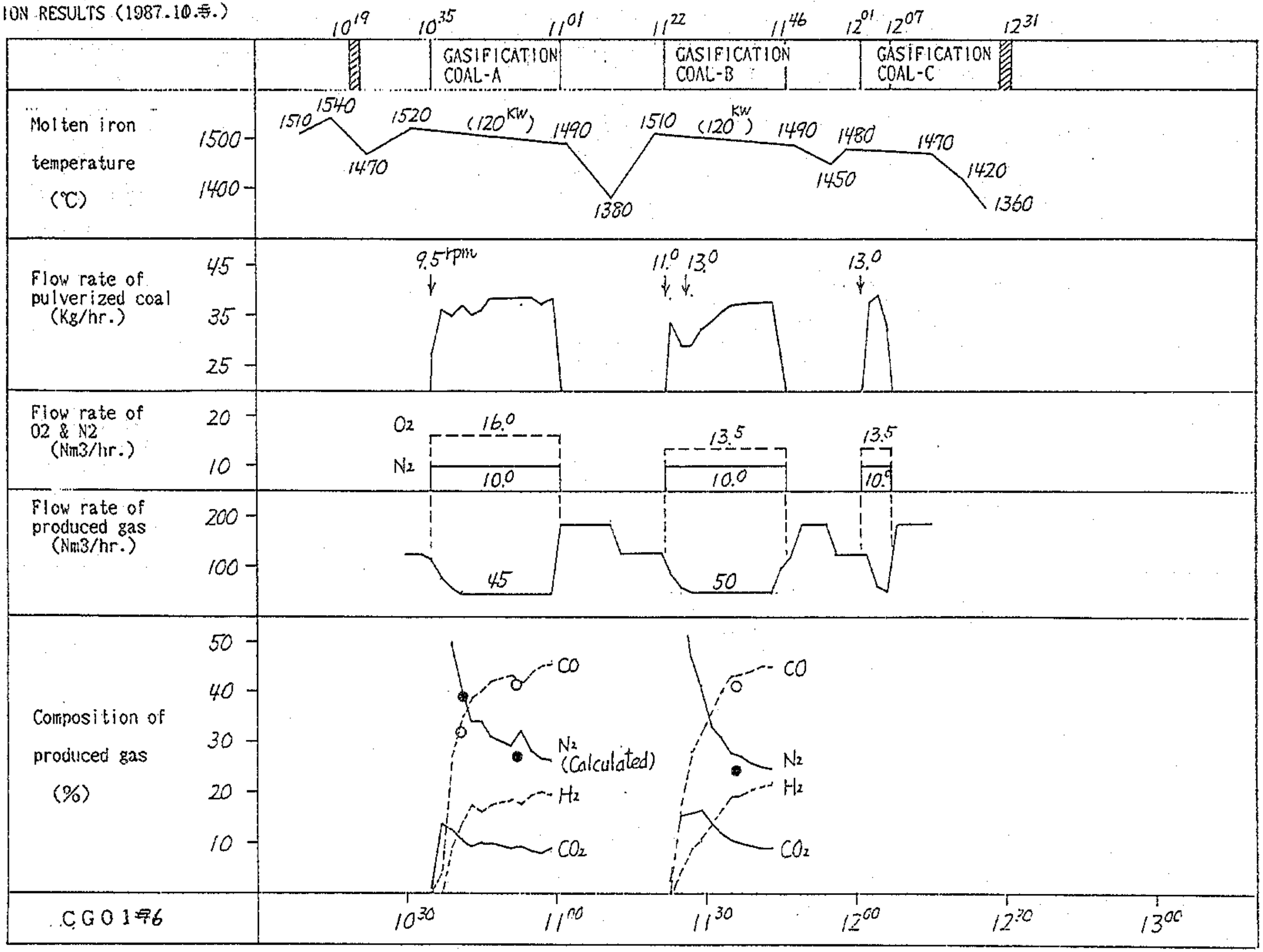
OPERATION RESULTS (1987.10.23.)



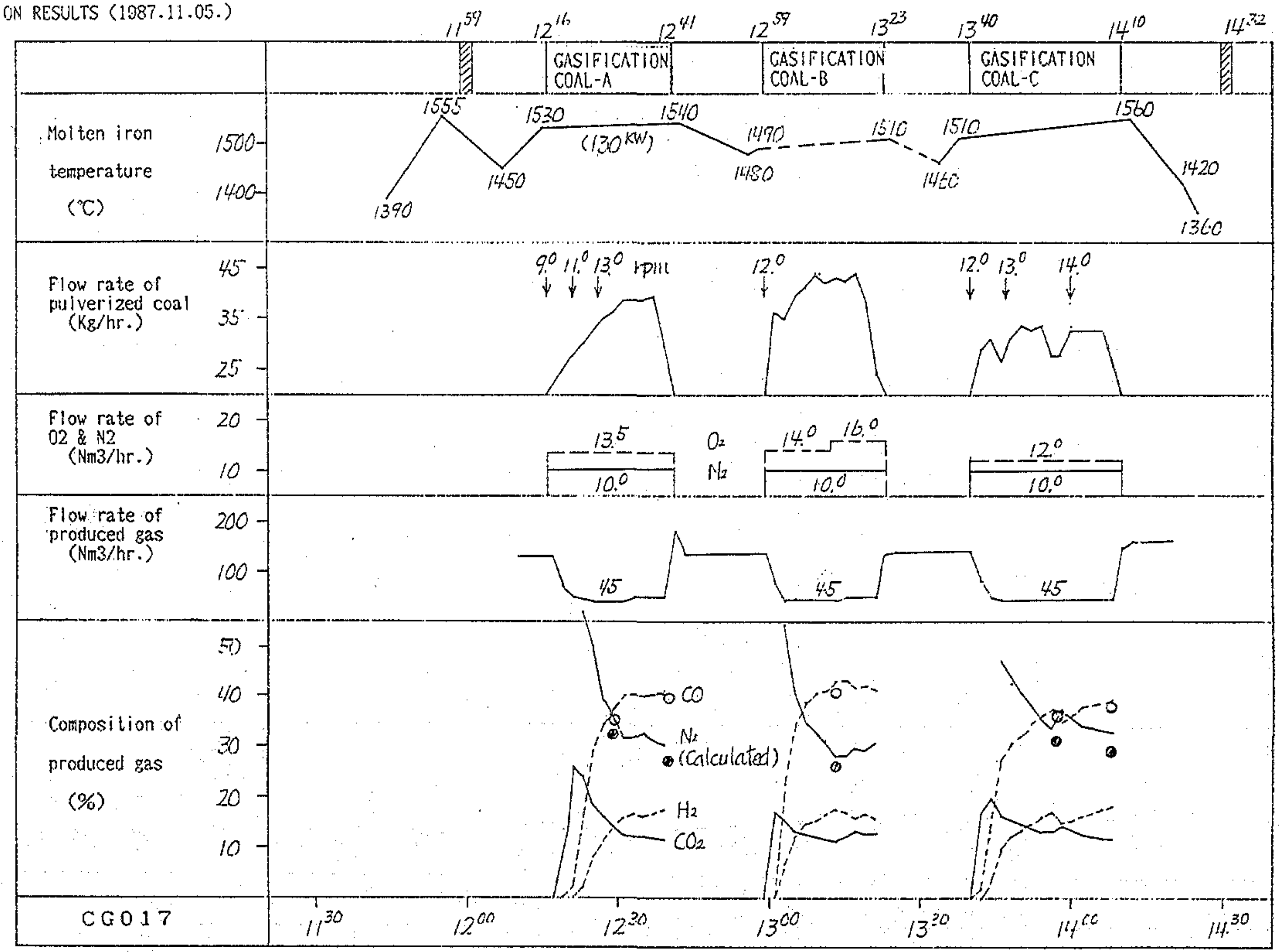
OPERATION RESULTS (1987.10.27.)



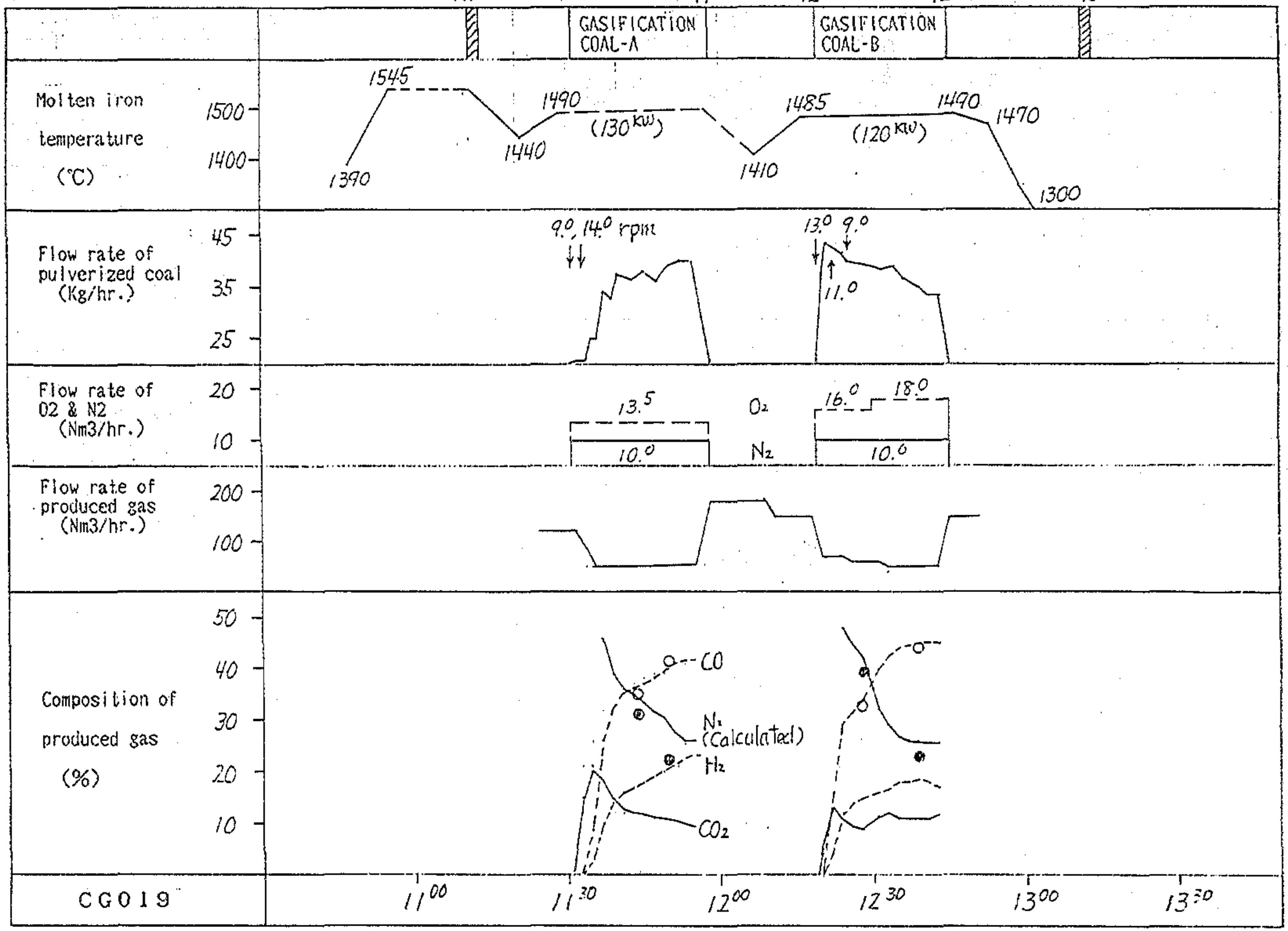
OPERATION RESULTS (1987.10.号.)



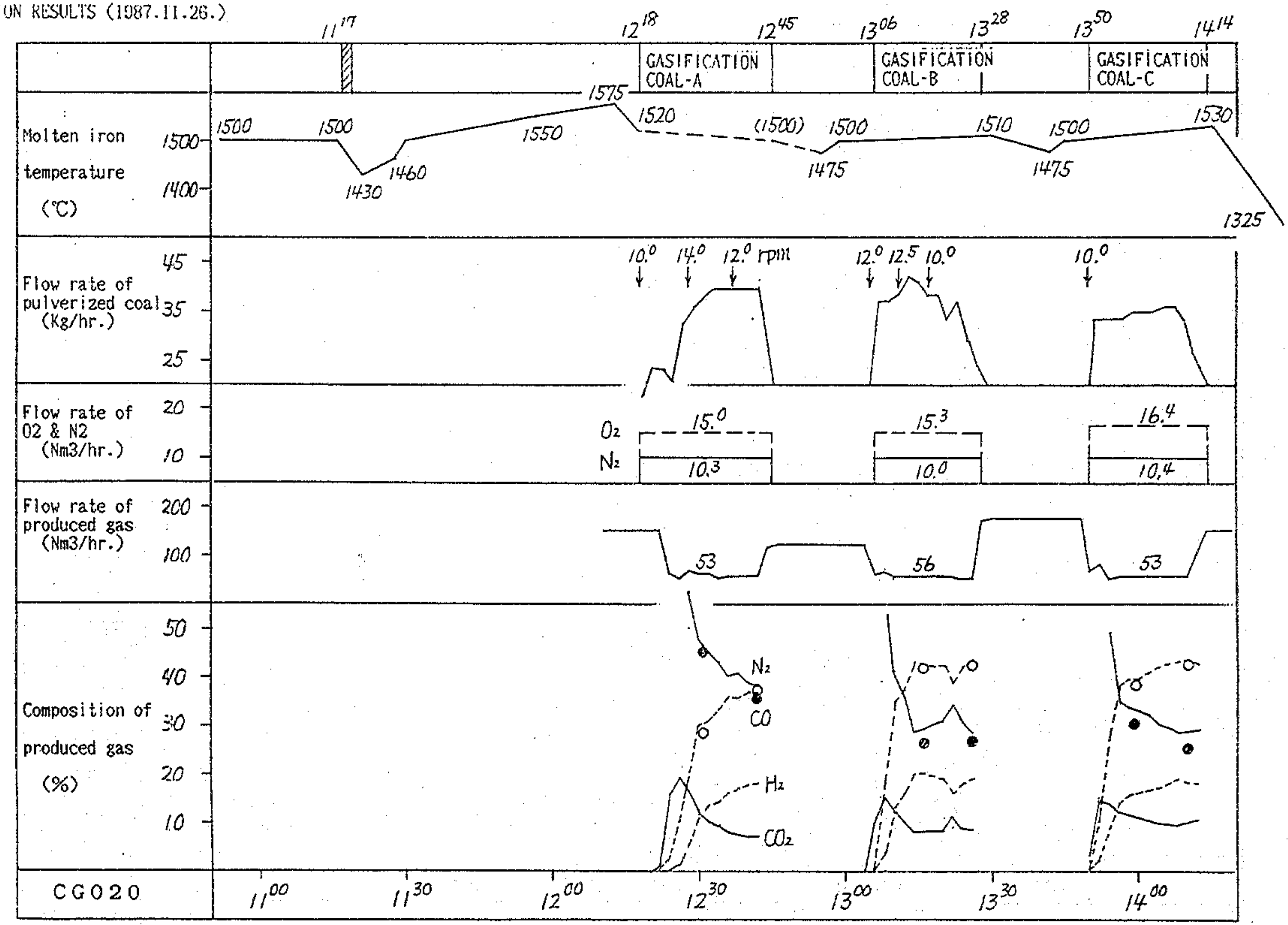
OPERATION RESULTS (1987.11.05.)



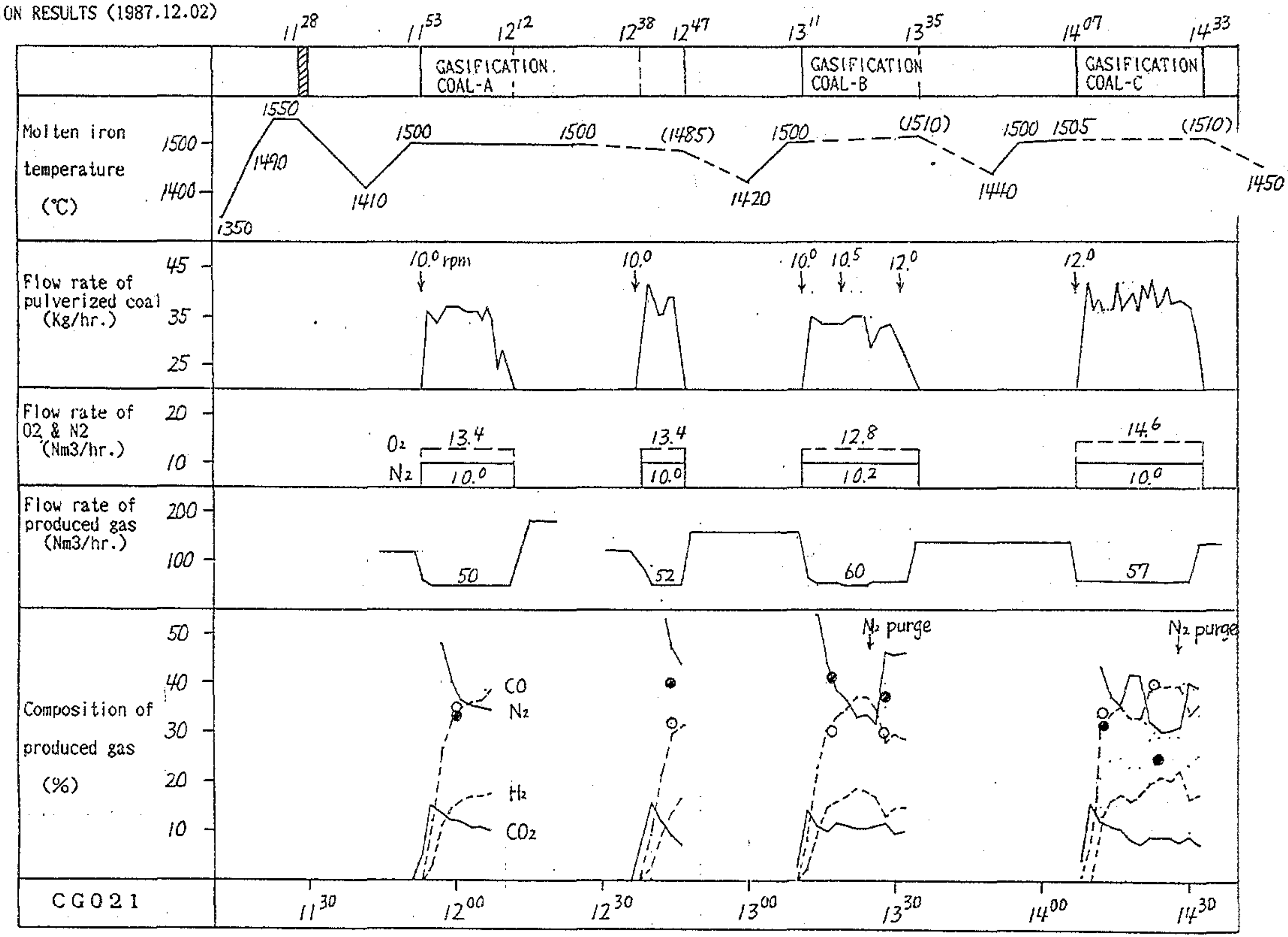
OPERATION RESULTS (1987.11.18.)



OPERATION RESULTS (1987.11.26.)



OPERATION RESULTS (1987.12.02)



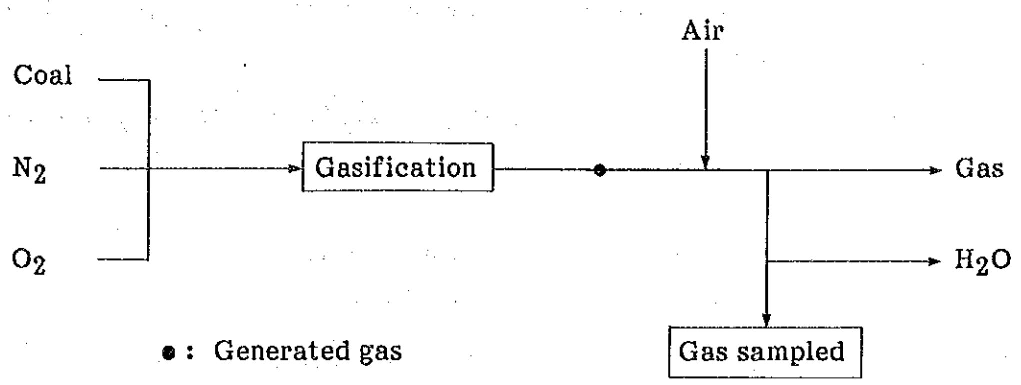
ATTACHMENT 8-3

1. Material Balance Based on Gas Sampled from Inside to Gasifier

2. Material Balance Based on Gas Sampled from Position just before IDF

1. Material Balance Based on Gas Sampled from Inside to Gasifier

1. Material Flow



As shown in material flow, coal, N_2 and O_2 become generated gas by gasification. We want to know an information of generated gas, however air from the atmosphere mixes and reacts with generated gas before we get gas sample.
Furthermore we analyzed gas component as dry.
Therefore we should estimate real gas component by material balance calculation.

2. Assumption

1 Oxygen in the air from the atmosphere reacts with CO and H_2 in the generated gas, generating CO_2 and H_2O.

2 If summation of each content of gas components such as CO, CO_2, H_2, H_2O, N_2 and so on would not be 100%, N_2 content would be modified to make the summation 100%.

3. Calculation Method

By making material balance for H_2, O_2 and N_2 around gasifier we can know the following unknown values.

Unknown values:
1) gas components in generated gas (CO, CO_2, H_2, O_2, N_2, H_2O, H_2S, COS)
2) amount of generated gas
3) amount of air from the atmosphere
4) H_2O content in sampled gas

Known values:
1) property of coal (ash, moisture, C, H, O, N, S)
2) operation conditions (coal feed rate, carrier gas flow rate, oxygen flow rate)
3) gas components in sampled gas (CO, CO_2, H_2, O_2, N_2, H_2S, COS)

(1) Hydrogen balance

$$\mathrm{HSUI} + \mathrm{HGEN} = \mathrm{HGAS} + \mathrm{HJO}$$

$$\mathrm{HSUI} = \frac{22.4}{18} \times \mathrm{CFR} \times \mathrm{Moi}/100$$

$$\mathrm{HGEN} = \frac{22.4}{2} \times \mathrm{CFR} \times (100 - \mathrm{Ash} - \mathrm{Moi})/100 \times \mathrm{H}/100$$

$$\mathrm{HGAS} = (\mathrm{Y} + 0.79\mathrm{Z} - \mathrm{X}) \times (\mathrm{H_2GS} + \mathrm{H_2SGS})/100$$

$$\mathrm{HJO} = \mathrm{X}$$

(2) Nitrogen balance

$$\mathrm{NGEN} + 0.79\mathrm{Z} + \mathrm{CGFR} = \mathrm{NGAS}$$

$$\mathrm{NGEN} = \frac{22.4}{28} \times \mathrm{CFR} \times (100 - \mathrm{Ash} - \mathrm{Moi})/100 \times \mathrm{N}/100$$

$$\mathrm{NGAS} = (\mathrm{Y} + 0.79\mathrm{Z} - \mathrm{X}) \times \mathrm{N2GSD}/100$$

(3) Oxygen balance

$$\mathrm{OSUI} + \mathrm{OGEN} + \mathrm{OFR} + 0.21\mathrm{Z} = \mathrm{OGAS} + \mathrm{OJO}$$

$$\mathrm{OSUI} = \frac{11.2}{18} \times \mathrm{CFR} \times \mathrm{Moi}/100$$

$$\mathrm{OGEN} = \frac{22.4}{32} \times \mathrm{CFR} \times (100 - \mathrm{Ash} - \mathrm{Moi})/100 \times \mathrm{O}/100$$

$$\mathrm{OGAS} = (\mathrm{Y} + 0.79\mathrm{Z} - \mathrm{X}) \times (\mathrm{COGS}/2 + \mathrm{CO2GS} + \mathrm{O2GS} + \mathrm{COSGS}/2)/100$$

$$\mathrm{OJO} = \mathrm{X}/2$$

(4) Gas compositions in generated gas

CO	:	$Y \times CO/100 - 0.21Z \times \eta co \times 2 = (Y + 0.79Z - X) \times COGS/100$
CO_2	:	$Y \times CO_2/100 + 0.21Z \times \eta co \times 2 = (Y + 0.79Z - X) \times CO_2GS/100$
H_2	:	$Y \times H_2/100 - 0.21Z \times (1 - \eta co) \times 2 = (Y + 0.79Z - X) \times H_2GS/100$
O_2	:	$Y \times O_2/100 = (Y + 0.79Z - X) \times O2GS/100$
N_2	:	$Y \times N_2/100 + 0.79Z = (Y + 0.79Z - X) \times N_2GS/100$
H_2S	:	$Y \times H_2S/100 = (Y + 0.79Z - X) \times H_2SGS/100$
COS	:	$Y \times COS/100 = (Y + 0.79Z - X) \times COSGS/100$
H_2O	:	$Y \times H_2O/100 + 0.21Z \times (1-\eta co) \times 2 = X$

Assumption: ηco is given under the following assumption

$$K = \frac{CO \times H_2O}{CO_2 \times H_2} = \frac{COGS \times X}{CO_2GS \times (Y+0.79Z-X) \times H_2GS/100}$$

X, Y and Z can be calculated by three simultaneous equations of (1), (2) and (3).

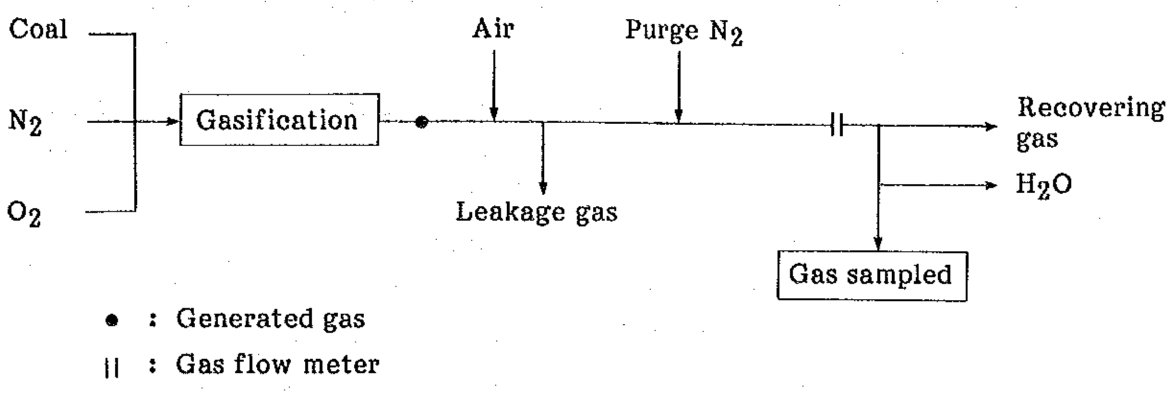
Therefore gas composition in generated gas can be also calculated by the upper equation (4).

Ash	Ash in coal (%)
Moi	Moisture in coal (%)
C	Carbon in coal (%) (d.a.f.)
H	Hydrogen in coal (%) (d.a.f.)
O	Oxygen in coal (%) (d.a.f.)
N	Nitrogen in coal (%) (d.a.f.)
S	Sulfur in coal (%) (d.a.f.)
CFR	Coal feed rate (kg/h)
CGFR	Carrier gas flow rate (Nm^3/h)
OFR	Oxygen flow rate (Nm^3/h)
COGS	CO content in sampled gas (%)
CO_2GS	CO_2 content in sampled gas (%)
H_2GS	H_2 content in sampled gas (%)
O_2GS	O_2 content in sampled gas (%)
N_2GS	N_2 content in sampled gas (%)
H_2SGS	H_2S content in sampled gas (%)
COSGS	COS content in sampled gas (%)

CO	CO content in generated gas (%)
CO_2	CO_2 content in generated gas (%)
H_2	H_2 content in generated gas (%)
O_2	O_2 content in generated gas (%)
N_2	N_2 content in generated gas (%)
H_2S	H_2S content in generated gas (%)
COS	COS content in generated gas (%)
H_2O	H_2O content in generated gas (%)
Y	Amount of generated gas (Nm^3/h)
Z	Amount of air (Nm^3/h)
X	Amount of H_2O in sampled gas (Nm^3/h)
AA	Summation of gas components in sampled gas (%)
N_2GSD	N_2 content in sampled gas after modification ($N_2GSD = N_2GS + 100 - AA$)
Y_2	Amount of leakage gas (Nm^3/h)
N_2P	Amount of purge N_2 (Nm^3/h)
HSUI	Hydrogen amount in moisture in coal (Nm^3/h)
HGEN	Hydrogen amount in coal (Nm^3/h)
HGAS	Hydrogen amount in sampled gas (Nm^3/h)
HJO	Hydrogen amount in H_2O in sampled gas (Nm^3/h)
NGEN	Nitrogen amount in coal (Nm^3/h)
NGAS	Nitrogen amount in sampled gas (Nm^3/h)
OSUI	Oxygen amount in moisture in coal (Nm^3/h)
OGEN	Oxygen amount in coal (Nm^3/h)
OGAS	Oxygen amount in sampled gas (Nm^3/h)
OJO	Oxygen amount in H_2O in sampled gas (Nm^3/h)
ηco	Utilization ratio of oxygen in air to burn CO
FI	Recovering gas flow rate (m^3/h)
ρo	Design value of density of recovering gas (kg/m^3)
ρ	Actual density of recovering gas (kg/m^3)
To	Design value of temperature of recovering gas (^oC)
T	Actual temperature of recovering gas (^oC)
PPI	Pressure difference in bag filter (mmH_2O)
Po	Design value of pressure of recovering gas (mmH_2O)

2. Material Balance Based on Gas Sampled from Position just before IDF

1. Material Flow



As shown in material flow, coal, N_2 and O_2 become generated gas by gasification. After that, air from the atmosphere mixes and reacts with generated gas and then a part of gas leaks from the space between hood and gasifier. Furthermore purge N_2 comes in from main lance hole and bag filter. After taking these change, gas passes through gas flow meter and is sampled at the position just before IDF in gas recovering duct.

In this material flow, we would know about an information of real generated gas.

2. Assumption

(1) Oxygen in the air from the atmosphere reacts with CO and H_2 in the generated gas, generating CO_2 and H_2O.

(2) If summation of each content of gas components such as CO, CO_2, H_2, H_2O, N_2 and so on would not be 100%, N_2 content would be modified to make the summation 100%.

3. Calculation Method

By making material balance for H_2, O_2 and N_2 around gasifier we can know the following unknown values.

Unknown values:

1) gas components in generated gas (CO, CO_2, H_2, O_2, N_2, H_2O, H_2S, COS)
2) amount of generated gas
3) amount of air from the atmosphere
4) amount of leakage gas
5) H_2O content in sampled gas

Known values:

1) property of coal (ash, moisture, C, H, O, N, S)
2) operation conditions (coal feed rate, carrier gas flow rate, oxygen flow rate, recovering gas flow rate)
3) gas components in sampled gas (CO, CO_2, H_2, O_2, N_2, H_2S, COS)

		Generated gas	After gasifier	Gas flow meter	Gas sampled
Gas amount	(Nm^3/h)	Y	Y+0.79Z	$Y+0.79Z-Y_2+N_2P$	/
CO	(%)	CO	COI	COII	COGS
CO_2	(%)	CO_2	CO_2I	CO_2II	CO_2GS
H_2	(%)	H_2	H_2I	H_2II	H_2GS
H_2O	(%)	H_2O	H_2OI	H_2OII	/
O_2	(%)	O_2	O_2I	O_2II	O_2GS
N_2	(%)	N_2	N_2I	N_2II	N_2GS
H_2S	(%)	N_2S	H_2SI	H_2SII	H_2SGS
COS	(%)	COS	COSI	COSII	COSGS

↑ Air Z Nm^3/h ↓ Leakage Y_2 Nm^3/h ↑ Purge N_2 N_2P Nm^3/h

(1) Hydrogen balance

$$HSUI + HGEN = Y\times(H_2 + H_2O + H_2S)/100$$
$$= (Y + 0.79Z)\times(H_2I + H_2OI + H_2SI)/100$$
$$= Y_2\times(H_2I + H_2OI + H_2SI)/100$$
$$+ (Y + 0.79Z - Y_2 + N_2P)\times(H_2II + H_2OII + H_2SII)/100$$

H_2 : $Y\times H_2/100 - Z\times 0.21\times 2\times(1 - \eta co) = (Y + 0.79Z)\times H_2GS\times A\times B/100$

H_2O : $Y\times H_2O/100 + Z\times 0.21\times 2\times(1 - \eta co) = (Y + 0.79Z)\times H_2OII\times B/100$

H_2S : $Y\times H_2S/100 = (Y + 0.79Z)\times H_2SGS\times A\times B/100$

$$Y\times(H_2 + H_2O + H_2S)/100 = (Y + 0.79Z)\times B\times(H_2OII + A\times(H_2GS + H_2SGS))/100 \quad \text{.....} \quad (1)$$

$$Y + 0.79Z - Y_2 + N_2P = FI\times D$$

$$D = SQRT \quad (\frac{\rho o}{\rho})\times(\frac{To+273}{T+273})\times(\frac{10^4\text{-}PDI}{Po})$$

$$A = (100 - H_2OII)/100$$

$$B = (Y + 0.79Z - Y_2 + N_2P)/(Y + 0.79Z - Y_2)$$

(2) Oxygen balance

$$OSUI + OGEN + OFR = Y\times(CO/2 + CO_2 + H_2O/2 + O_2 + COS/2)/100$$
$$OSUI + OGEN + OFR + 0.21Z = (Y + 0.79Z)\times(COI/2 + CO_2I + H_2OI/2 + O_2I + COSI/2)$$
$$= Y_2\times(COI/2 + CO_2I + H_2OI/2 + O_2I + COSI/2,$$
$$+ (Y + 0.79Z - Y_2 + N_2P)\times(COII/2 + CO_2II + H_2OII/2 + O_2II + COSII/2)/100$$

CO : $COI = COGS\times A\times B$

CO_2 : $CO_2I = CO_2GS\times A\times B$

H_2O : $H_2OI = H_2OII\times B$

O_2 : $O_2I = O_2GS\times A\times B$

COS : $COSI = COSGS\times A\times B$

$$\times\ OSUI + OGEN + OFR + 0.21Z = (Y + 0.79Z)\times B\times(A\times(COS/2 + CO_2GS + O_2GS + COSGS/2) + H_2OII/2)/100 \quad \text{......} \quad (2)$$

(3) Nitrogen balance

$$NGEN + CGFR = Y \times N_2/100$$

$$NGEN + CGFR + 0.79Z = (Y + 0.79Z) \times N_2I/100$$

$$NGEN + CGFR + 0.79Z - Y_2 \times N_2I/100 + N_2P = (Y + 0.79Z - Y_2 + N_2P) \times N_2II/100$$

$$(Y + 0.79Z - Y_2) \times N_2I/100 = (Y + 0.79Z - Y_2 + N_2P) \times N_2II/100 - N_2P$$

$$N_2II = N_2GS \times A$$

$$NGEN + CGFR + 0.79Z = (Y + 0.79Z) \times B \times (A \times N_2GS/100 - N_2P/(Y + 0.79Z - Y_2 + N_2P)) \quad \ldots\ldots (3)$$

From equation (1) and (2), Y and Z can be calculated, if H_2OII could be assumed a certain value.

After that we check whether both sides in equation (3) are equal or not, if they are OK, we can have all components in generated gas.

Ash	Ash in coal (%)
Moi	Moisture in coal (%)
C	Carbon in coal (%) (d.a.f.)
H	Hydrogen in coal (%) (d.a.f.)
O	Oxygen in coal (%) (d.a.f.)
N	Nitrogen in coal (%) (d.a.f.)
S	Sulfur in coal (%) (d.a.f.)
CFR	Coal feed rate (kg/h)
CGFR	Carrier gas flow rate (Nm^3/h)
OFR	Oxygen flow rate (Nm^3/h)
COGS	CO content in sampled gaas (%)
CO_2GS	CO_2 content in sampled gas (%)
H_2GS	H_2 content in sampled gas (%)
O_2GS	O_2 content in sampled gas (%)
N_2GS	N_2 content in sampled gas (%)
H_2SGS	H_2S content in sampled gas (%)
COSGS	COS content in sampled gas (%)
CO	CO content in generated gas (%)

CO_2	CO_2 content in generated gas (%)
H_2	H_2 content in generated gas (%)
O_2	O_2 content in generated gas (%)
N_2	N_2 content in generated gas (%)
H_2S	H_2S content in generated gas (%)
COS	COS content in generated gas (%)
H_2O	H_2O content in generated gas (%)
Y	Amount of generated gas (Nm^3/h)
Z	Amount of air (Nm^3/h)
X	Amount of H_2O in sampled gas (Nm^3/h)
AA	Summation of gas components in sampled gas (%)
N_2GSD	N_2 content in sampled gas after modification ($N_2GSD = N_2GS + 100 - AA$)
Y_2	Amount of leakage gas (Nm^3/h)
N_2P	Amount of purge N_2 (Nm^3/h)
HSUI	Hydrogen amount in moisture in coal (Nm^3/h)
HGEN	Hydrogen amount in coal (Nm^3/h)
HGAS	Hydrogen amount in sampled gas (Nm^3/h)
HJO	Hydrogen amount in H_2O in sampled gas (Nm^3/h)
NGEN	Nitrogen amount in coal (Nm^3/h)
NGAS	Nitrogen amount in sampled gas (Nm^3/h)
OSUI	Oxygen amount in moisture in coal (Nm^3/h)
OGEN	Oxygen amount in coal (Nm^3/h)
OGAS	Oxygen amount in sampled gas (Nm^3/h)
OJO	Oxygen amount in H_2O in sampled gas (Nm^3/h)
ηco	Utilization ratio of oxygen in air to burn CO
FI	Recovering gas flow rate (Nm^3/h)
ρo	Design value of density of recovering gas (kg/m^3)
ρ	Actual density of recovering gas (kg/m^3)
To	Design value of temperature of recovering gas (^oC)
T	Actual temperature of recovering gas (^oC)
PPI	Pressure difference in bag filter (mmH_2O)
Po	Design value of pressure of recovering gas (mmH_2O)

ATTACHMENT 9-2

1. Production Cost Comparison between Methanol and Methanol/Urea Co-products

2. Comparison of Electricity Generation Cost

1. Production Cost Comparison between Methanol and Methanol/Urea Co-products

Production Cost Comparison between Methanol and Methanol/Urea Co-products

1. Objective of the Study

This study has been carried out to grasp the cost comparison between methanol production and methanol/urea co-production from Banko coal on the basis of the master plan established in the 2nd stage.

(Note): The results of the study is cited from the Interim Report (Stage II), March 1988.

2. Outline of the Case Study

Fuel methanol production and fuel methanol/urea co-production are taken up out of possible products for the Proposed Project and the following two cases have been set up.

Case 1 is to produce only fuel methanol of which total plant capacity is 5,000 t/d and can be defined as a base case, since fuel methanol is expected as the most prospective derivatives of coal in Indonesia.

Master plan and overall block flow diagram of Case 1 are shown in Fig. 1 and 2.

Case 2 is to produce 4,060 t/d of methanol as well as 1,750 t/d of urea through ammonia. Since a demand of urea in Indonesia will still grow up, this case is selected. However, a viability of this case will mainly depend on a sales price of urea after a decade and possibility of natural gas supply for a new project in Indonesia, since PUSRI has urea production facilities starting from natural gas in Palembang and there is enough amount of natural gas resources to produce urea but not enough for export.

Master plan and overall block flow diagram of Case 2 are shown in Fig. 3 and 4.

3. Assumptions for Financial Analysis

3-1 Master Plan Case 1

3-1-1 Production Schedule

(1) Annual Production; 1,600,000 t of chemical grade methanol

(2) Plant Construction Period; 1990 - 1993 (4 years)
where 30% completion at the end of 1990
60% completion at the end of 1991
80% completion at the end of 1992
100% completion at the end of 1993

(Note); In this financial study, it is assumed that escalation factor is out of considerations. Therefore, time schedule such as 1990 - 1993 is assumed only for reference.

(3) Project Life; 1994 - 2023 (30 years)
where 70% of full operation in 1994
85% of full operation in 1995
100% of full operation in 1996 and after

(4) Annual Operation Days; 320 days

3-1-2 Finance

(1) Debt/Equity Ratio; 75/25

(2) Currency

For Annual Revenue/Expenditure; Rupiah
For Capital Investment; Yen
Exchange Rate; 0.18 Yen/Rupiah
Accordingly, debt is repayed by exchanging Rupiah for yen at the above exchange rate.

(3) Debt Repayment Schedule

Terms of 12 years after commitment, including 4 years of grace period with 8 years equal payments of principal.

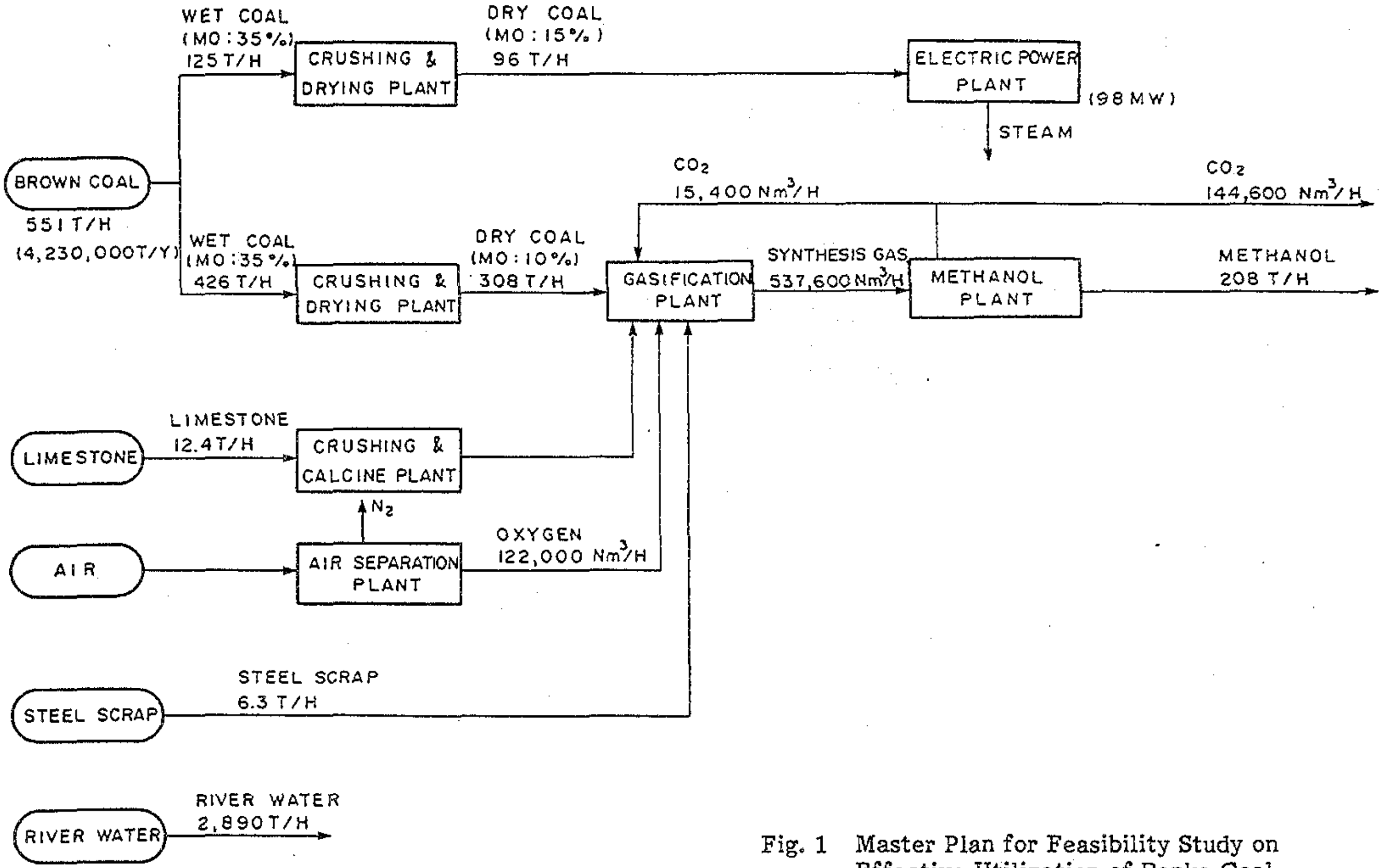


Fig. 1 Master Plan for Feasibility Study on Effective Utilization of Banko Coal

Case 1

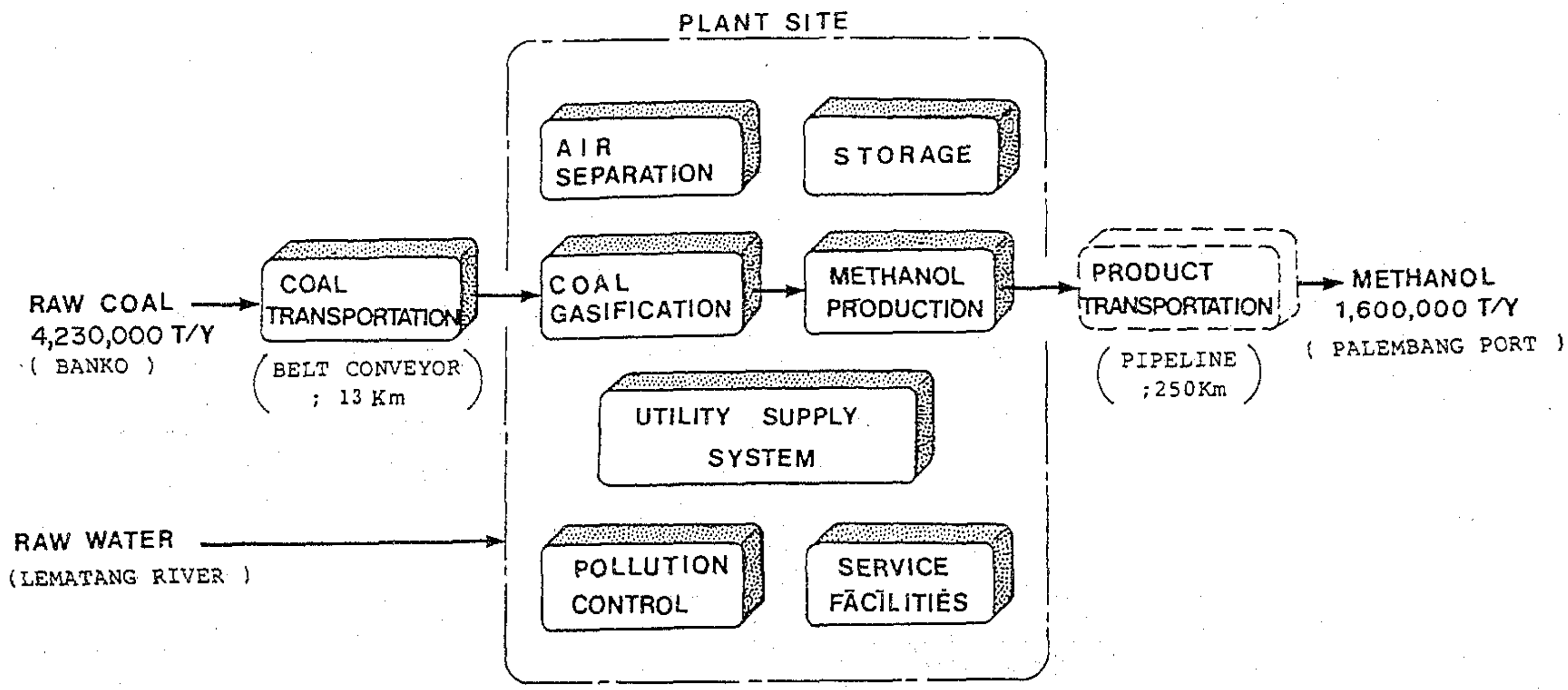


Fig. 2 Overall Block Flow Diagram (Case 1)

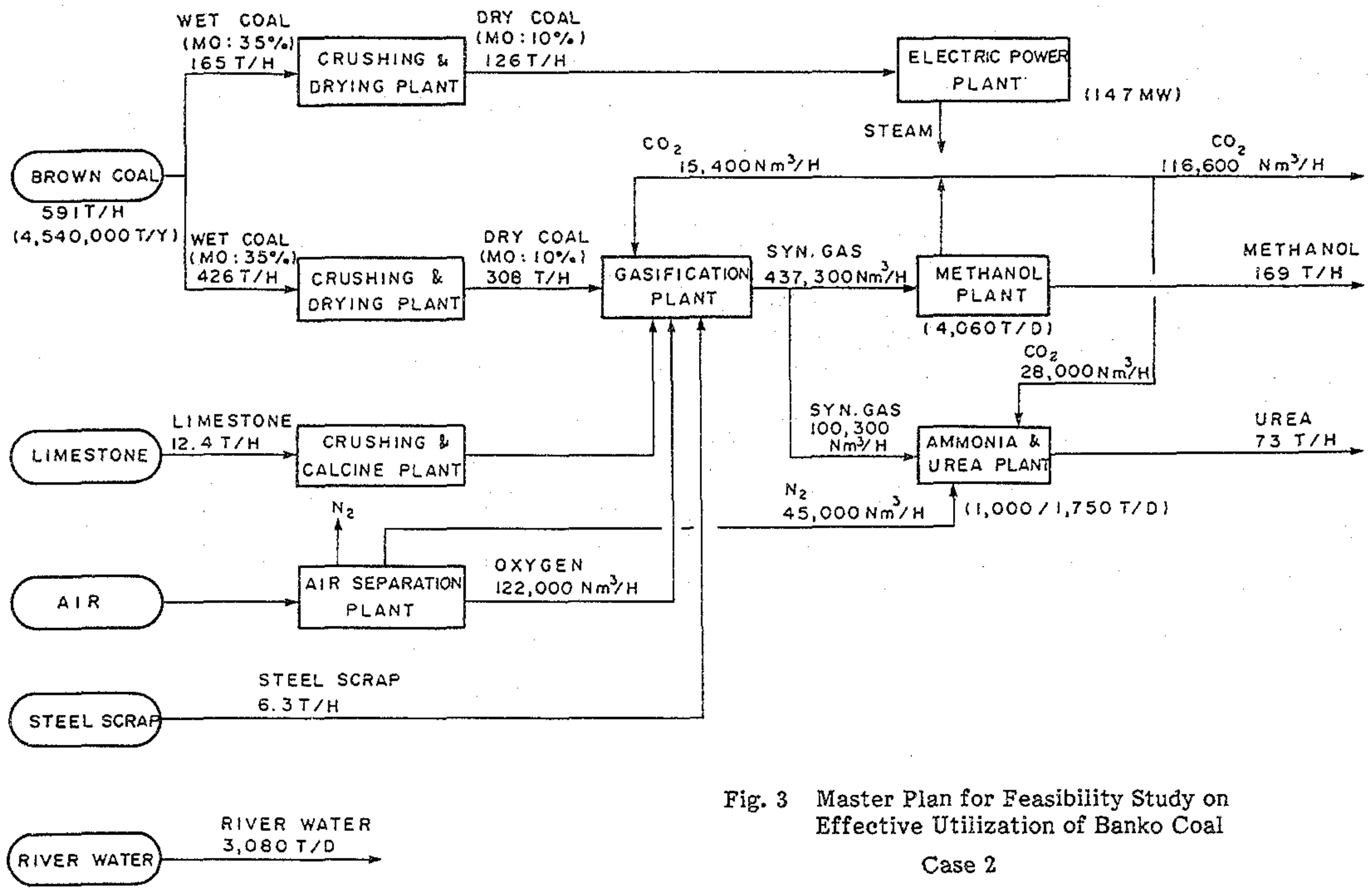


Fig. 3 Master Plan for Feasibility Study on Effective Utilization of Banko Coal

Case 2

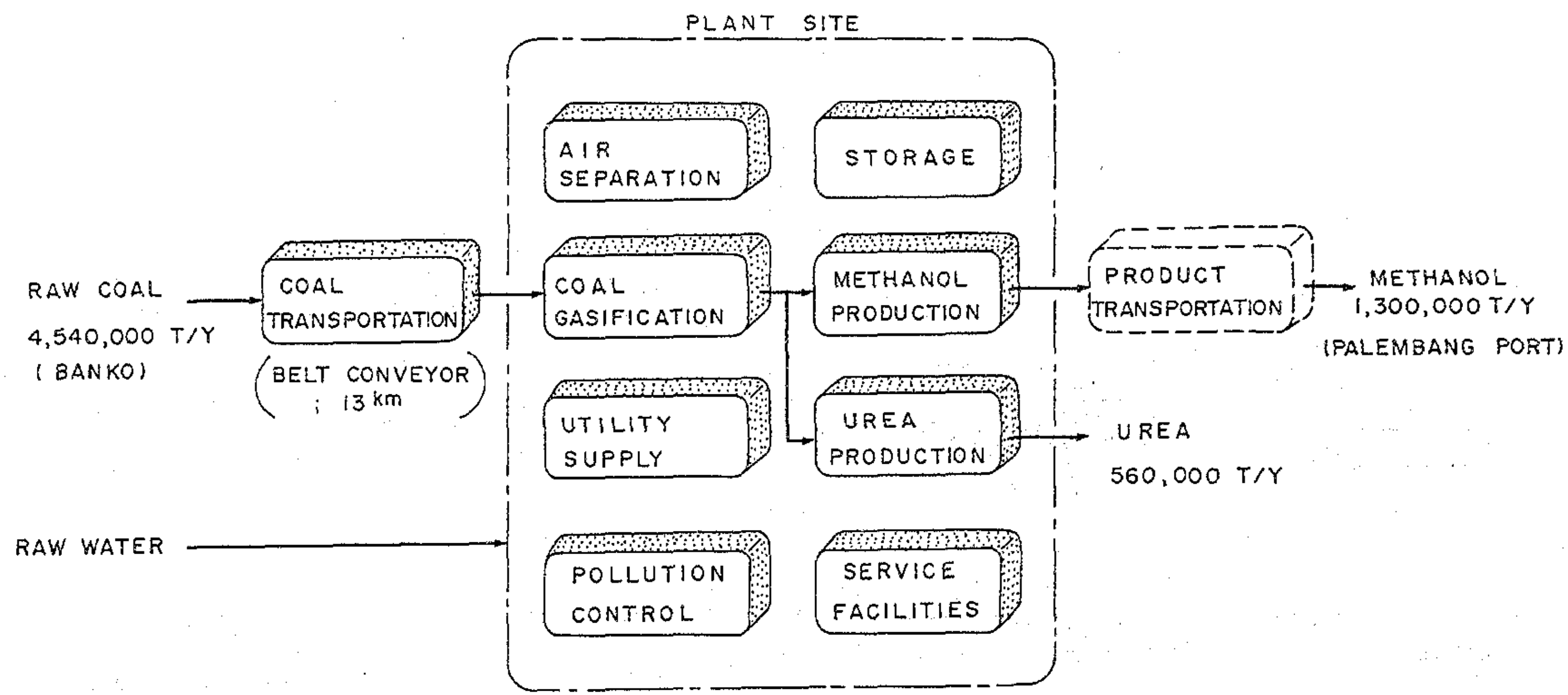


Fig. 4 Overall Block Flow Diagram (Case 2)

(4) Interest

1) Long-term Loan; 8% per annum

Assumed supplyer's credit (7.2% p.a.) plus bank loan and project risk premium.

2) Short-term Loan; 8% per annum

A short term loan would be raised commensurate with annual cash deficiency and would be repayed after development loan.

3) Interest during Construction Period

In accordance with a general rule in similar projects, interest paid or accrued during construction period is capitallized and amortized over a 10-year period from 1994.

3-1-3 Escalation

No escalation is assumed.

3-1-4 Price and Costs

(1) Sales Price of Methanol at Plant Gate; 194 Rp/kg (35 ¥/kg, 175 $/t)

(2) Capital Investment Costs

1) Fixed-capital Investment;

	10^6 Rupiah	(10^6 Yen)
Coal Gasification	301,900	(54,500)
Coal Transportation	43,800	(7,900)
Methanol Synthesis	188,400	(34,000)
Air Separation	89,200	(16,100)
Power Generation	99,700	(18,000)
Support Facilities	159,600	(28,800)
Equipment Transportation	63,700	(11,500)
Contingency	47,600	(8,600)
Total	993,900	(179,400)

(Note); Construction cost of each plant was reviewed based on the revised master plan. As the result, total fixed-capital investment cost was slightly increased in comparison with that of previous estimation in the study of FY1985.

		10^6 Rp/y	(10^6¥/y)
2)	Working Capital;	50,216	(9,064)

(Note); Working capital is added as cash-flow at the end of the project.

3)	Start-up Expense;	6,882	(1,242)
4)	Operator Training Cost;	2,598	(469)
5)	Investment Schedule;	Shown in Table 1	

Table 1 Investment Schedule

	1990	1991	1992	1993
Fixed Capital	30%	30%	20%	20%
Working Capital	-	-	-	100%
Start-up Expense	-	-	-	100%
Operator Training	-	-	-	100%

(3) Annual Expense

1) Fixed Costs

i) Depreciation and Amortization

	Period	Amount	
	Years	10^6 Rp/y	(10^6 ¥/y)
- Boiler, Power Plant, Cooling Tower, Buildings	15	13,702	(2,473)
- Others	10	94,296	(17,020)
ii) Maintenance		23,172	(4,182)
iii) Insurance		9,269	(1,673)

(Note); Capital investment for the plant construction including expense and interests during construction period is depreciated and amortized based on straight line method.

	10^6 Rp/y	(10^6 ¥/y)
2) Variable Costs		
i) Raw Materials[1]		
- Coal	67,895	(12,255)
- $CaCO_3$	665	(120)
ii) Superviser and Operating Labor		
- Foreign Staff[2]		
- Local Labor	2,715	(490)
iii) Catalysts and Chemicals	3,413	(616)

(Note); 1) In the study of preliminary evaluation of economic feasibility in FY1985 and FY1986, \$14.85/t-coal was assumed as raw material cost. In this study, coal cost was assumed to be \$14.48/t on the basis of the study on coal mining cost in FY1986 (for details, see the Interim Report III, page 71 -102). Cost of lime stone consumed in gasification plant and fluidized-bed boiler was estimated to be \$4.83/t assuming that it was one-thrid of coal cost.

2) Foreign staff decrease in number as the project proceeds.

Table 2 Costs for Foreign Staffs

Op. Year	1st	2nd	3rd	4th	5th	6th-30th
Year	1994	1995	1996	1997	1998	1999-2023
% on 1st year	100	70	50	30	10	0
Cost, 10^6 Rp/y	7,900	5,530	3,950	2,370	790	0
(Cost, 10^6 ¥/y)	(1,426)	(998)	(713)	(428)	(143)	(0)

	10^6 Rp/y	(10^6 ¥/y)
iii) Plant Overhead Costs	10,615	(1,916)
iv) Administration Expenses	5,307	(958)

3-1-5 Evaluation Criteria

(1) Financial Statement

1) Profit and Loss Statement
2) Cash Flow Statement
3) Balance Sheet

(2) IRR on Total Project Cost before Tax

In accordance with the following equation, cash flow is discounted to the present value as of 1985.

$$\sum_{i=0}^{n} \frac{(Cin, i - Cout, i)}{(1+r)^i} = 0$$

where,

Cin, i; cash-inflow at ith year from 1985
Cout, i; cash-outflow at ith year from 1985
r ; discount rate (=IRR)
n ; project life (1990-2023)
i = 0 at 1985

Cash-inflow	Cash-outflow
• Sales Proceeds	• Investment excluding interest during construction period.
• Residual value of investment	• Total operating expenditure excluding depreciation and interest

3-2 Master Plan Case 2

3-2-1 Production Schedule

(1) Annual Production;

Methanol 1,300,000 t (Chemical grade)
Urea 560,000 t (Ditto)

(2) Plant Construction Period; Same as with Case 1

(3) Project Life; Same as with Case 1

(4) Annual Operation Days; Same as with Case 1

3-2-2 Finance

Same as with Case 1.

3-2-3 Escalation

Same as with Case 1.

3-2-4 Price and Costs

(1) Sales Price of Products at Plant Gate;

Methanol	194 Rp/kg (35 ¥/kg, 175 $/t)
Urea	166 Rp/kg (30 ¥/kg, 150 $/t)

(Note); Sales price of methanol is same as that in Case 1. Sales price of urea at plant gate was assumed referring to the preliminary evaluation study on urea production cost executed in FY1986 in which international FOB price and transportation cost of urea from plant to Palembang were estimated to be 170-180 $/t and 25 $/t respectively.

(2) Capital Investment Costs

1) Fixed-capital Investment;

	10^6 Rupiah	(10^6 Yen)
Coal Gasification	301,900	(54,500)
Coal Transportation	45,400	(8,200)
Methanol Synthesis	162,900	(29,400)
Ammonia/Urea Synthesis	154,000	(27,800)
Air Separation	89,200	(16,100)
Power Generation	139,600	(25,200)
Support Facilities	164,600	(29,700)
Equipment Transportation	63,700	(11,500)
Contingency	56,600	(10,200)
Total	1,177,800	(212,600)

(Note); Construction cost of each plant was reviewed based on the information in FY 1987. As the result, total fixed-capital investment cost was almost same as that of estimation in FY1986.

	10^6 Rp/y	(10^6 ¥/y)
2) Working Capital;	57,839	(10,440)

(Note); Working capital is added as cash-flow at the end of the project.

3) Start-up Expense;	7,490	(1,352)
4) Operator Training Cost;	3,202	(578)
5) Investment Schedule;	Same as with Case 1	

(3) Annual Expense

1) Fixed Costs

i) Depreciation and Amortization

	Period	Amount	
	Years	10^6 Rp/y	(10^6 ¥/y)
- Boiler, Power Plant, Cooling Tower, Buildings	15	16,952	(3,060)
- Others	10	110,614	(19,966)
ii) Maintenance		27,770	(5,012)
iii) Insurance		11,108	(2,005)

(Note); See the relevant note in 3-1-4 (3).

	10^6 Rp/y	(10^6 ¥/y)
2) Variable Costs		
i) Raw Materials[1]		
- Coal	72,825	(13,145)
- $CaCO_3$	715	(129)
ii) Superviser and Operating Labor		
- Foreign Staff[2]		
- Local Labor	3,346	(604)
iii) Catalysts and Chemicals	3,324	(600)

(Note); 1) See the relevant note in 3-1-4 (3).

2) Foreign staff decrease in number as the project proceeds.

Table 3 Costs for Foreign Staff

Op. Year	1st	2nd	3rd	4th	5th	6th-30th
Year	1994	1995	1996	1997	1998	1999-2023
% on 1st year	100	70	50	30	10	0
Cost, 10^6 Rp/y	9,651	6,756	4,825	2,895	965	0
(Cost, 10^6 ¥/y)	(1,742)	(1,219)	(871)	(523)	(174)	(0)

	10^6 Rp/y	(10^6 ¥/y)
3) Plant Overhead Costs	12,997	(2,346)
4) Administration Expenses	6,499	(1,173)

3-2-5 Evaluation Criteria

Same as with Case 1

4. Results and Evaluation

4-1 Results

Results are summerized in Table 4.
Profit and loss statement and cash flow statement are shown in Table 5 to Table 8.

Table 4 Results of Financial Analysis

Case	Case 1 (Methanol Production)	Case 2 (Methanol/Urea Co-production)
IRR on Total Investment	13.0%	12.2%
First Year to Have Profit before Tax (Year from Operation Starts)	3rd	3rd
Clear off of Accumulated Loss (Year from Operation Starts)	6th	7th
Pay off of All the Debts (Year from Loan Raised)	12th	12th
Minimum Sales Price (IRR=Interest Rate (8%))	Methanol 148 Rp/kg (26.7 ¥/kg) (175 $/t)	Methanol 194 Rp/kg (35 ¥/kg) Urea 37 Rp/kg (6.7 ¥/kg) (33.4 $/t)

(Note); Minimum sales price of urea are calculated under fixed price of methanol.

Table 5 Profit and Loss Statement of Case 1

(Unit: 10^9 Rupiah)

Year	OP Year	Revenue	Expenditure					Profit			Retained Earning
			Variable Cost	Fixed Cost	General	Interest Paid	Total	Before Tax	(Tax)	Net Profit	
1994	1	217.2	61.0	140.4	15.9	70.4	287.8	-70.6	0	-70.6	-70.6
1995	2	263.7	69.4	140.4	15.9	65.7	291.5	-27.8	0	-27.8	-98.4
1996	3	310.2	78.6	140.4	15.9	57.5	292.5	17.8	0	17.8	-80.6
1997	4	310.2	77.1	140.4	15.9	46.9	280.4	29.9	0	29.9	-50.7
1998	5	310.2	75.5	140.4	15.9	35.4	267.2	43.0	0	43.0	-7.7
1999	6	310.2	74.7	140.4	15.9	23.7	254.7	55.5	22.0	33.5	25.8
2000	7	310.2	74.7	140.4	15.9	13.5	244.6	56.7	30.2	35.5	61.3
2001	8	310.2	74.7	140.4	15.9	4.5	235.5	74.7	34.4	40.3	101.6
2002	9	310.2	74.7	140.4	15.9	0	231.0	79.2	36.4	42.8	144.4
2003	10	310.2	74.7	140.4	15.9	0	231.0	79.2	36.4	42.8	187.2
2004	11	310.2	74.7	46.1	15.9	0	136.8	173.5	79.8	93.7	280.9
2005	12	310.2	74.7	46.1	15.9	0	136.8	173.5	79.8	93.7	374.5
2006	13	310.2	74.7	46.1	15.9	0	136.8	173.5	79.8	93.7	468.2
2007	14	310.2	74.7	46.1	15.9	0	136.8	173.5	79.8	93.7	561.9
2008	15	310.2	74.7	46.1	15.9	0	136.8	173.5	79.8	93.7	655.6
2009	16	310.2	74.7	32.4	15.9	0	123.1	187.2	86.1	101.1	756.7
2010	17	310.2	74.7	32.4	15.9	0	123.1	187.2	86.1	101.1	857.8
2011	18	310.2	74.7	32.4	15.9	0	123.1	187.2	86.1	101.1	958.9
2012	19	310.2	74.7	32.4	15.9	0	123.1	187.2	86.1	101.1	1,060.0
2013	20	310.2	74.7	32.4	15.9	0	123.1	187.2	86.1	101.1	1,161.1
2014	21	310.2	74.7	32.4	15.9	0	123.1	187.2	86.1	101.1	1,262.1
2015	22	310.2	74.7	32.4	15.9	0	123.1	187.2	86.1	101.1	1,363.2
2016	23	310.2	74.7	32.4	15.9	0	123.1	187.2	86.1	101.1	1,464.3
2017	24	310.2	74.7	32.4	15.9	0	123.1	187.2	86.1	101.1	1,565.4
2018	25	310.2	74.7	32.4	15.9	0	123.1	187.2	86.1	101.1	1,666.5
2019	26	310.2	74.7	32.4	15.9	0	123.1	187.2	86.1	101.1	1,767.6
2020	27	310.2	74.7	32.4	15.9	0	123.1	187.2	86.1	101.1	1,868.7
2021	28	310.2	74.7	32.4	15.9	0	123.1	187.2	86.1	101.1	1,969.8
2022	29	310.2	74.7	32.4	15.9	0	123.1	187.2	86.1	101.1	2,070.8
2023	30	310.2	74.7	32.4	15.9	0	123.1	187.2	86.1	101.1	2,171.9
	Total	9,167.9	2,228.8	2,121.7	477.7	317.6	5,145.8	4,022.1	1,850.2	2,171.9	

Table 6 Cash Flow Statement of Case 1

(Unit: 10^9 Rupiah)

(IRR: 13.0%)

Year	OP Year	Investment	Profit Before Tax	Depreciation/ Amortization	Interest Paid	Cash Flow	DCF (Base; 1985)
1990		-298.2	-	-	-	-298.2	-161.6
1991		-298.2	-	-	-	-298.2	-143.0
1992		-198.8	-	-	-	-198.8	-84.4
1993		-258.5	-	-	-	-258.5	-97.0
1994	1	-	-70.6	108.0	70.4	107.8	35.8
1995	2	-	-27.8	108.0	65.7	145.9	42.9
1996	3	-	17.8	108.0	57.5	183.2	47.6
1997	4	-	29.9	108.0	46.9	184.8	42.5
1998	5	-	43.0	108.0	35.4	186.4	37.9
1999	6	-	55.5	108.0	23.7	187.2	33.7
2000	7	-	56.7	108.0	13.5	187.2	29.8
2001	8	-	74.7	108.0	4.5	187.2	26.4
2002	9	-	79.2	108.0	0	187.2	23.3
2003	10	-	79.2	108.0	0	187.2	20.7
2004	11	-	173.5	13.7	0	187.2	18.3
2005	12	-	173.5	13.7	0	187.2	16.2
2006	13	-	173.5	13.7	0	187.2	14.3
2007	14	-	173.5	13.7	0	187.2	12.7
2008	15	-	173.5	13.7	0	187.2	11.2
2009	16	-	187.2	0	0	187.2	9.9
2010	17	-	187.2	0	0	187.2	8.8
2011	18	-	187.2	0	0	187.2	7.8
2012	19	-	187.2	0	0	187.2	6.9
2013	20	-	187.2	0	0	187.2	6.1
2014	21	-	187.2	0	0	187.2	5.3
2015	22	-	187.2	0	0	187.2	4.8
2016	23	-	187.2	0	0	187.2	4.2
2017	24	-	187.2	0	0	187.2	3.7
2018	25	-	187.2	0	0	187.2	3.3
2019	26	-	187.2	0	0	187.2	2.9
2020	27	-	187.2	0	0	187.2	2.6
2021	28	-	187.2	0	0	187.2	2.3
2022	29	-	187.2	0	0	187.2	2.0
2023	30	-	187.2	0	0	237.4	2.3
	Total	-1,053.7	4,022.1	1,148.5	317.6	4,484.8	0.0

Table 7 Profit and Loss Statement of Case 2

(Unit: 10^9 Rupiah)

Year	OP Year	Revenue	Expenditure					Profit			Retained Earning
			Variable Cost	Fixed Cost	General	Interest Paid	Total	Before Tax	(Tax)	Net Profit	
1994	1	241.6	66.8	166.4	19.5	83.8	336.5	-94.9	0	-94.9	-94.9
1995	2	293.4	75.4	166.4	19.5	79.3	340.6	-47.3	0	-47.3	-142.2
1996	3	345.2	85.0	166.4	19.5	70.8	341.8	3.4	0	3.4	-138.8
1997	4	345.2	83.1	166.4	19.5	59.8	328.9	16.3	0	16.3	-122.6
1998	5	345.2	81.2	166.4	19.5	47.8	314.9	30.3	0	30.3	-92.3
1999	6	345.2	80.2	166.4	19.5	34.6	300.7	44.4	0	44.4	-47.9
2000	7	345.2	80.2	166.4	19.5	20.5	286.6	58.5	5.2	53.4	5.5
2001	8	345.2	80.2	166.4	19.5	6.6	272.8	72.4	33.3	39.1	44.6
2002	9	345.2	80.2	166.4	19.5	0	266.2	79.0	36.3	42.7	87.2
2003	10	345.2	80.2	166.4	19.5	0	266.2	79.0	36.3	42.7	129.9
2004	11	345.2	80.2	55.8	19.5	0	155.5	189.6	87.2	102.4	232.3
2005	12	345.2	80.2	55.8	19.5	0	155.5	189.6	87.2	102.4	334.7
2006	13	345.2	80.2	55.8	19.5	0	155.5	189.6	87.2	102.4	437.1
2007	14	345.2	80.2	55.8	19.5	0	155.5	189.6	87.2	102.4	539.5
2008	15	345.2	80.2	55.8	19.5	0	155.5	189.6	87.2	102.4	641.9
2009	16	345.2	80.2	38.9	19.5	0	138.6	206.6	95.0	111.5	753.4
2010	17	345.2	80.2	38.9	19.5	0	138.6	206.6	95.0	111.5	865.0
2011	18	345.2	80.2	38.9	19.5	0	138.6	206.6	95.0	111.5	976.5
2012	19	345.2	80.2	38.9	19.5	0	138.6	206.6	95.0	111.5	1,088.0
2013	20	345.2	80.2	38.9	19.5	0	138.6	206.6	95.0	111.5	1,199.6
2014	21	345.2	80.2	38.9	19.5	0	138.6	206.6	95.0	111.5	1,311.1
2015	22	345.2	80.2	38.9	19.5	0	138.6	206.6	95.0	111.5	1,422.7
2016	23	345.2	80.2	38.9	19.5	0	138.6	206.6	95.0	111.5	1,534.2
2017	24	345.2	80.2	38.9	19.5	0	138.6	206.6	95.0	111.5	1,645.8
2018	25	345.2	80.2	38.9	19.5	0	138.6	206.6	95.0	111.5	1,757.3
2019	26	345.2	80.2	38.9	19.5	0	138.6	206.6	95.0	111.5	1,868.9
2020	27	345.2	80.2	38.9	19.5	0	138.6	206.6	95.0	111.5	1,980.4
2021	28	345.2	80.2	38.9	19.5	0	138.6	206.6	95.0	111.5	2,092.0
2022	29	345.2	80.2	38.9	19.5	0	138.6	206.6	95.0	111.5	2,203.5
2023	30	345.2	80.2	38.9	19.5	0	138.6	206.6	95.0	111.5	2,315.1
	Total	10,199.3	2,396.8	2,526.8	584.9	403.1	5,911.6	4,287.7	1,972.6	2,315.1	

Table 8 Cash Flow Statement of Case 2

(Unit: 10^9 Rupiah)

(IRR: 12.2%)

Year	OP Year	Investment	Profit Before Tax	Depreciation/ Amortization	Interest Paid	Cash Flow	DCF (Base; 1985)
1990		-353.4	-	-	-	-353.4	-198.4
1991		-353.4	-	-	-	-353.4	-176.7
1992		-235.5	-	-	-	-235.5	-105.0
1993		-304.1	-	-	-	-304.1	-120.7
1994	1	-	-94.9	127.6	83.8	116.4	41.2
1995	2	-	-47.3	127.6	79.3	159.6	50.3
1996	3	-	3.4	127.6	70.8	201.7	56.6
1997	4	-	16.3	127.6	59.8	203.7	51.0
1998	5	-	30.3	127.6	47.8	205.6	45.8
1999	6	-	44.4	127.6	34.6	206.6	41.0
2000	7	-	58.5	127.6	20.5	206.6	36.5
2001	8	-	72.4	127.6	6.6	206.6	32.6
2002	9	-	79.0	127.6	0	206.6	29.0
2003	10	-	79.0	127.6	0	206.6	25.8
2004	11	-	189.6	16.9	0	206.6	23.0
2005	12	-	189.6	16.9	0	206.6	20.5
2006	13	-	189.6	16.9	0	206.6	18.3
2007	14	-	189.6	16.9	0	206.6	16.3
2008	15	-	189.6	16.9	0	206.6	14.5
2009	16	-	206.6	0	0	206.6	12.9
2010	17	-	206.6	0	0	206.6	11.5
2011	18	-	206.6	0	0	206.6	10.3
2012	19	-	206.6	0	0	206.6	9.1
2013	20	-	206.6	0	0	206.6	8.1
2014	21	-	206.6	0	0	206.6	7.3
2015	22	-	206.6	0	0	206.6	6.5
2016	23	-	206.6	0	0	206.6	5.8
2017	24	-	206.6	0	0	206.6	5.1
2018	25	-	206.6	0	0	206.6	4.6
2019	26	-	206.6	0	0	206.6	4.1
2020	27	-	206.6	0	0	206.6	3.6
2021	28	-	206.6	0	0	206.6	3.2
2022	29	-	206.6	0	0	206.6	2.9
2023	30	-	206.6	0	0	264.4	3.3
	Total	-1,246.4	4,287.7	1,360.4	403.1	4,862.7	0.0

4-2 Evaluation

(1) Profit and Loss

From the viewpoint of profitability, both projects of Case 1 and Case 2 are financially viable. After the projects record deficit for the first two years, they record surplus from the third year onward.
The cumulative deficit of Case 1 is cleared off in the 6th year but that of Case 2 is in the 7th year.

(2) Internal Rate of Return before Tax

As far as IRR is concerned, the resulting 13.0% of IRR on Case 1 and 12.2% on Case 2 cannot be considered as a high rate in general standard due to large investment costs. However, if low cost funds such as the interest rate of 8% assumed in this study is arranged, both cases are considered to be viable.

(3) Debt Repayment

Debt repayment is accomplished in eight years from start of plant operation in both cases. This period is not so long term in consideration of thirty years of project life.

(4) Evaluation

Profitability of Case 1 is superior to that of Case 2 from the viewpoint of IRR.
Provided that the crude oil price rises higher than 30$/bbl which corresponds to 35¥/kg of methanol price at plant gate, the viability of the project Case 1 would be enhanced because the noncommerical Banko coal is not affected by oil.

2. Comparison of Electricity Generation Cost

1. Objective of the Study

This study has been carried out for the purpose of preliminary evaluation of economic feasibility on the case of electricity generation from Banko coal by using the fluidized-bed boiler (FBB) in order to compare with the economic evaluation of coal gasification combined-cycle (CGCC) power generation.

As a matter of convenience for cost comparison between this plant and CGCC power plant, the same gross generating capacity (900 MW), and assumptions of economic factors such as electricity generation schedule, finance, sales price and raw material cost were selected in this study.

Note): These results are abstructed and compiled from the Interim Report III (FY 1986) and the Interim Report, Stage II (March, 1988) on the Feasibility Study on Effective Utilization of Banko Coal in the Republic of Indonesia. For details, refer to these reports.

2. Outline of Power Plants

2-1 Coal Gasification Combined-cycle Plant (CGCC)

2-1-1 Design Basis

(1) Type of Power Plant : Combined Cycle Generation

(2) Generating Power

Gross Generating Power	:	900 MW
Available Generating Power	:	855 MW
Net Generating Power	:	835 MW
(Power to Gasification Plant	:	20 MW)

(3) Annual Operation Days : 320 d/y

(4) Plant Location : Tanjung Priok

(5) Electricity Transmission : Switchyard of Power Plant

Note*): Electricity will be sold to PLN.

(6) Feed Coal Specification :

C, %	:	27.4
V.M., %	:	32.8
Ash, %	:	4.8
Mo., %	:	35.0
Total, %	:	100.0
HV, Kcal/kg	:	4,430

(7) Coal Receiving : Bunker Hopper at Mine Site

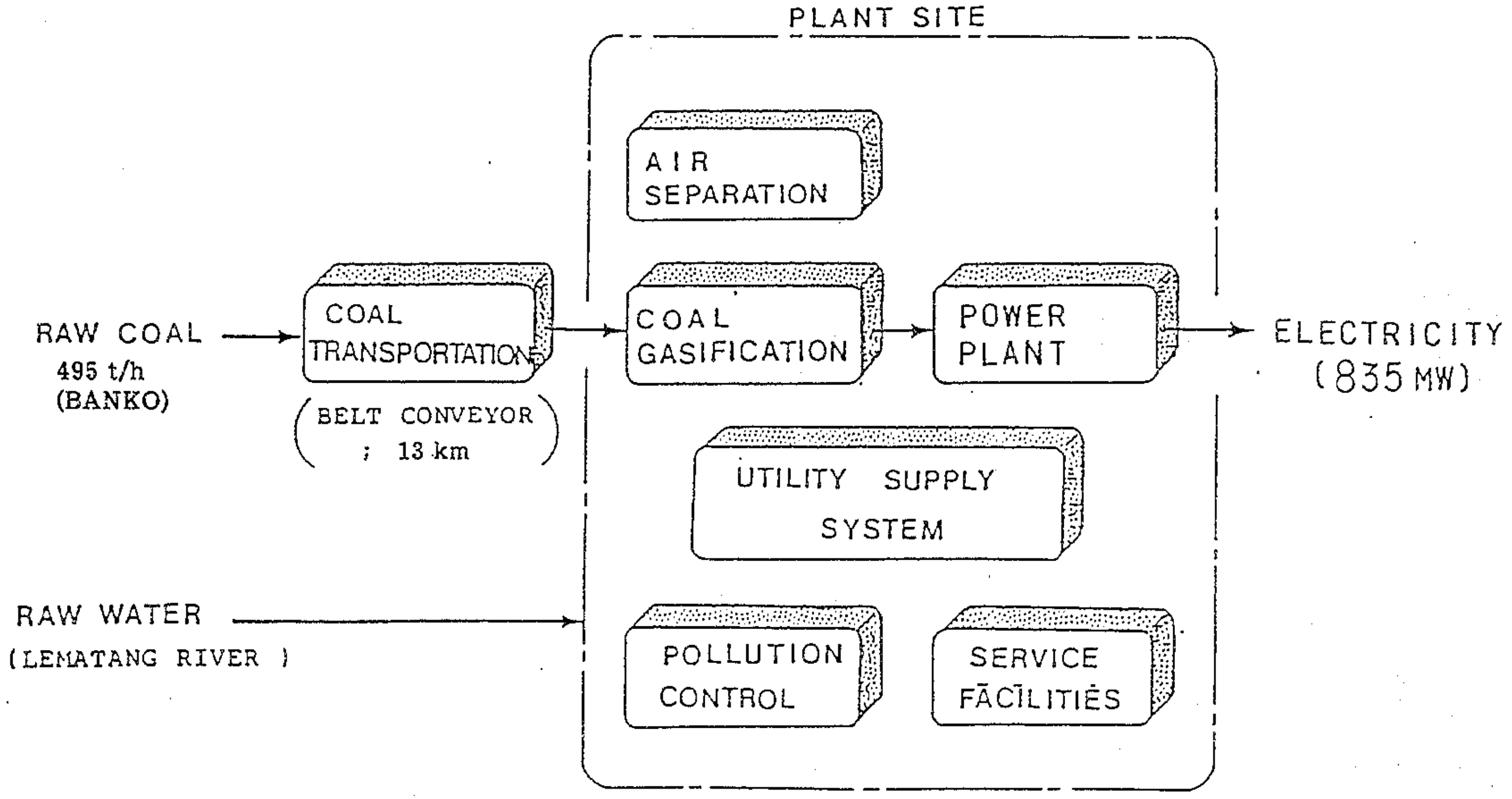
(8) Utilities : All the utilities except raw water and coal are generated inside the plant

Conditions:

HP St'm	:	480°C, 65 kg/cm²G
MP St'm	:	250°C, 40 kg/cm²G
LP St'm	:	155°C, 3.5 kg/cm²G
BFW (I)	:	110°C, 5 kg/cm²G
BFW (II)	:	110°C, 55 kg/cm²G
C. Water	:	30°C (Supply)/37°C (Return)

2-1-2 Plant Configuration

Fig. 1 shows the scope of coal gasification and electricity generation complex devided into seven blocks each of which has its individual function. The component facilities in each block are listed in Table 1.



* Component facilities consisting each block are listed in Table 1.

Fig. 1 Overall Block Flow Diagram

Table 1 Plant Configuration

1) Belt Conveyor System

Primary Crusher/Feeder
Overland Coal Conveyor

2) Coal Gasification

Coal Storage and Handling
Coal Pretreatment
Coal Gasification
Gas Cooling/Dedusting
Calcination

3) Air Separation Plant

Air Separation
Liquid Oxygen Tank
Liquid Nitrogen Tank

4) Power Plant & Utility System

Gas Turbine/Generator
Steam Turbine/Generator
Heat Recovery Steam Generator (HRSG)
HP & LP Steam Circuit
Power Distribution
Water Cooling
Raw Water Intake/Pretreatment
Instrument/Plant Air Supply

5) Pollution Control/Safety System

Waste Water Treatment
Solid Waste Disposal
Flare/Blowdown
Fire Fighting

6) **Service Facilities**

Administration Office
Laboratory
Warehouse
Accommodation
Canteen
Cafeteria
Leisure Center
Mosque
Communication System
Maintenance Shop
Potable Water Supply

2-1-3 Electricity Generation

(1) Process Flow Diagram

See Fig. 2.

(2) Process Description

1) The plant comprises three combined cycle blocks. Each consists of two 100 MW class gas turbines, two heat recovery steam generators (HRSG) and a steam turbine.

2) The gas turbine/generator packages convert about 31% of the fuel energy into electric power and release almost all the remainder as waste heat in the exhaust gas at about 530°C. This wasted energy is recovered for use as heat. The heat recovery steam generator (HRSG) positioned on the exhaust paths reduce the exhaust temperature to about 130°C and recover the gas turbine losses by converting them into steam. The stream is used to drive steam turbines to generate additional power and process steam. Thus the gross efficiency of power plant becomes about 45%.

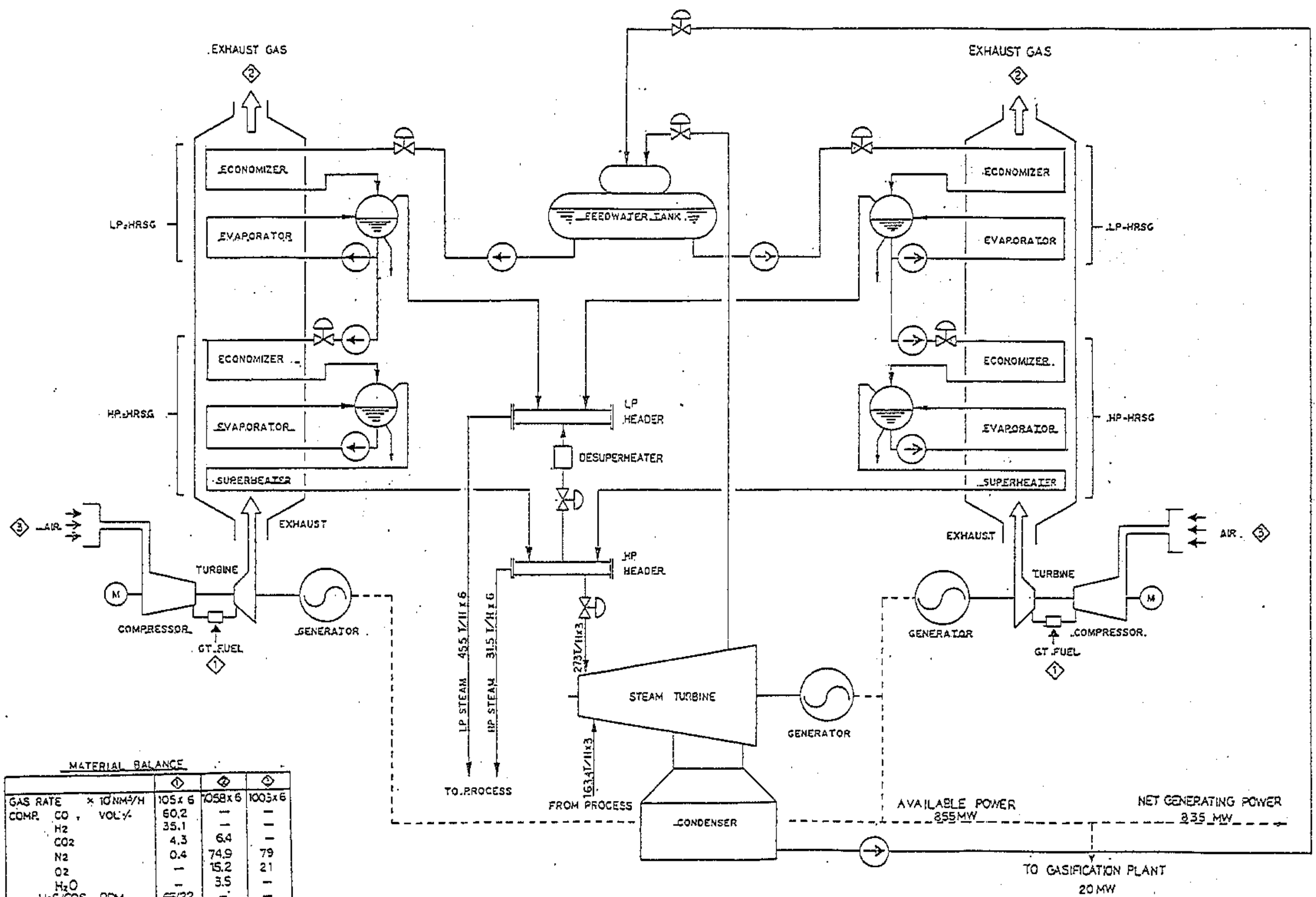
3) The HRSG is of dual pressure system and produces two different pressure steams.

   HP steam: 65 kg/cm^{2}G x 480°C
   LP steam: 3.5 kg/cm^{2}G x 155°C

   The feedwater is first heated in feedwater tank and then in the LP economizer. Evaporation takes place in forced circulation LP evaporator and transferred to the process. HP part of the HRSG has the same system as that of LP part, though superheater is furnished in this case, and is placed in series in the exhaust gas stream. A part of HP steam is transferred to the process and the remainder is used to drive steam turbine. MP steam (40 kg/cm^{2}G x 250°C) is input to the intermediate stage of the steam turbine.

(3) Major Equipment

Specifications and the number of units of major equipment are listed in Table 2.



MATERIAL BALANCE

		①	②	③
GAS RATE	× 10^3 NM³/H	105 x 6	1058 x 6	1003 x 6
COMP. CO	VOL %	60.2	—	—
H_2		35.1	—	—
CO_2		4.3	6.4	—
N_2		0.4	74.9	79
O_2		—	15.2	21
H_2O		—	3.5	—
H_2S/COS	PPM	65/22	—	—
DUST	G/NM³	0.01-0.05	—	—

Fig. 2 Simplified Process Flow Diagram (CGCC)

Table 2 Major Equipment (CGCC)

Description	Q'ty	Specification
Gas turbine/generator package	*6*	*100 MW*
Heat recovery steam generator	6	HP: 65 kg/cm^2G x 480°C x 168 t/h LP: 3.5 kg/cm^2G x 156°C x 46 t/h
Steam turbine/generator unit	3	100 MW
Steam condenser	3	390 t/h x 722 mmHgV
Vacuum pump	3	722 mmHgV
Condensate pump	9 (3 standby)	215 m^3/h x 100m
Feedwater tank	3	10 m^3
HP feedwater pump	9 (3 standby)	200 m^3/h x 750 m
LP feedwater pump	9 (3 standby)	250 m^3/h x 75m
Cooling tower	1	100,000 t/h
Fuel gas compressor unit	6	115,000 Nm^3/h x 17 kg/cm^2
Demineralized water plant	1	100 t/h
Raw water pump	3 (1 standby)	1,630 t/h x 30m
Feed water pump for gasification	2 (1 standby)	640 t/h x 550 m

2-1-4 Utility Requirement

See Table 3 and Fig. 3.

Table 3 Utility Requirement

Coal	495	t/h (external supply)
Raw Water	2,960	t/h (ditto)
Electricity	835,000	kW (outside supply)
ditto	20,000	kW (internal supply)
Cooling Water	119,100	t/h (ditto)
BFW	1,703	t/h (ditto)
HP Steam	189	t/h (ditto)
LP Steam	273	t/h (ditto)

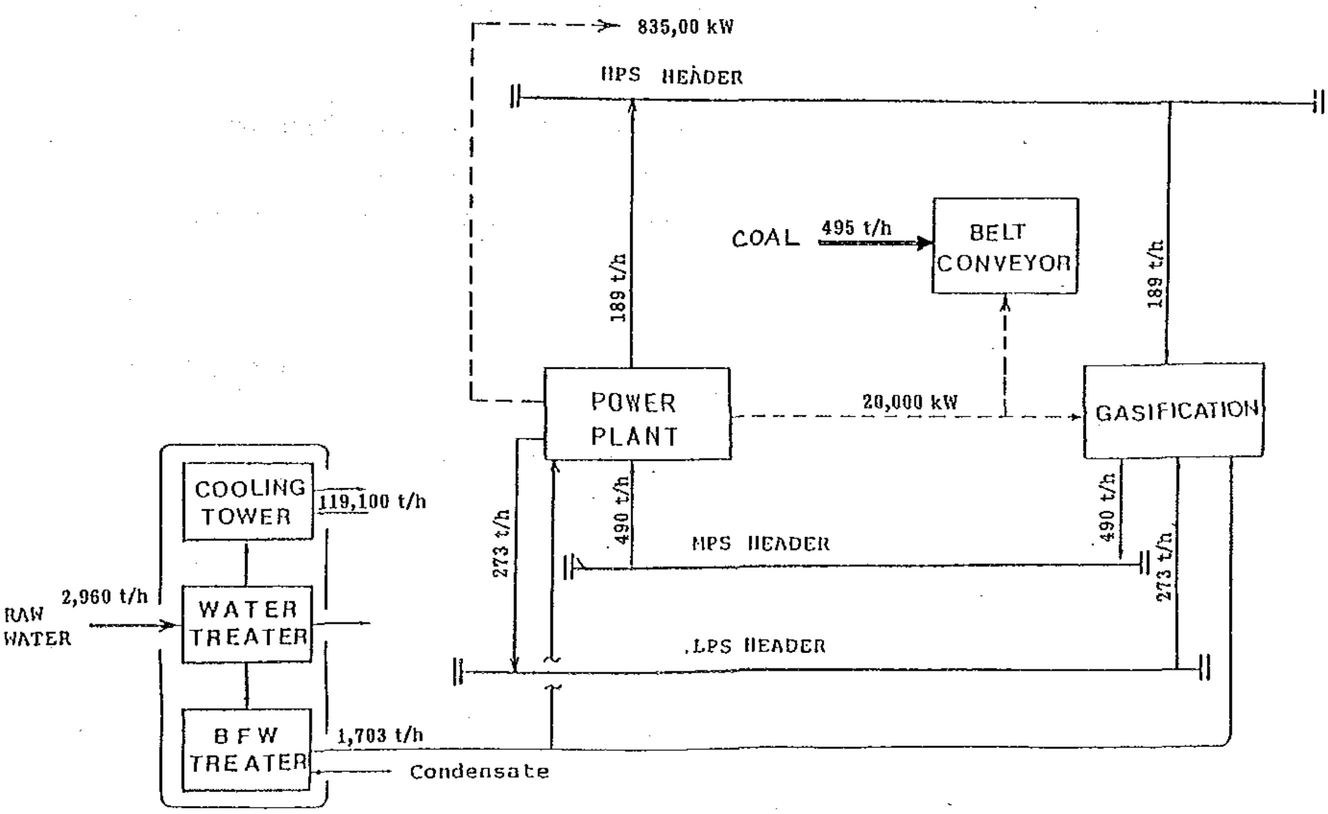


Fig. 3 Utility Flow Diagram (CGCC)

2-2 Fluidized-bed Boiler Plant (FBB)

2-2-1 Design Basis

(1) Type of Power Plant : Thermal Power Plant with Fluidized-bed Boiler

(2) Generating Power

Gross Generating Power : 900 MW
Net Generating Power : 818 MW
(For Home Consumption : 82 MW)

(3) Annual Operation Days : 320 d/y

(4) Plant Location : Tanjung Priok

(5) Electricity Transmission : Switchyard of Power Plant
(Note): Electricity will be sold to PLN.

(6) Feed Coal Specification : Same to the coal for CGCC Plant

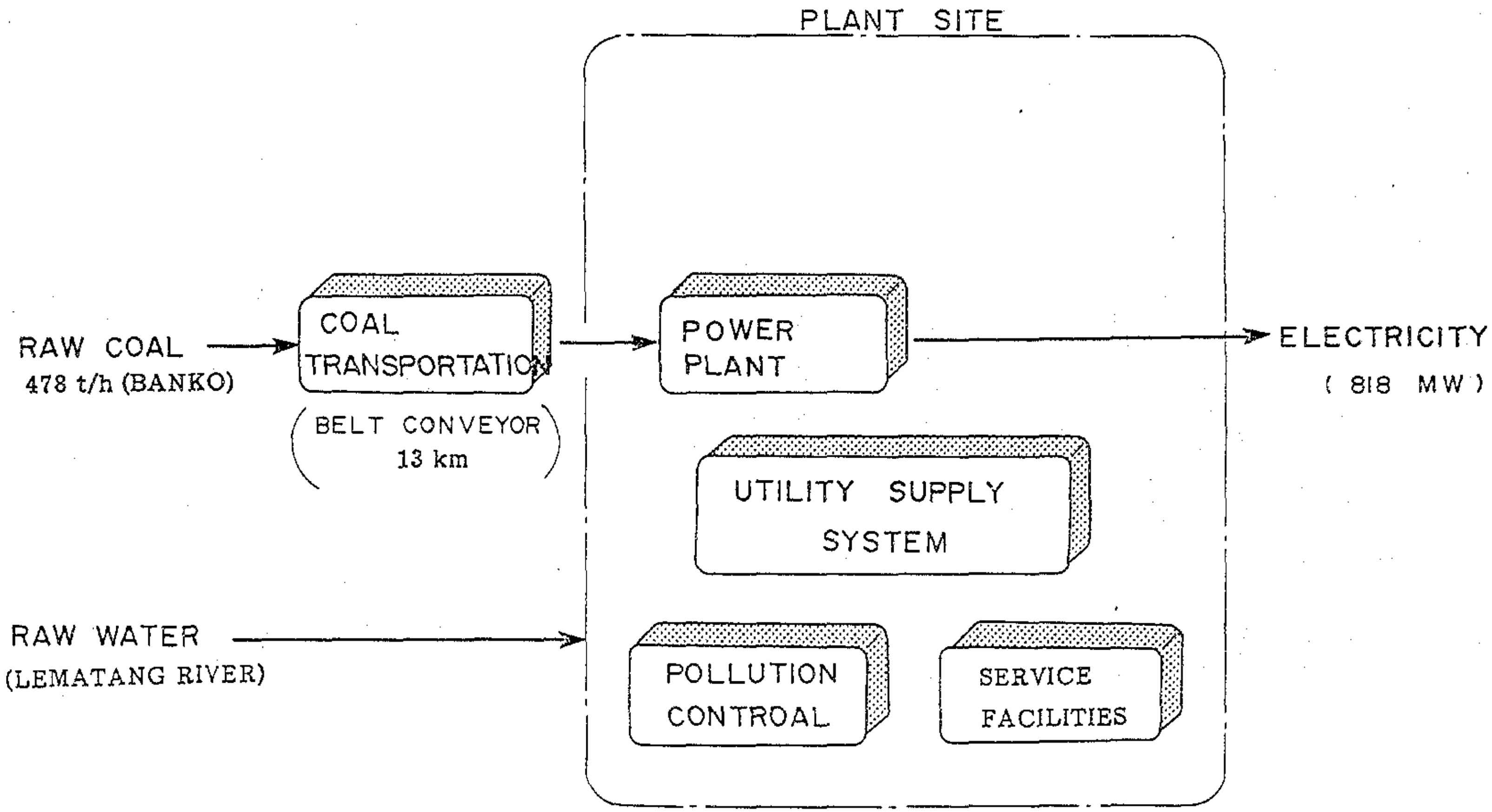
(7) Coal Receiving : Bunker Hopper at Mine Site

(8) Utilities

All the utilities except raw water and coal are generated insdie the plant.
Drying of coal is carried out by utilizing the heat of boiler flue gas.
Cooling water for main condenser is supplied at 30°C and returned at 37°C.

2-2-2 Plant Configuration

Fig 4 shows the scope of power plant devided into five blockes each of which has its individual function.
The component facilities in each block are listed in Table 4.



* Component facilities consisting each block are listed in Table 4.

Fig. 4 Overall Block Flow diagram

Table 4 Plant Configuration

1) Belt Conveyor System
   - Primary Crusher/Feeder
   - Overland Coal Conveyor

2) Coal and Limestone Handling
   - Coal Storage and Handling
   - Coal Pretreatment
   - Limestone Storage and Handling

3) Power Plant & Utility System
   - Gas Turbine/Generator
   - Steam Turbine/Generator
   - Coal Fired Fluidized Bed Boiler
   - Power Distribution
   - Water Cooling
   - Raw Water Intake/Pretreatment
   - Instrument/Plant Air Supply

4) Pollution Control/Safety System
   - Waste Water Treatment
   - Solid Waste Disposal
   - Flare/Blowdown
   - Fire Fighting

5) Service Facilities
   - Administration Office
   - Laboratory
   - Warehouse
   - Accommodation
   - Canteen
   - Cafeteria
   - Leisure Center
   - Mosque
   - Communication System
   - Maintenance Shop
   - Potable Water Supply

2-2-3 Electricity Generation

(1) Process Flow Diagram

See Fig. 5.

(2) Process Description (Fig. 5 & Fig. 6)

1) The plant comprises of three trains. Each train consists of 300 MW single reheat steam turbine generator set and 3 units of fluidized bed boiler.

2) The fluidized bed boiler is especially suitable for burning the difficult-burn coal such as lignite with high water content and anthracite.

3) The feedwater is heated by 3 units of LP feedwater heaters, deaerator, and 4 units of HP feedwater heaters. The steam for heating of each feedwater is extracted from the respective steam turbine bleeding point.

(3) Major Equipment

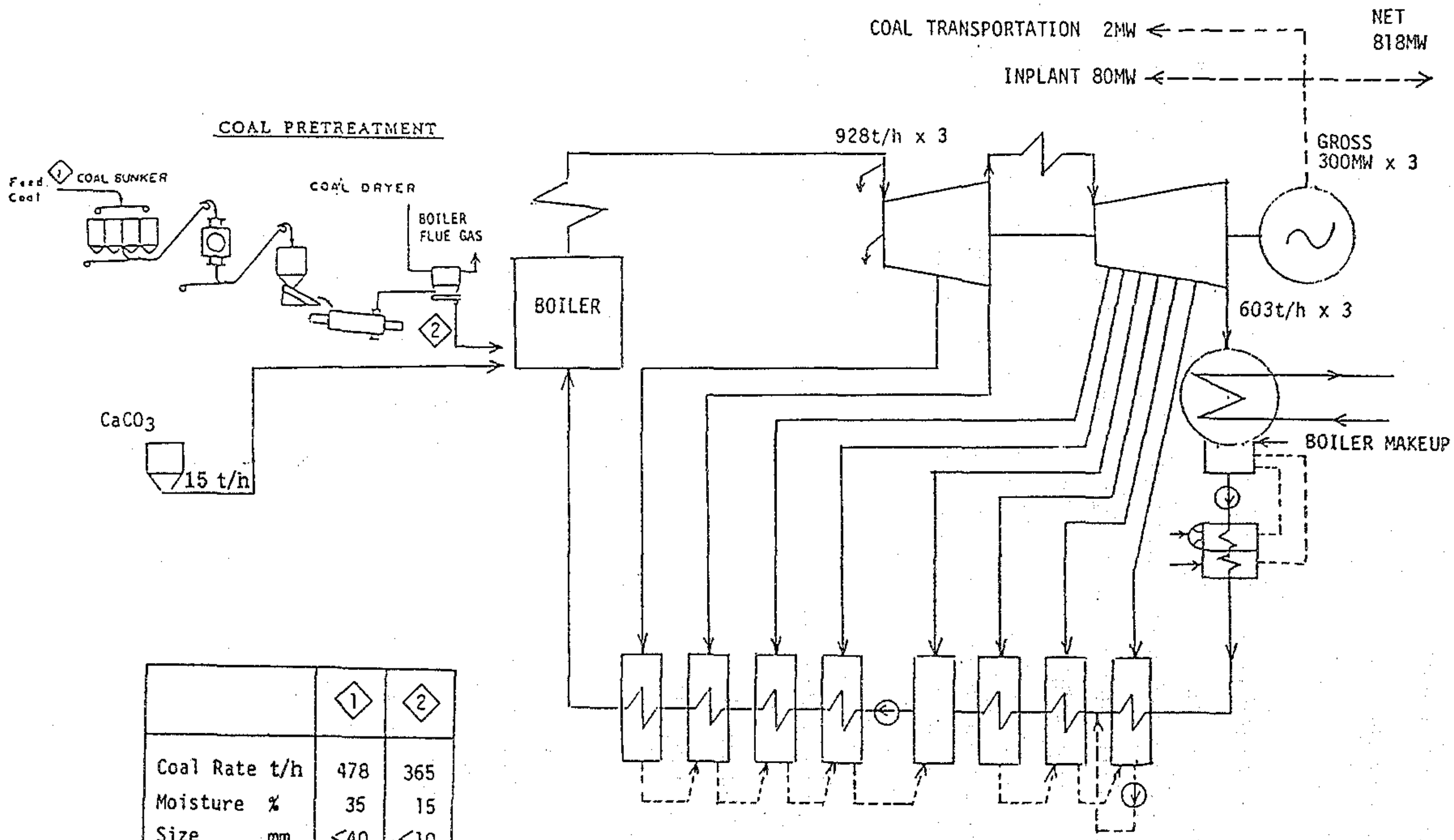
Specifications and the number of units of major equipment are listed in Table 5.

2-5 Utility Requirement

See Table 6 and Fig. 7.

Table 6 Utility Requirement

Coal	478	t/h (external supply)
Raw Water	1,680	t/h (ditto)
Electricity	818,000	kW (outside supply)
ditto	82,000	kW (internal supply)
Cooling Water	155,000	t/h (ditto)
$CaCO_3$	15	t/h



	①	②
Coal Rate t/h	478	365
Moisture %	35	15
Size mm	<40	<10

Fig. 5 Power Plant Flow Diagram (FBB)

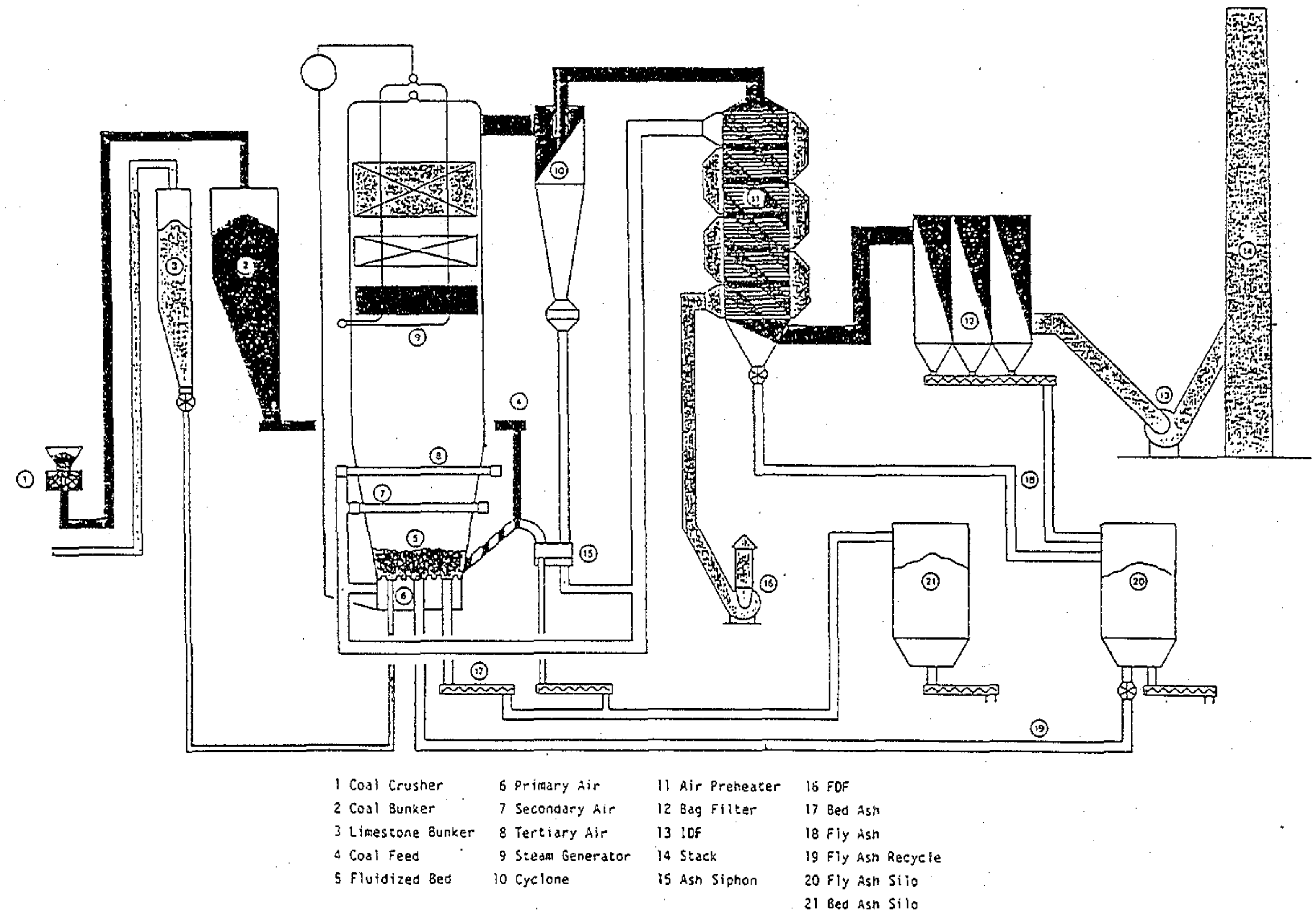


Fig. 6 Scheme of Fluidized Bed Boiler

Table 5 Major Equipment (FBB)

Description	Q'ty	Capacity
1. Coal Handling Section		
1.1 Primary Crusher	3	200 t/h
1.2 Dewatering Drum	3	160 t/h
2. Thermal Power Plant Section		
Fluidized bed boiler	9	310 t/h
Steam turbine/generator unit	3	300 MW
Steam condesner	3	603 t/h x 700 mmHgV
Vacuum pump	3	700 mmHgV
Condensate pump	9 (3 standby)	360 m^3/h x 200 m
Feedwater tank	3	10 m^3
HP feedwater heaters	12	928 t/h
Deaerators	3	928 t/h
LP feedwater heaters	9	702 t/h
Boiler feed pumps	9 (3 standby)	510 t/h x 198 at
Cooling tower	1	155,000 t/h
Demineralized water plant	3	35 t/h
Raw water pump	2 (1 standby)	1,900 t/h x 30m

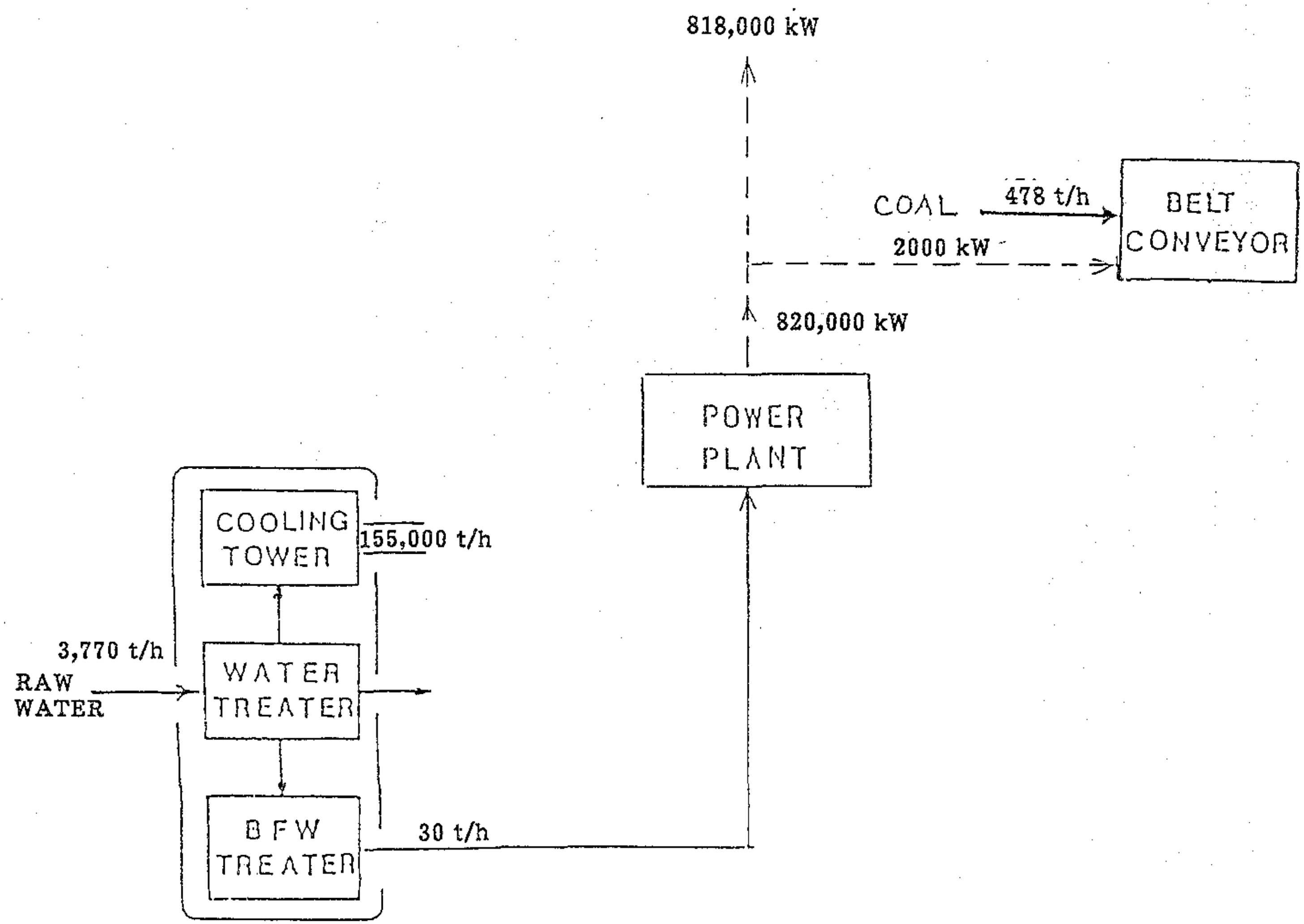


Fig. 7 Utility Flow Diagram (FBB)

3. Financial Analysis

Financial viability and profitability of the Project was evaluated by means of financial statements* and internal rate of return (hereafter referred to as IRR) on total project investment.

* Projected Profit and Loss Statement
Projected Cash Flow Statement
Projected Balance Sheet

3-1 Assumptions

(1) Electricity Generation Schedule

1) Net Generating Power : 835 MW (CGCC), 818 MW (FBB)

2) Average Load Factor : 66%

3) Plant Construction Period : 1990 - 1993 (4 years)
where 30% Completion at the end of 1990
60% Completion at the end of 1991
80% Completion at the end of 1992
100% Completion at the end of 1993

4) Project Life : 1994 - 2023 (30 years)
where 70% of full operation in 1994
85% of full operation in 1995
100% of full operation in 1996 and after

5) Annual Operation Days : 320 days

(2) Finance

1) Debt/Equity Ratio : 75/25

2) Currency

For Annual Revenue/Expenditure ; Rupiah
For Capital Investment ; Yen
Exchange Rate ; 0.18 Yen/Rupiah

Accordingly, debt is repayed by exchanging Rupiah for yen at the above exchange rate.

3) Debt Repayment Schedule

Terms of 12 years after commitment, including 4 years of grace period with 8 years equal payments of principal.

4) Interest

i) Long-term Loan ; 8% per annum

Assumed supplyer's credit (7.2% p.a.) plus bank loan and project risk premium.

ii) Short-term Loan ; 8% per annum

A short term loan would be raised commensurate with annual cash deficiency and would be repayed after development loan.

iii) Interest during Construction Period

In accordance with a general rule in similar projects, interest paid or accrued during construction period is capitalized and amortized over a 10-year period from 1994.

(3) Escalation

No escalation is assumed.

(4) Ex-Power Plant Price of Electricity

Supply to Jakarta:

Case E-5,7	:	43 Rp/kWh (7.76 ¥/kWh)
Case E-6,8	:	53 Rp/kWh (9.57 ¥/kWh)

Supply to Adjacent Area:

Case E-4,9	:	64 Rp/kWh (11.55 ¥/kWh)
Case E-1,10	:	78 Rp/kWh (14.08 ¥kWh)

Note*) Ex-Power Plant Price was assumed referring to the electric rate in Indonesia as of April 1984 and estimated sales cost. Estimation of price in each case is shown in Table 7.

Table 7 Sales Price and Cost Estimation of Electricity

(Unit: Rp/kWh)

Case	Case E-5,7	Case E-6,8	Case E-4,9	Case E-1,10
Average Sales Price of PLN ①	98			
Administration and Distribution Cost of PLN	30%	20%	20%	20%
Transmission Loss	15%	15%	15%	0%
Sub-total ②	45% 44	35% 34	35% 34	20% 20
Transmission Cost to Java ③	11	11	-	-
Total ② + ③ = ④	55	45	34	20
Ex-Power Plant Price ① - ④	43	53	64	78

3-2 Capital Investiment Costs

3-2-1 CGCC Plant Case

(1) Fixed-capital Investment:

	10^6 Rupiah	(10^6 Yen)
Coal Gasification	461,500	(83,300)
Coal Transportation	41,000	(7,400)
Power Plant/Support Facilities	304,200	(54,900)
Equipment Transportation	89,200	(16,100)
Contingency	44,300	(8,000)
Total	940,200	(169,700)

(2) Working capital 39,100 (7,058)

Note): Working capital is added as cash-inflow at the end of the project.

(3) Start-up Expense: 4,300 (777)

(4) Operator Training Cost: 2,400 (430)

Note): Table 8 shows the investment schedule.

Table 8 Investment Schedule

	1990	1991	1992	1993
Fixed Capital	30%	30%	20%	20%
Working Capital	-	-	-	100%
Start-up Expense	-	-	-	100%
Operator Training	-	-	-	100%

3-2-2 FBB Plant Case

(1) Fixed-capital Investment:

	10^6 Rupiah	(10^6 Yen)
Coal Transportation	39,900	(7,200)
Power Plant/Support Facilities	736,800	(133,000)
Equipment Transportation	74,200	(13,400)
Contingency	42,700	(7,700)
Total	893,600	(161,300)

(2) Working capital: 33,820 (6,105)

Note): Working capital is added as cash-inflow at the end of the project.

(3) Start-up Expense: 4,160 (750)

(4) Operator Training Cost: 2,070 (374)

Note): Investment schedule is same as the CGCC Plant Case.

3-3 Annual Expense

3-3-1 CGCC Plant Case

(1) Fixed Costs

1) Depreciation and Amortization1)*

	Period	Amount	
	Year	10^6 Rupia/Year	(10^6 Yen/Year)
· Boiler, Power Plant, Cooling Tower, Buildings	15	18,986	(3,427)
· Others	10	79,900	(14,422)
2) Maintenance		21,163	(3,820)
3) Insurance		8,465	(1,528)
(2) Variable Costs			
1) Raw Material (Coal)2)*		41,285	(7,452)
2) Superviser & Operating Labor			
· Foreign Staff3)*			
· Local Labor		2,476	(447)
3) Chemicals		404	(73)
(3) Plant Overhead Costs		9,934	(1,793)
(4) Administration Expenses		4,970	(897)

Note): 1) Capital investment for the plant construction including expenses and interests during construction period is depreciated and a amortized based on straight line method.

2) In the strategic study in FY1984, mining cost was estimated at \$13.88/ton-coal. In this study \$14.85/ton-coal is assumed as raw material costs by adding 7% to the mining cost as overhead.

3) Foreign staff decrease in number as the project proceeds. (See Table 9)

Table 9 Costs for Foreign Staff

Op. Year	1st	2nd	3rd	4th	5th	6th-30th
Year	1994	1995	1996	1997	1998	1999-2023
% on 1st year	100	70	50	30	10	0
Cost, 10^6 rupiah/year	7,457	5,220	3,729	2,237	746	0
(Cost, 10^6 yen/year)	(1,346)	(942)	(673)	(404)	(135)	(0)

3-3-2 FBB Plant Case

(1) Fixed Costs

1) Depreciation and Amortization[1)*]

	Period	Amount	
	Year	10^6 Rupia/Year	(10^6 Yen/Year)
· Boiler, Power Plant, Cooling Tower, Buildings	15	49,269	(8,893)
· Others	10	29,086	(5,250)
2) Maintenance		20,388	(3,680)
3) Insurance		8,155	(1,472)
(2) Variable Costs			
1) Raw Material (Coal)[2)*]		39,867	(7,196)
2) Superviser & Operating Labor			
· Foreign Staff[3)*]			
· Local Labor		2,166	(391)
3) Chemicals		1,224	(221)
(3) Plant Overhead Costs		8,748	(1,579)
(4) Administration Expenses		4,377	(790)

Note): 1 - 3: Same as the CGCC Plant Case.

3-4 *Evaluation Criteria*

1) Financial Statement

a) Profit and Loss Statement

b) Cash Flow Statement

c) Balance Sheet

2) IRR on Total Project Cost before Tax
(For details, see the Interim Report II (FY 1985), page 218 - 219.)

3-5 Results and Evaluation

3-5-1 Results

Results of the financial analysis for CGCC Plant Case and FBB Plant Case are summarized in Tables 10 and 11 respectively. Profit and loss statements and cash *flow statements for Case E-4 and E-9 are shown in Table 12 through 15.*

Table 10 Results of Financial Analysis (CGCC Plant)

Case	Supply to Jakarta		Supply to Adjacent Area	
	E-5	E-6	E-4	E-1
Ex-plant Price of Electricity	43 Rp/ kWh (7.76 ¥ /kWh)	53 Rp/ kWh (9.57 ¥ /kWh)	64 Rp/ kWh (11.55 ¥ /kWh)	78 Rp/ kWh (14.08 ¥ /kWh)
IRR on Total Investment	6.9 %	10.3 %	13.5 %	17.0 %
First Year to Have Profit before Tax (Year from Operation Starts)	11th	7th	3rd	2nd
Clear off of Accumulated Loss (Year from Operation Starts)	28th	13th	5th	2nd
Pay off of All the Debts (Year from Loan Raised)	28th	15th	12th	12th
Minimum Sales Price (IRR = Interest Rate)	46 Rp/kWh (8.31 ¥/kWh)			

Table 11 Results of Financial Analysis (FBB Plant)

Case	Supply to Jakarta		Supply to Adjacent Area	
	E-7	E-8	E-9	E-10
Ex-plant Price of Electricity	43 Rp/kWh (7.76 ¥/kWh)	53 Rp/kWh (9.57 ¥/kWh)	64 Rp/kWh (11.55 ¥/kWh)	78 Rp/kWh (14.08 ¥/kWh)
IRR on total Investment	7.4 %	10.8 %	14.0 %	17.5 %
First Year to Have Profit before Tax (Year from Operation Starts)	11th	4th	2nd	1st
Clean off of Accumulated Loss (Year from Operation Starts)	24th	9th	3rd	1st
Pay off of All the Debts (Year from Loan Raised)	23th	14th	12th	12th
Minimum Sales Price (IRR = Interest Rate)	44.7 Rp/kWh (8.08 ¥/kWh)			

3-5-2 Evaluation

As for economic comparison for power generation, generating system by fluidized-bed coal-fired steam cycle is slightly superior to that by CGCC though the difference in IRR between two systems is narrow.

Table 12 Profit and Loss Statement of Case E-4

(Unit: 10^6 Rupiah)

Year	OP	REVENUE	EXPENDITURE					PROFIT			Retained
	Year		Variable Cost	Fixed Cost	General	Interest Paid	Total	Before Tax	(Tax)	Net Profit	Earning
1994	1	189.6	39.1	128.5	14.9	65.8	248.3	- 58.7	0	- 58.7	- 58.7
1995	2	230.3	43.1			60.9	247.4	- 17.2	0	- 17.2	- 75.8
1996	3	270.9	47.9			52.6	243.9	27.0	0	27.0	- 48.8
1997	4		46.4			42.0	231.8	39.1	0	39.1	- 9.7
1998	5		44.9			31.3	219.6	51.3	19.1	32.2	22.5
1999	6		44.2			21.4	209.0	61.9	28.5	33.4	55.9
2000	7					12.6	200.2	70.7	32.5	38.2	94.1
2001	8					4.2	191.8	79.1	36.4	42.7	136.8
2002	9					0	187.6	83.3	38.3	45.0	181.8
2003	10						187.6	83.3	38.3	45.0	226.8
2004	11			128.5			107.7	163.2	75.1	88.1	314.9
2005	12			48.6			107.7	163.2	75.1	88.1	403.1
2006	13						107.7	163.2	75.1	88.1	491.2
2007	14						107.7	163.2	75.1	88.1	579.3
2008	15			48.6			107.7	163.2	75.1	88.1	667.5
2009	16			29.6			88.7	182.2	83.8	98.4	765.9
2010	17										864.3
2011	18										962.7
2012	19										1,061.1
2013	20										1,159.5
2014	21										1,257.9
2015	22										1,356.3
2016	23										1,454.6
2017	24										1,553.0
2018	25										1,651.4
2019	26										1,749.8
2020	27										1,848.2
2021	28										1,946.6
2022	29										2,045.0
2023	30	270.9	44.2	29.6	14.9	0	88.7	182.2	83.8	98.4	2,143.4
	Total	8,005.5	1,325.6	1,972.7	447.1	290.8	4,036.2	3,969.3	1,825.9	2,143.4	

Table 13 Cash Flow Statement of Case E-4

(Unit: 10^9 Rupiah)

Year	OP Year	INVESTMENT	Profit Before TAX	Depreciaiton/ Amortization	Interest Paid	CASH FLOW	DCF (Base; 1985)
1990		- 282.1	-	-	-	- 282.1	- 150.0
1991		- 282.1	-	-	-	- 282.1	- 132.2
1992		- 188.0	-	-	-	- 188.0	- 77.7
1993		- 233.8	-	-	-	- 233.8	- 85.2
1994	1	-	- 58.7	98.9	65.8	106.0	34.0
1995	2	-	- 17.2		60.9	142.6	40.4
1996	3	-	27.0		52.6	178.5	44.5
1997	4	-	39.1		42.0	180.0	39.6
1998	5	-	51.3		31.3	181.5	35.2
1999	6	-	61.9		21.4	182.2	31.1
2000	7	-	70.7		12.6		27.4
2001	8	-	79.1		4.2		24.2
2002	9	-	83.3		0		21.3
2003	10	-	83.3	98.9			18.8
2004	11	-	163.2	19.0			16.6
2005	12	-	163.2				14.6
2006	13	-	163.2				12.9
2007	14	-	163.2				11.3
2008	15	-	163.2	19.0			10.0
2009	16	-	182.2	0			8.8
2010	17	-					7.8
2011	18	-					6.8
2012	19	-					6.0
2013	20	-					5.3
2014	21	-					4.7
2015	22	-					4.1
2016	23	-					3.6
2017	24	-					3.2
2018	25	-					2.8
2019	26	-					2.5
2020	27	-					2.2
2021	28	-					1.9
2022	29	-				182.2	1.7
2023	30	-	182.2	0	0	221.3	1.8
	Total	- 986.0	3,969.3	1,083.8	290.8	4,397.0	0

Table 14 Profit and Loss Statement of Case E-9

(Unit: 10^9 Rupiah)

Year	OP Year	Revenue	Expenditure					Profit			Retained Earning
			Variable Cost	Fixed Cost	General	Interest Paid	Total	Before Tax	(Tax)	Net Profit	
1994	1	185.7	37.5	106.9	13.1	62.0	219.6	-33.8	0	-33.8	-33.8
1995	2	225.5	41.7	106.9	13.1	56.8	218.6	7.0	0	7.0	-26.9
1996	3	265.3	46.5	106.9	13.1	48.7	215.3	50.0	10.7	39.4	12.5
1997	4	265.3	45.2	106.9	13.1	39.6	204.8	60.5	27.8	32.7	45.2
1998	5	265.3	43.9	106.9	13.1	30.5	194.4	70.9	32.6	38.3	83.5
1999	6	265.3	43.3	106.9	13.1	20.9	184.2	81.1	37.3	43.8	127.3
2000	7	265.3	43.3	106.9	13.1	12.0	175.3	90.1	41.4	48.6	175.9
2001	8	265.3	43.3	106.9	13.1	4.0	167.3	98.1	45.1	53.0	228.9
2002	9	265.3	43.3	106.9	13.1	0	163.3	102.1	47.0	55.1	284.0
2003	10	265.3	43.3	106.9	13.1	0	163.3	102.1	47.0	55.1	339.1
2004	11	265.3	43.3	77.8	13.1	0	134.2	131.1	60.3	70.8	409.9
2005	12	265.3	43.3	77.8	13.1	0	134.2	131.1	60.3	70.8	480.8
2006	13	265.3	43.3	77.8	13.1	0	134.2	131.1	60.3	70.8	551.6
2007	14	265.3	43.3	77.8	13.1	0	134.2	131.1	60.3	70.8	622.4
2008	15	265.3	43.3	77.8	13.1	0	134.2	131.1	60.3	70.8	693.2
2009	16	265.3	43.3	28.5	13.1	0	84.9	180.4	83.0	97.4	790.7
2010	17	265.3	43.3	28.5	13.1	0	84.9	180.4	83.0	97.4	888.1
2011	18	265.3	43.3	28.5	13.1	0	84.9	180.4	83.0	97.4	985.5
2012	19	265.3	43.3	28.5	13.1	0	84.9	180.4	83.0	97.4	1,082.9
2013	20	265.3	43.3	28.5	13.1	0	84.9	180.4	83.0	97.4	1,180.4
2014	21	265.3	43.3	28.5	13.1	0	84.9	180.4	83.0	97.4	1,277.8
2015	22	265.3	43.3	28.5	13.1	0	84.9	180.4	83.0	97.4	1,375.2
2016	23	265.3	43.3	28.5	13.1	0	84.9	180.4	83.0	97.4	1,472.7
2017	24	265.3	43.3	28.5	13.1	0	84.9	180.4	83.0	97.4	1,570.1
2018	25	265.3	43.3	28.5	13.1	0	84.9	180.4	83.0	97.4	1,667.5
2019	26	265.3	43.3	28.5	13.1	0	84.9	180.4	83.0	97.4	1,764.9
2020	27	265.3	43.3	28.5	13.1	0	84.9	180.4	83.0	97.4	1,862.4
2021	28	265.3	43.3	28.5	13.1	0	84.9	180.4	83.0	97.4	1,959.8
2022	29	265.3	43.3	28.5	13.1	0	84.9	180.4	83.0	97.4	2,057.2
2023	30	265.3	43.3	28.5	13.1	0	84.9	180.4	83.0	97.4	2,154.6
	Total	7,840.9	1,296.4	1,886.2	393.7	274.6	3,850.8	3,990.1	1,835.5	2,154.6	

Table 15 Cash Flow Statement of Case E-9

(Unit: 10^9 Rupiah)

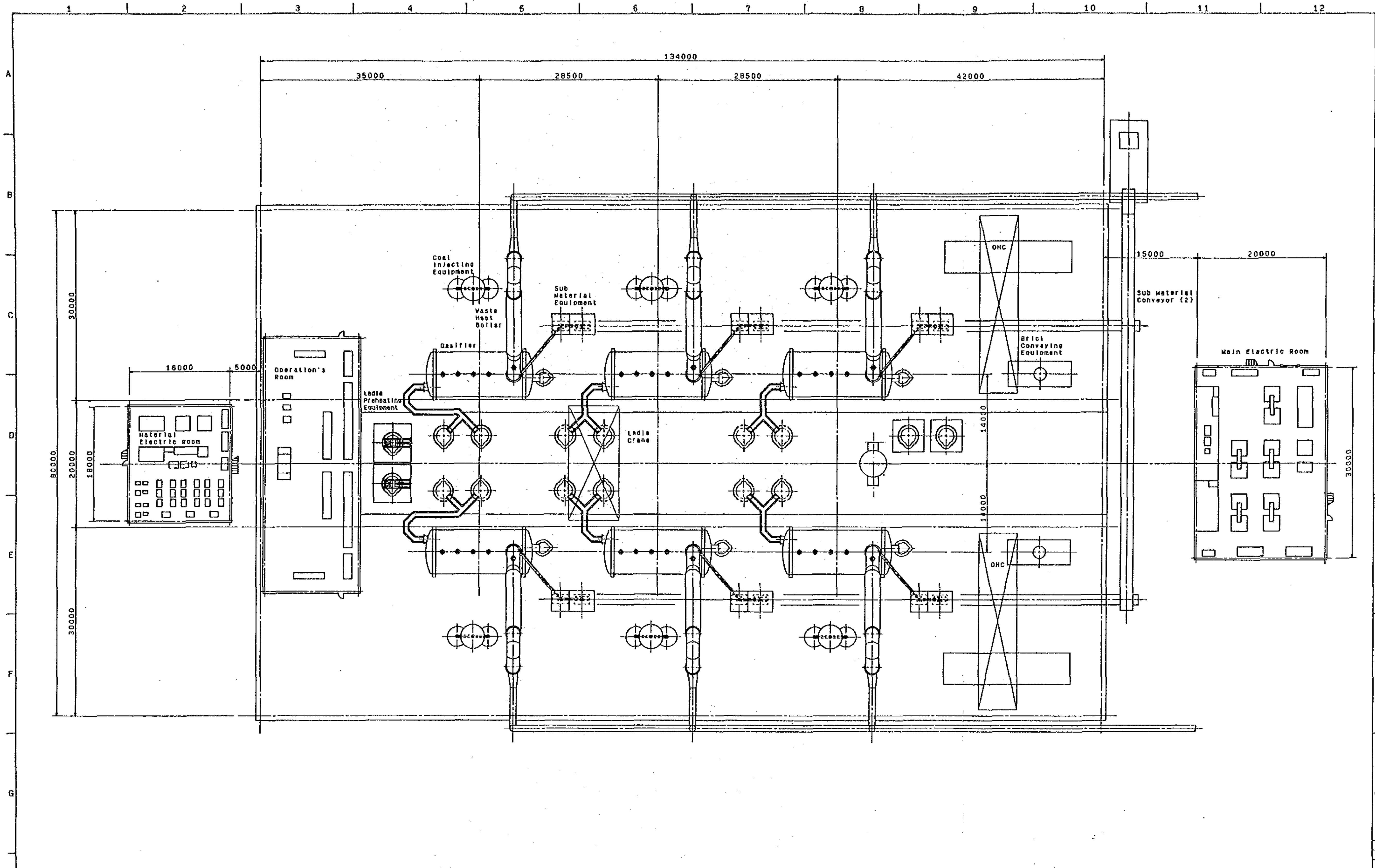
Year	OP Year	Investment	Profit Before Tax	Depreciation/ Amortization	Interest Paid	Cash Flow	DCF (Base; 1985)
1990		-268.1	-	-	-	-268.1	-139.4
1991		-268.1	-	-	-	-268.1	-122.3
1992		-178.7	-	-	-	-178.7	-71.5
1993		-218.8	-	-	-	-218.8	-76.8
1994	1	-	-33.8	78.4	62.0	106.6	32.8
1995	2	-	7.0	78.4	56.8	142.2	38.4
1996	3	-	50.0	78.4	48.7	177.1	42.0
1997	4	-	60.5	78.4	39.6	178.4	37.1
1998	5	-	70.9	78.4	30.5	179.8	32.8
1999	6	-	81.1	78.4	20.9	180.4	28.9
2000	7	-	90.1	78.4	12.0	180.4	25.3
2001	8	-	98.1	78.4	4.0	180.4	22.2
2002	9	-	102.1	78.4	0	180.4	19.5
2003	10	-	102.1	78.4	0	180.4	17.1
2004	11	-	131.1	49.3	0	180.4	15.0
2005	12	-	131.1	49.3	0	180.4	13.2
2006	13	-	131.1	49.3	0	180.4	11.6
2007	14	-	131.1	49.3	0	180.4	10.1
2008	15	-	131.1	49.3	0	180.4	8.9
2009	16	-	180.4	0	0	180.4	7.8
2010	17	-	180.4	0	0	180.4	6.8
2011	18	-	180.4	0	0	180.4	6.0
2012	19	-	180.4	0	0	180.4	5.3
2013	20	-	180.4	0	0	180.4	4.6
2014	21	-	180.4	0	0	180.4	4.1
2015	22	-	180.4	0	0	180.4	3.6
2016	23	-	180.4	0	0	180.4	3.1
2017	24	-	180.4	0	0	180.4	2.7
2018	25	-	180.4	0	0	180.4	2.4
2019	26	-	180.4	0	0	180.4	2.1
2020	27	-	180.4	0	0	180.4	1.9
2021	28	-	180.4	0	0	180.4	1.6
2022	29	-	180.4	0	0	180.4	1.4
2023	30	-	180.4	0	0	214.2	1.5
	Total	-933.7	3,990.1	1,029.9	274.6	4,394,7	0

ATTACHMENT 11-1

1. Figures for Conceptual Design of On-site Facilities

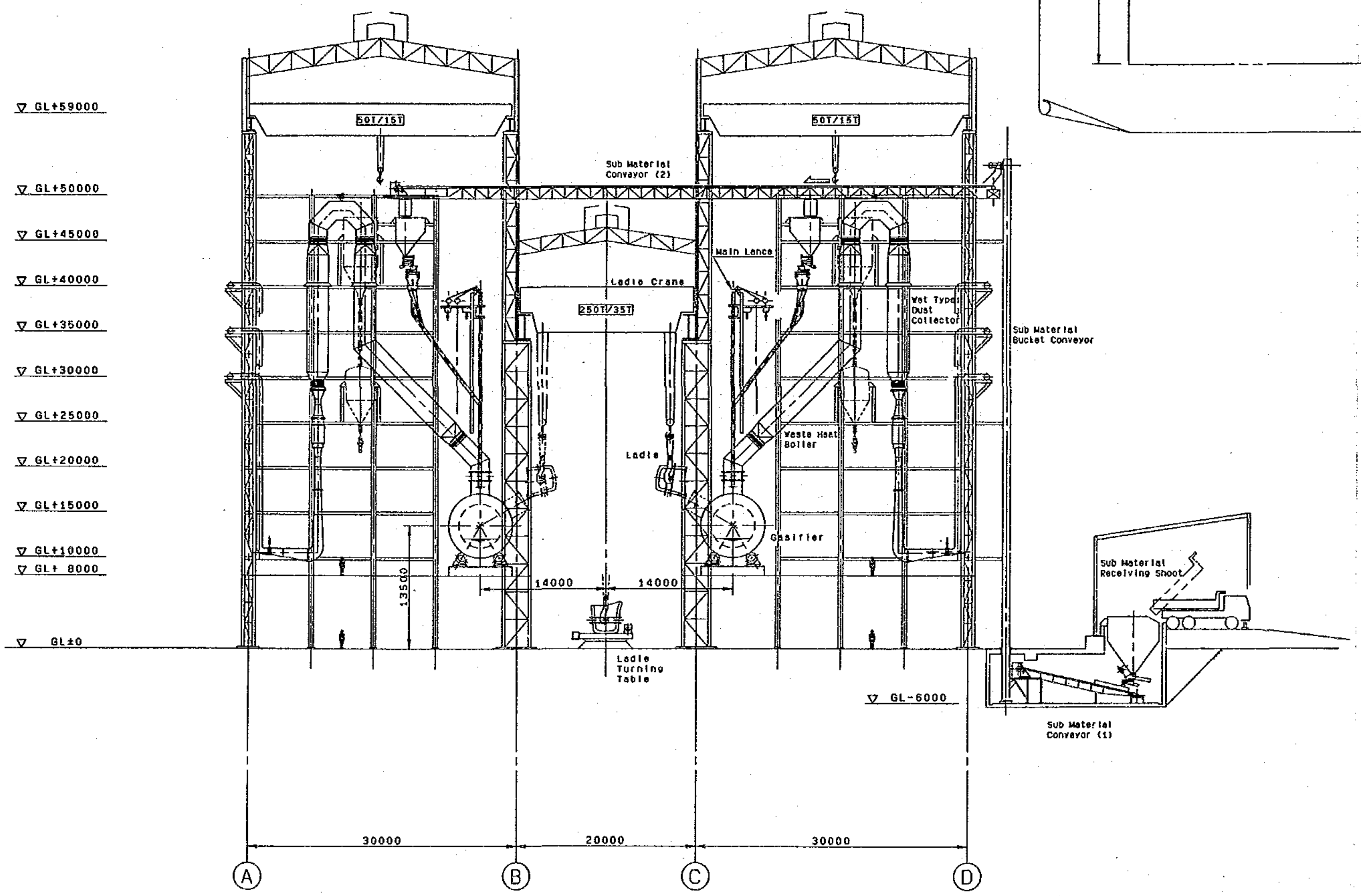
2. Equipment List (Gasification Plant)

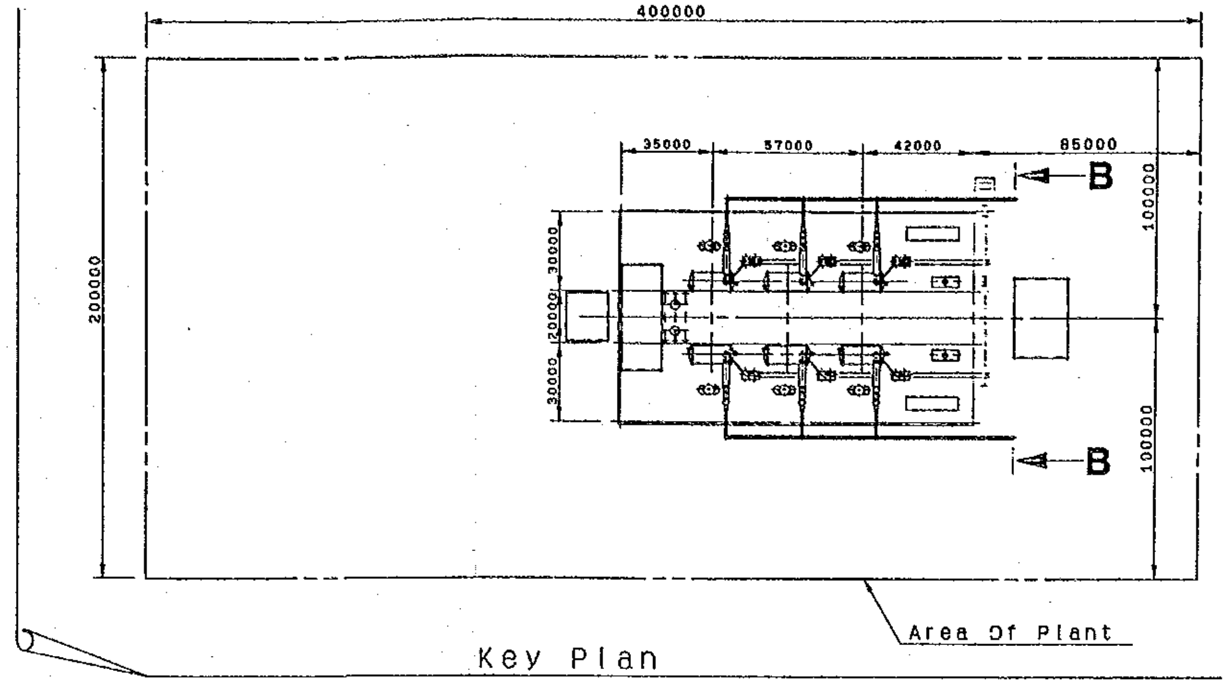
1. Figures for Conceptual Design of On-site Facilities



COMPUTER AIDED DESIGN

DATE Oct. 1988	MANAGER OF DEP.	Banko Coal Gasification Plant	WORK NO P3066
SCALE 1:300	MANAGER / CHIEF	Top View Of Gasifier Building	DRAWING NO Fig. 11-1-4
	CHECKED BY / DRAWN BY	JAPAN INTERNATIONAL COOPERATION AGENCY	

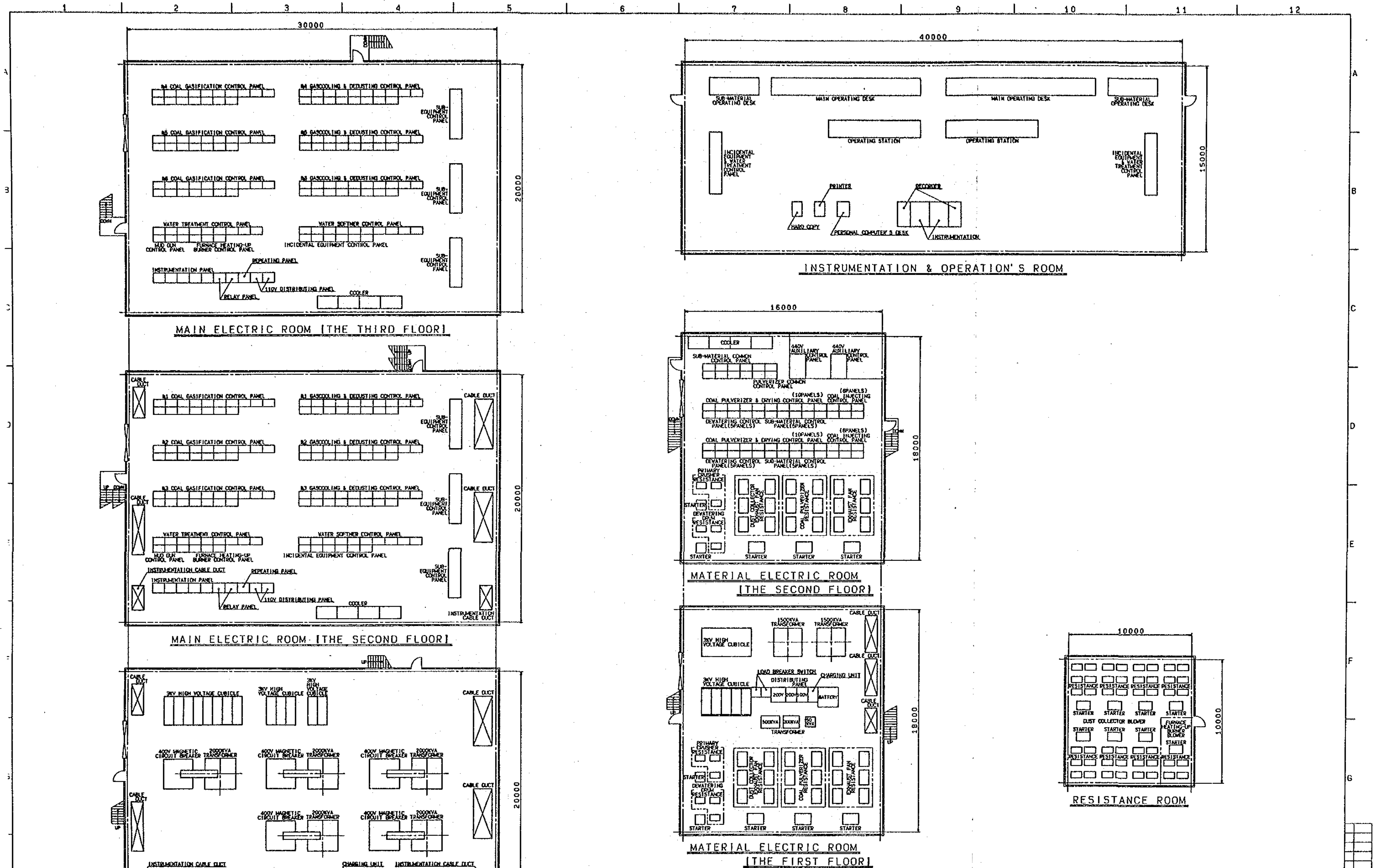




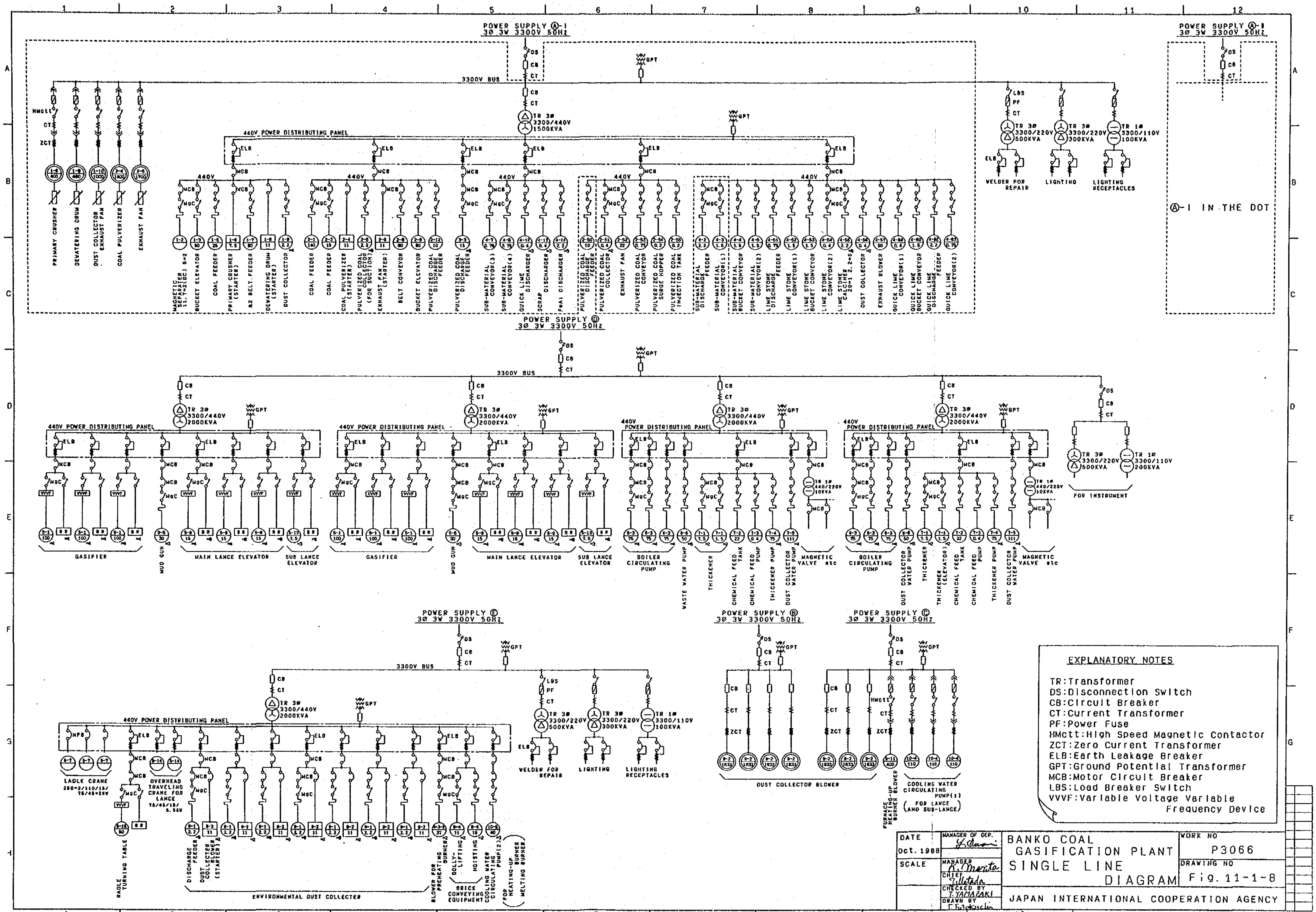
SECTION B-B

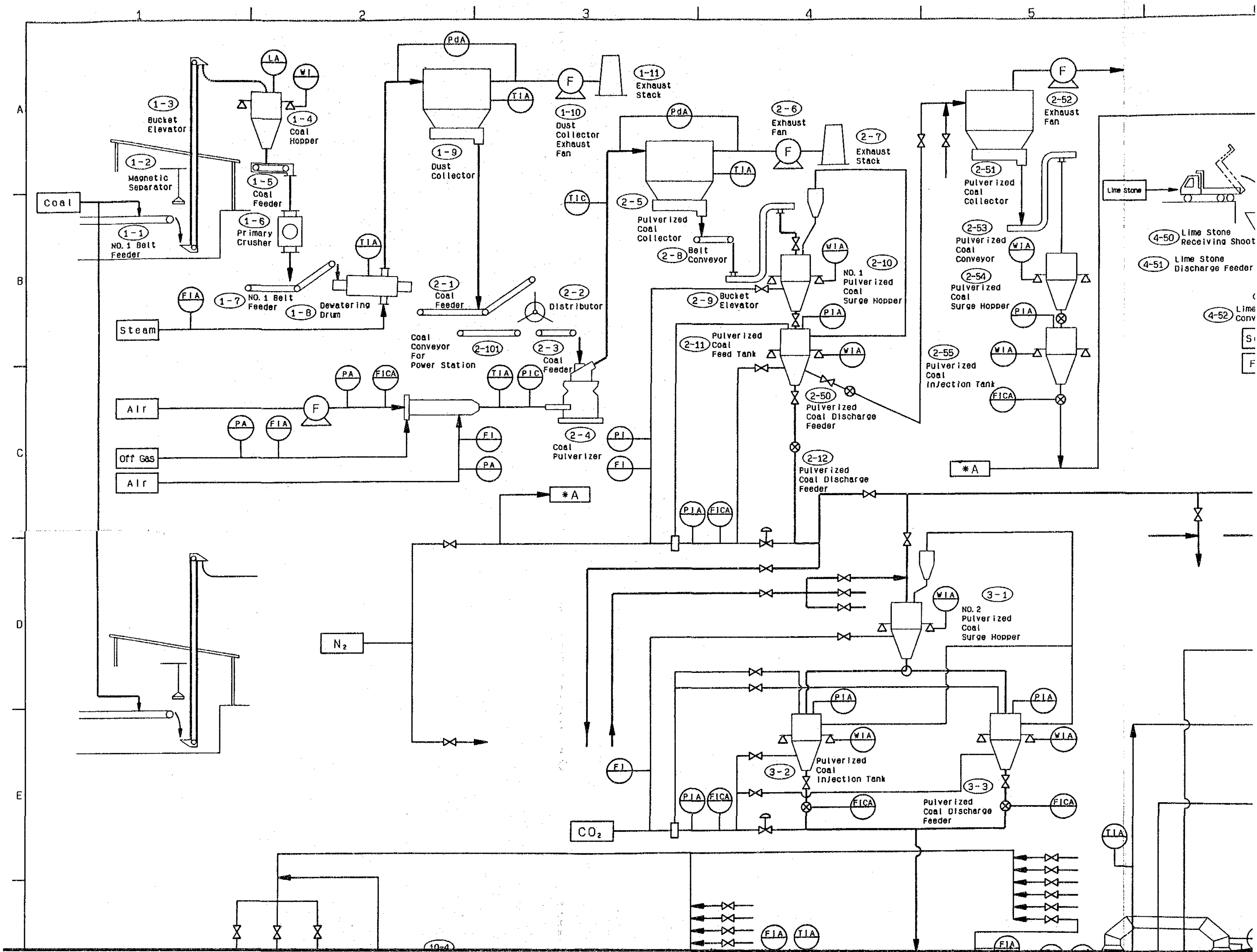
COMPUTER AIDED DESIGN

DATE Oct. 1988	MANAGER OF DEP.	Banko Coal Gasification Plant Cross Section View Of Gasifier Building (Section B-B)	WORK NO P3066
SCALE 1:300	MANAGER CHIEF		DRAWING NO Fig. 11-1-6
	CHECKED BY DRAWN BY	JAPAN INTERNATIONAL COOPERATION AGENCY	

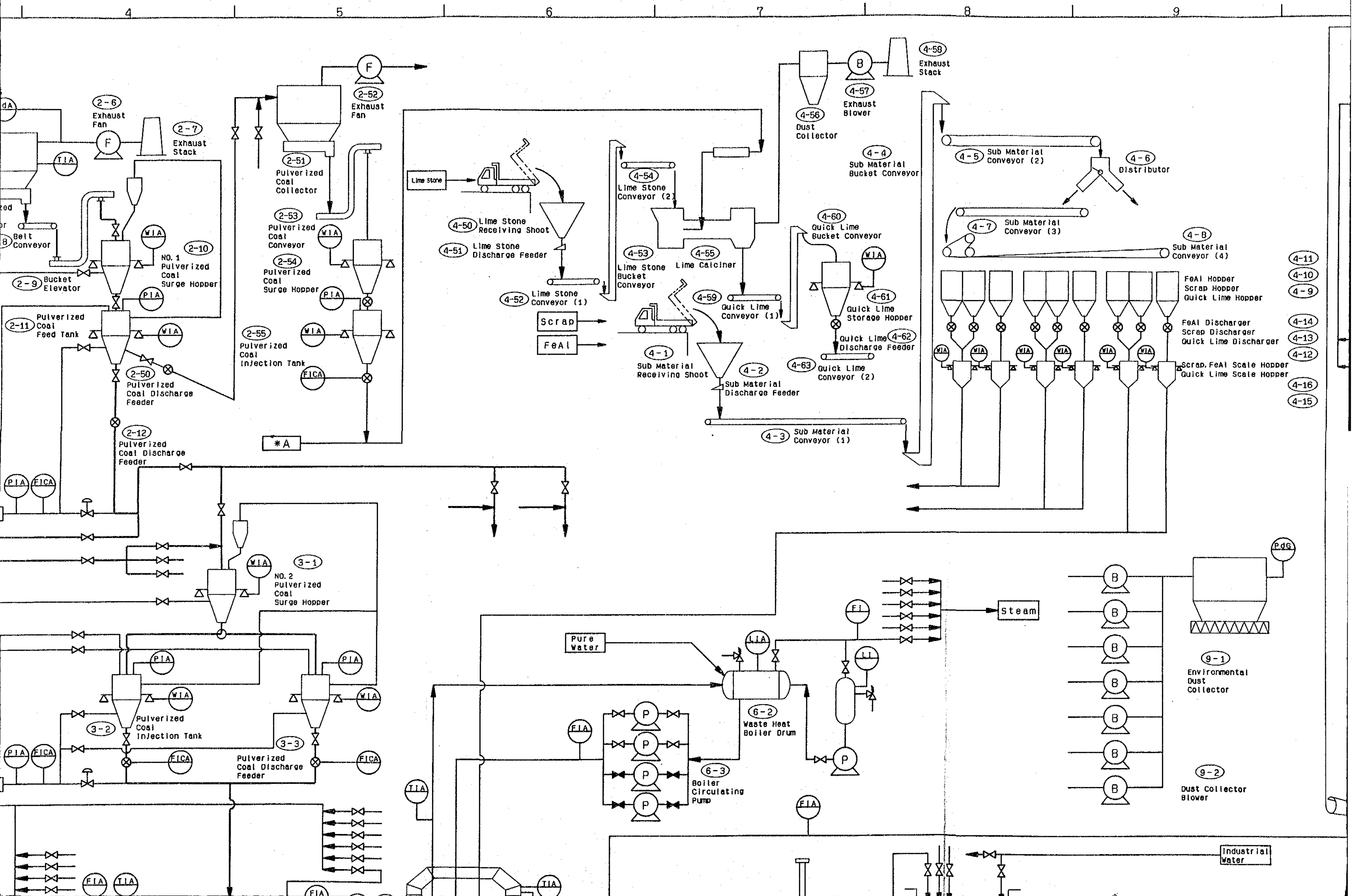


DATE	MANAGER OF DEP.	BANKO COAL GASIFICATION PLANT	WORK NO
Oct. 1988			P3066
SCALE	MANAGER	LAYOUT OF ELECTRIC ROOM	DRAWING NO
1:150	CHIEF		Fig. 11-1-7
	CHECKED BY T.YAMAZAKI	JAPAN INTERNATIONAL COOPERATION AGENCY	
	DRAWN BY		

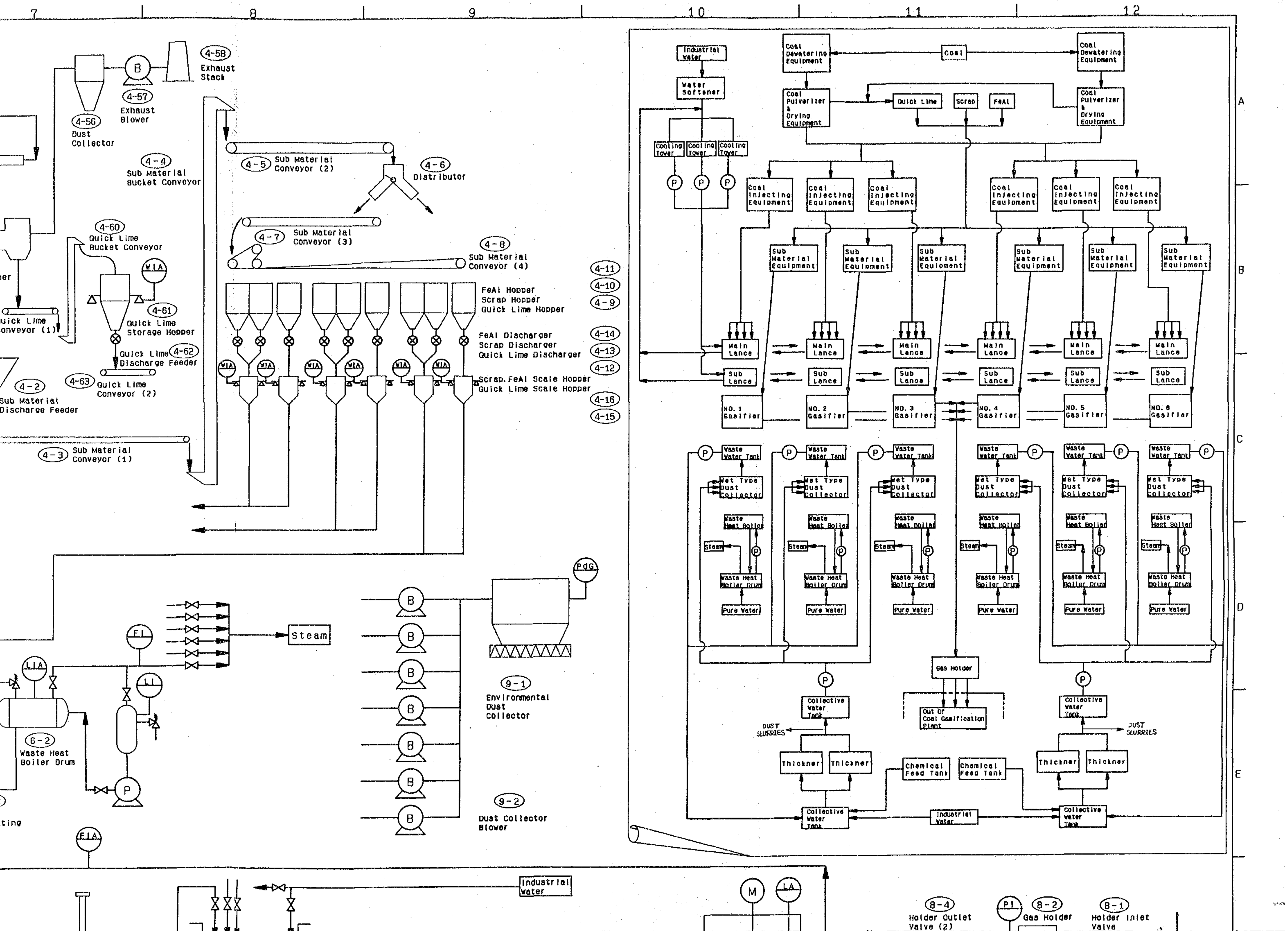

POWER SUPPLY Ⓐ-I
3Ø 3W 3300V 50Hz
3300V BUS
TR 3Ø 3300/440V 1500KVA
440V POWER DISTRIBUTING PANEL
Ⓐ-I IN THE DOT
POWER SUPPLY Ⓓ
3Ø 3W 3300V 50Hz
TR 3Ø 3300/440V 2000KVA
GASIFIER
MUD GUN
MAIN LANCE ELEVATOR
SUB LANCE ELEVATOR
BOILER CIRCULATING PUMP
FOR INSTRUMENT
POWER SUPPLY Ⓒ
3Ø 3W 3300V 50Hz
POWER SUPPLY Ⓑ
3Ø 3W 3300V 50Hz
LADLE CRANE
OVERHEAD TRAVELING CRANE FOR LANCE
LADLE TURNING TABLE
ENVIRONMENTAL DUST COLLECTER
WELDER FOR REPAIR
LIGHTING
LIGHTING RECEPTACLES
DUST COLLECTOR BLOWER
EXPLANATORY NOTES
TR:Transformer
DS:Disconnection Switch
CB:Circuit Breaker
CT:Current Transformer
PF:Power Fuse
HMctt:High Speed Magnetic Contactor
ZCT:Zero Current Transformer
ELB:Earth Leakage Breaker
GPT:Ground Potential Transformer
MCB:Motor Circuit Breaker
LBS:Load Breaker Switch
VVVF:Variable Voltage Variable Frequency Device
DATE Oct. 1988
SCALE
BANKO COAL GASIFICATION PLANT SINGLE LINE DIAGRAM
WORK NO P3066
DRAWING NO Fig. 11-1-8
JAPAN INTERNATIONAL COOPERATION AGENCY



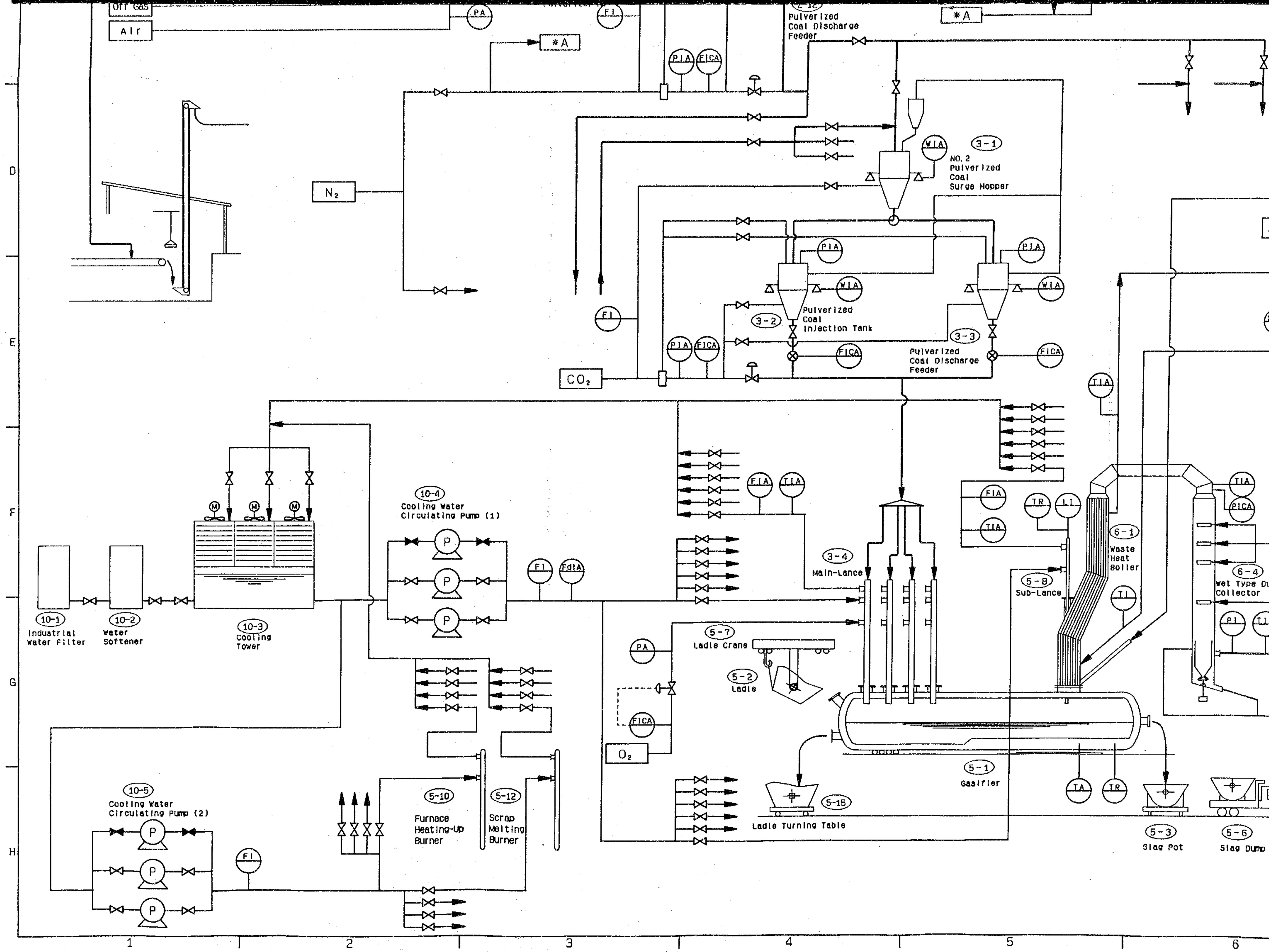
1
2
3
4
5
A
B
C
D
E
Coal
(1-1) NO. 1 Belt Feeder
(1-2) Magnetic Separator
(1-3) Bucket Elevator
(1-4) Coal Hopper
(1-5) Coal Feeder
(1-6) Primary Crusher
(1-7) NO. 1 Belt Feeder
(1-8) Dewatering Drum
(1-9) Dust Collector
(1-10) Dust Collector Exhaust Fan
(1-11) Exhaust Stack
Steam
Air
Off Gas
Air
(2-1) Coal Feeder
(2-2) Distributor
(2-3) Coal Feeder
(2-101) Coal Conveyor For Power Station
(2-4) Coal Pulverizer
(2-5) Pulverized Coal Collector
(2-6) Exhaust Fan
(2-7) Exhaust Stack
(2-8) Belt Conveyor
(2-9) Bucket Elevator
(2-10) NO. 1 Pulverized Coal Surge Hopper
(2-11) Pulverized Coal Feed Tank
(2-50) Pulverized Coal Discharge Feeder
(2-12) Pulverized Coal Discharge Feeder
(2-51) Pulverized Coal Collector
(2-52) Exhaust Fan
(2-53) Pulverized Coal Conveyor
(2-54) Pulverized Coal Surge Hopper
(2-55) Pulverized Coal Injection Tank
Lime Stone
(4-50) Lime Stone Receiving Shoot
(4-51) Lime Stone Discharge Feeder
(4-52) Lime Conv
*A
*A
N_2
CO_2
(3-1) NO. 2 Pulverized Coal Surge Hopper
(3-2) Pulverized Coal Injection Tank
(3-3) Pulverized Coal Discharge Feeder
LA
WI
PdA
TIA
TIC
PIA
WIA
FIA
FICA
PA
PIC
FI
PI
F
(10-4)



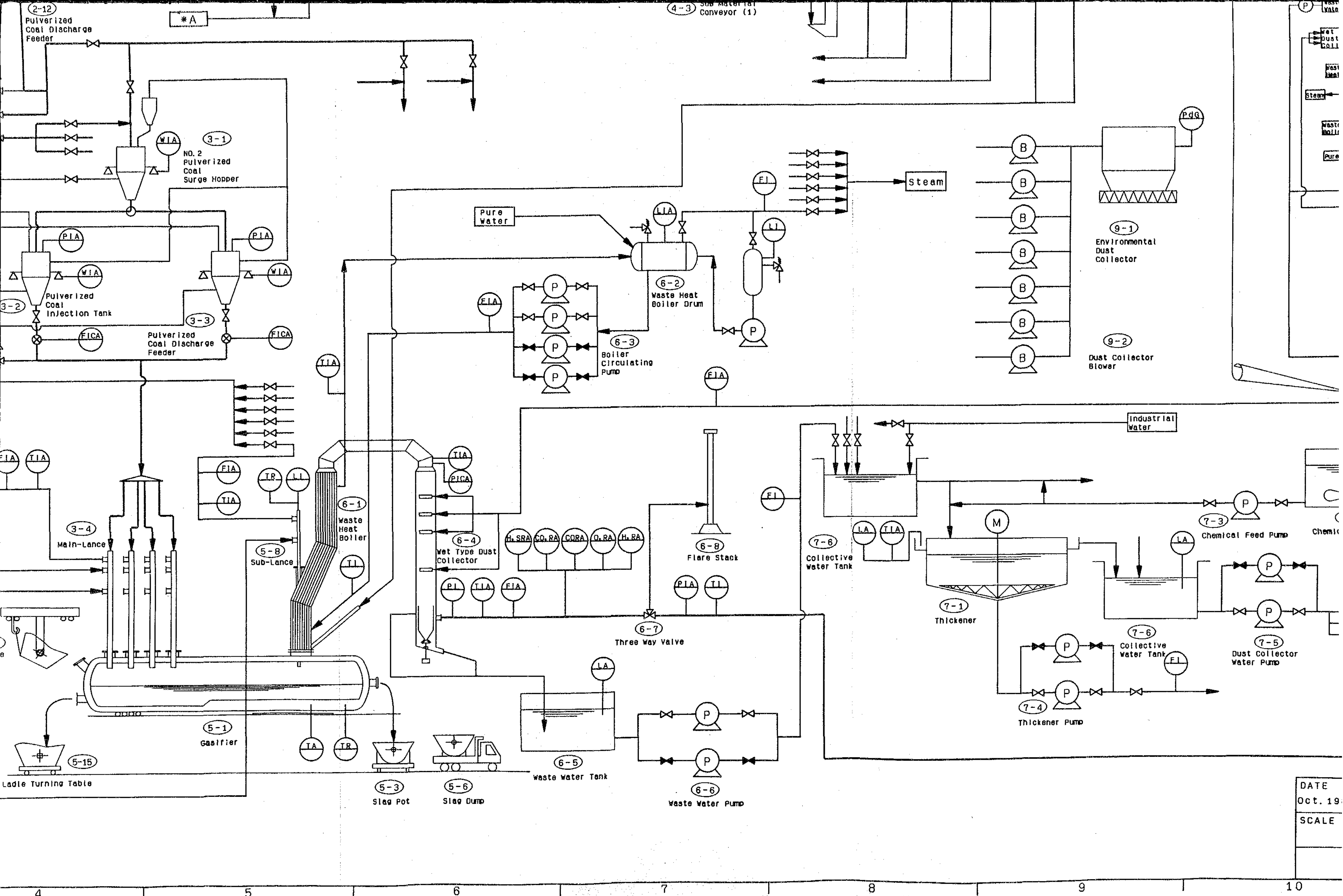
4
5
6
7
8
9
2-6 Exhaust Fan
2-7 Exhaust Stack
Belt Conveyor
2-9 Bucket Elevator
2-10 NO. 1 Pulverized Coal Surge Hopper
2-11 Pulverized Coal Feed Tank
2-50 Pulverized Coal Discharge Feeder
2-12 Pulverized Coal Discharge Feeder
2-51 Pulverized Coal Collector
2-52 Exhaust Fan
2-53 Pulverized Coal Conveyor
2-54 Pulverized Coal Surge Hopper
2-55 Pulverized Coal Injection Tank
*A
Lime Stone
4-50 Lime Stone Receiving Shoot
4-51 Lime Stone Discharge Feeder
4-52 Lime Stone Conveyor (1)
Scrap
FeAl
4-54 Lime Stone Conveyor (2)
4-53 Lime Stone Bucket Conveyor
4-55 Lime Calciner
4-59 Quick Lime Conveyor (1)
4-1 Sub Material Receiving Shoot
4-2 Sub Material Discharge Feeder
4-3 Sub Material Conveyor (1)
4-56 Dust Collector
4-57 Exhaust Blower
4-58 Exhaust Stack
4-4 Sub Material Bucket Conveyor
4-60 Quick Lime Bucket Conveyor
4-61 Quick Lime Storage Hopper
4-62 Quick Lime Discharge Feeder
4-63 Quick Lime Conveyor (2)
4-5 Sub Material Conveyor (2)
4-6 Distributor
4-7 Sub Material Conveyor (3)
4-8 Sub Material Conveyor (4)
FeAl Hopper 4-11
Scrap Hopper 4-10
Quick Lime Hopper 4-9
FeAl Discharger 4-14
Scrap Discharger 4-13
Quick Lime Discharger 4-12
Scrap, FeAl Scale Hopper 4-16
Quick Lime Scale Hopper 4-15
3-1 NO. 2 Pulverized Coal Surge Hopper
3-2 Pulverized Coal Injection Tank
3-3 Pulverized Coal Discharge Feeder
Pure Water
6-2 Waste Heat Boiler Drum
6-3 Boiler Circulating Pump
Steam
9-1 Environmental Dust Collector
9-2 Dust Collector Blower
Industrial Water
TIA
WIA
PIA
FICA
FIA
LIA
LI
FI
PdG
F
B
P



4-58 Exhaust Stack
4-57 Exhaust Blower
4-56 Dust Collector
4-4 Sub Material Bucket Conveyor
4-5 Sub Material Conveyor (2)
4-6 Distributor
4-60 Quick Lime Bucket Conveyor
4-7 Sub Material Conveyor (3)
4-8 Sub Material Conveyor (4)
4-61 Quick Lime Storage Hopper
4-62 Quick Lime Discharge Feeder
4-63 Quick Lime Conveyor (2)
4-2 Sub Material Discharge Feeder
4-3 Sub Material Conveyor (1)
Quick Lime Conveyor (1)
4-11 4-10 4-9 FeAl Hopper Scrap Hopper Quick Lime Hopper
4-14 4-13 4-12 FeAl Discharger Scrap Discharger Quick Lime Discharger
4-16 4-15 Scrap.FeAl Scale Hopper Quick Lime Scale Hopper
WIA
Steam
FI
LIA
LI
6-2 Waste Heat Boiler Drum
FIA
9-1 Environmental Dust Collector
9-2 Dust Collector Blower
PdG
Industrial Water
Water Softener
Cooling Tower
Coal Dewatering Equipment
Coal
Coal Pulverizer & Drying Equipment
Quick Lime
Scrap
FeAl
Coal Injecting Equipment
Sub Material Equipment
Main Lance
Sub Lance
NO. 1 Gasifier
NO. 2 Gasifier
NO. 3 Gasifier
NO. 4 Gasifier
NO. 5 Gasifier
NO. 6 Gasifier
Waste Water Tank
Wet Type Dust Collector
Waste Heat Boiler
Waste Heat Boiler Drum
Pure Water
Gas Holder
Out of Coal Gasification Plant
Collective Water Tank
DUST SLURRIES
Thickner
Chemical Feed Tank
Industrial Water
M
LA
8-4 Holder Outlet Valve (2)
PI
8-2 Gas Holder
8-1 Holder Inlet Valve



Off Gas
Air
PA
FI
*A
Pulverized
Coal Discharge
Feeder
PIA
FICA
N2
WIA
3-1
NO. 2
Pulverized
Coal
Surge Hopper
PIA
WIA
3-2
Pulverized
Coal
Injection Tank
3-3
Pulverized
Coal Discharge
Feeder
FICA
CO2
TIA
FIA
3-4
Main-Lance
TR
LI
6-1
Waste
Heat
Boiler
PICA
6-4
Wet Type Dust
Collector
5-8
Sub-Lance
TI
PI
10-4
Cooling Water
Circulating Pump (1)
FdIA
10-1
Industrial
Water Filter
10-2
Water
Softener
10-3
Cooling
Tower
5-7
Ladle Crane
5-2
Ladle
O2
5-1
Gasifier
TA
5-15
Ladle Turning Table
5-3
Slag Pot
5-6
Slag Dump
10-5
Cooling Water
Circulating Pump (2)
5-10
Furnace
Heating-Up
Burner
5-12
Scrap
Melting
Burner
D
E
F
G
H
1
2
3
4
5
6



2-12
Pulverized Coal Discharge Feeder
*A
4-3
Sub Material Conveyor (1)
3-1
NO. 2 Pulverized Coal Surge Hopper
WIA
PIA
FICA
3-2
Pulverized Coal Injection Tank
3-3
Pulverized Coal Discharge Feeder
3-4
Main-Lance
5-8
Sub-Lance
5-1
Gasifier
5-15
Ladle Turning Table
5-3
Slag Pot
5-6
Slag Dump
TA
TR
LI
TI
TIA
FIA
PI
PICA
6-1
Waste Heat Boiler
6-2
Waste Heat Boiler Drum
6-3
Boiler Circulating Pump
6-4
Wet Type Dust Collector
6-5
Waste Water Tank
6-6
Waste Water Pump
6-7
Three Way Valve
6-8
Flare Stack
Pure Water
Steam
LIA
FI
LA
PdG
H₂SRA
CO₂RA
CORA
O₂RA
H₂RA
9-1
Environmental Dust Collector
9-2
Dust Collector Blower
Industrial Water
7-1
Thickener
7-3
Chemical Feed Pump
7-4
Thickener Pump
7-5
Dust Collector Water Pump
7-6
Collective Water Tank
M
B
P
DATE
Oct. 19
SCALE
4
5
6
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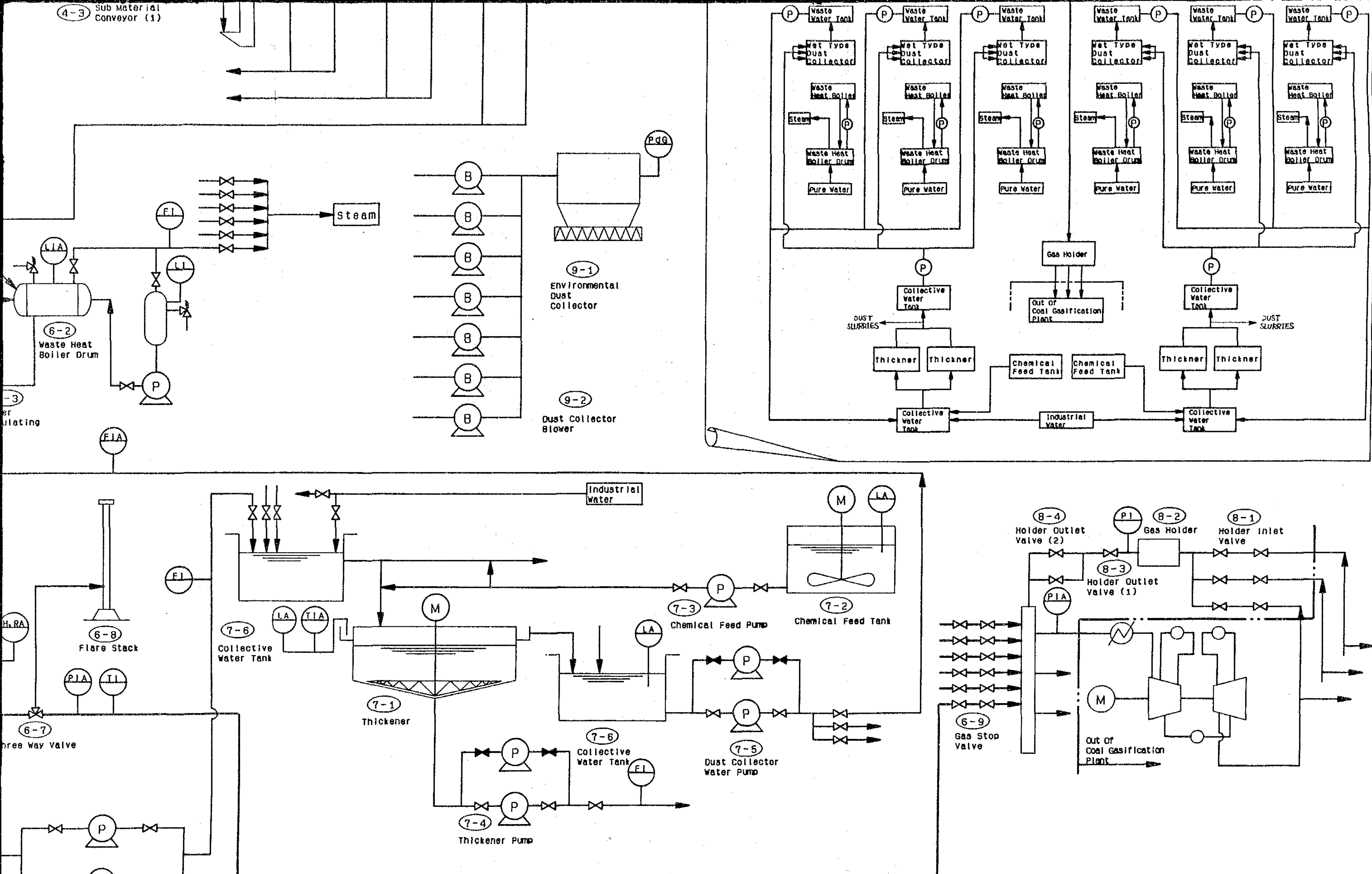
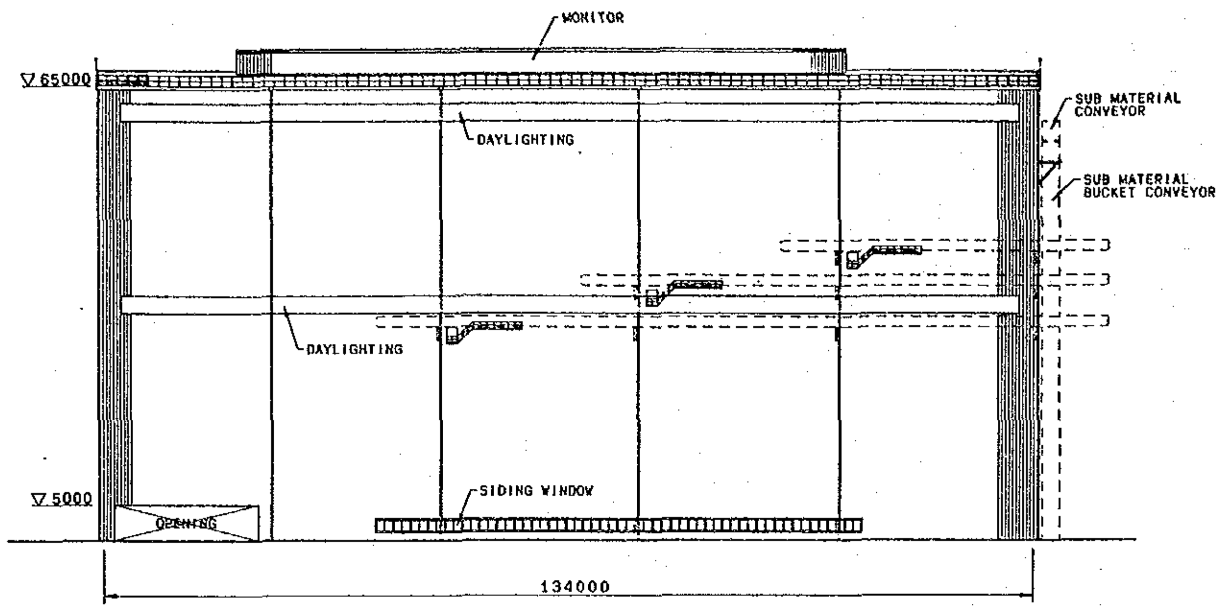
10



COMPUTER AIDED DESIGN

DATE Oct. 1988	MANAGER OF DEP.	Banko Coal Gasification Plant	WORK NO	P3066
SCALE	MANAGER / CHIEF / CHECKED BY / DRAWN BY	Piping And Instrumentation Diagram	DRAWING NO	Fig. 11-1-9
		JAPAN INTERNATIONAL COOPERATION AGENCY		

7 8 9 10 11 12



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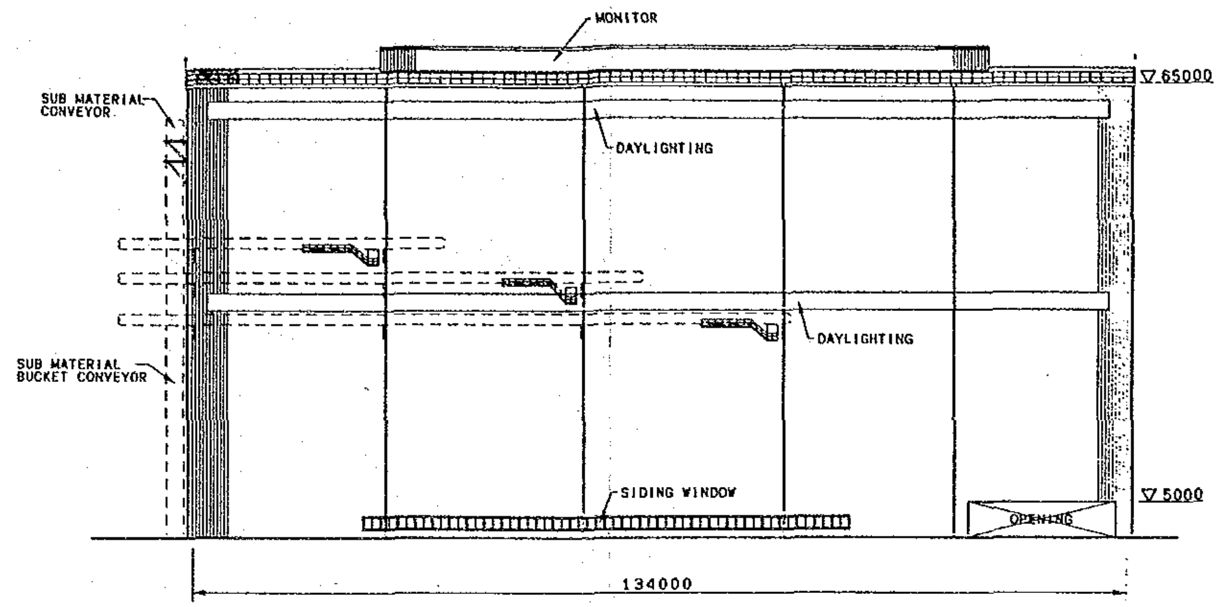

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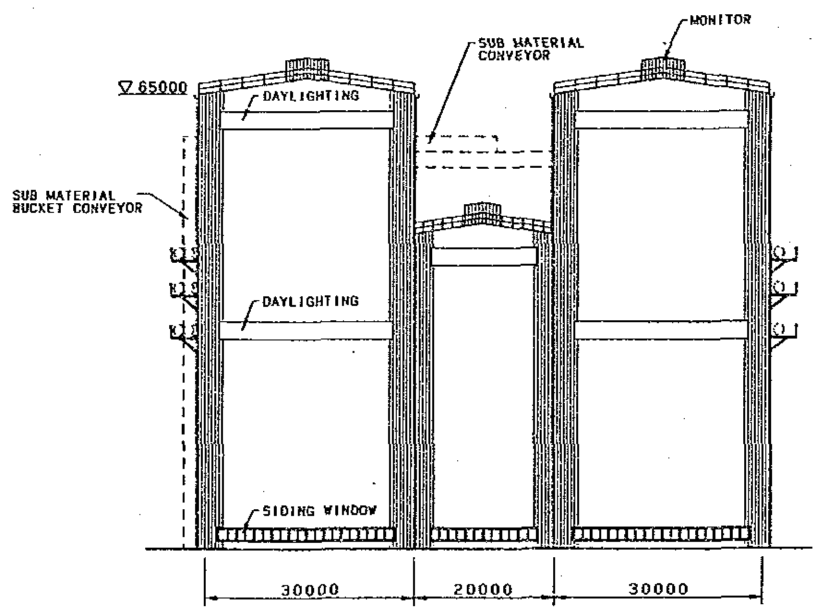
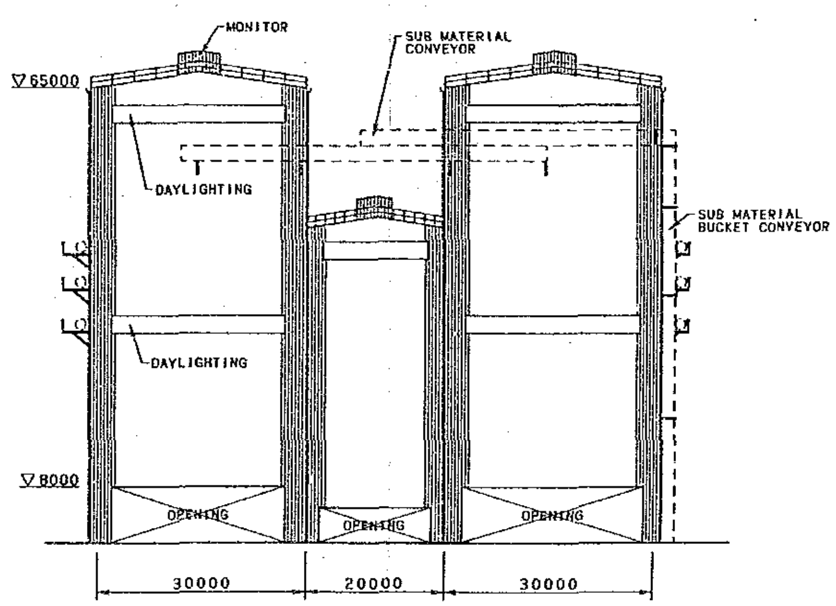
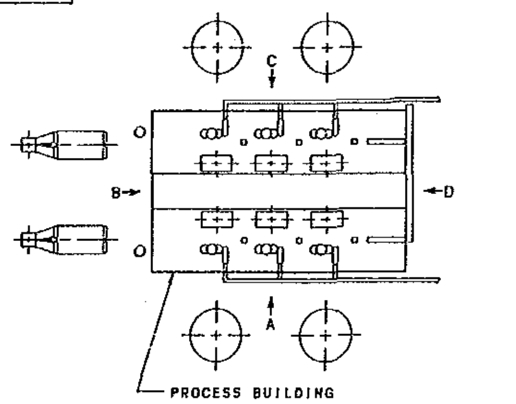


ELEVATION "B"



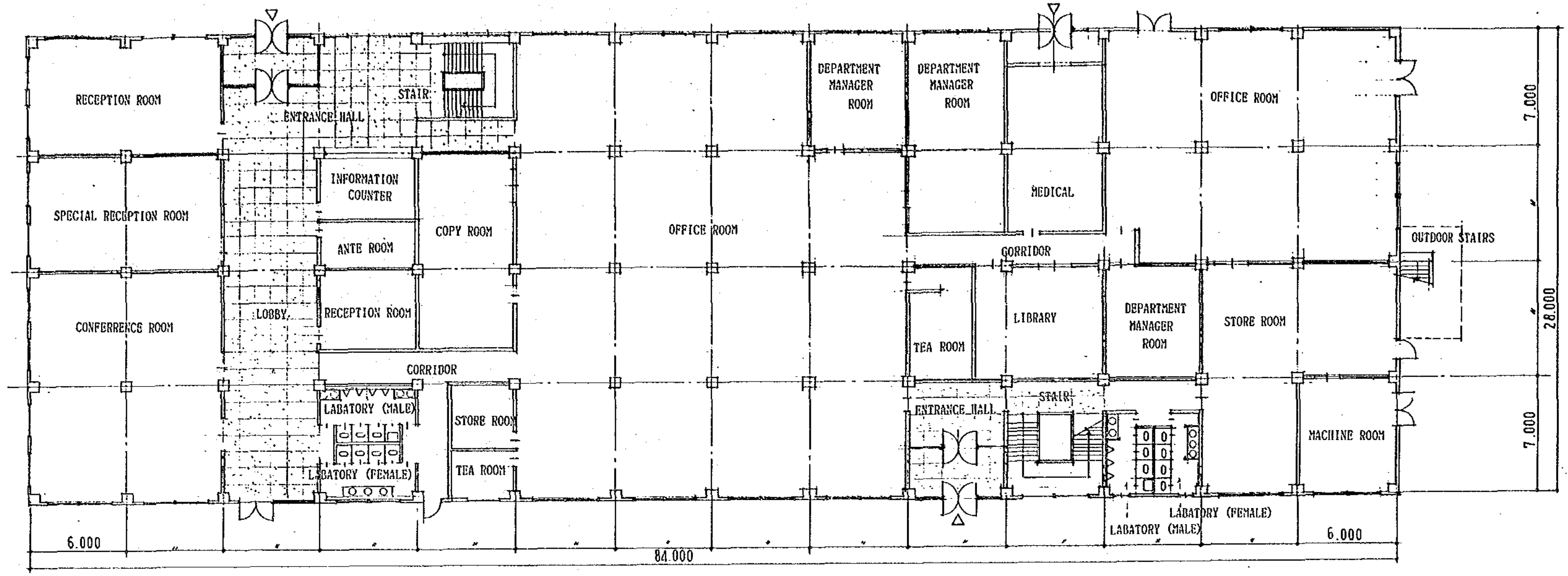
ELEVATION "D"

KEY PLAN

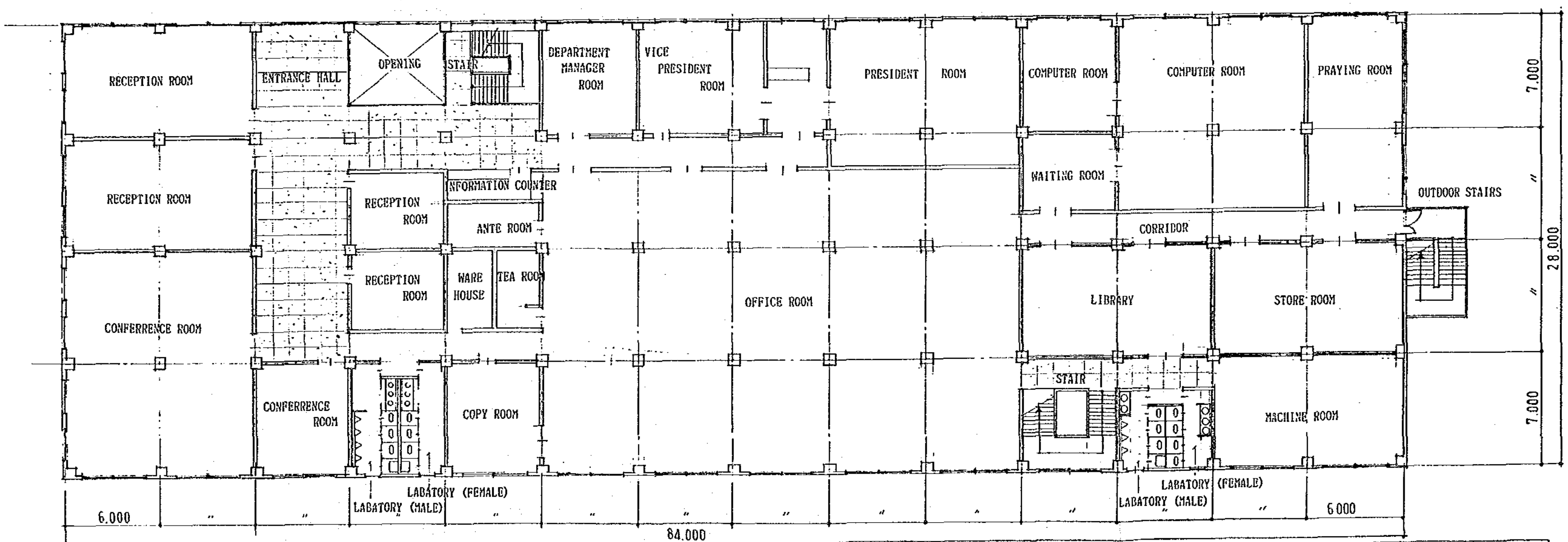


REVISION		
NO	DATE	DESCRIPTION

DATE	MANAGER OF DEP.	Banko Coal Gasification Plant	WORK NO P 3066
SCALE 1/500	MANAGER Y. Amemiya	Process Building (Elevation)	DRAWING NO FIG-11-1-10
	CHIEF T. Inoue / CHECKED BY / DRAWN BY	JAPAN INTERNATIONAL CORPORATION AGENCY	



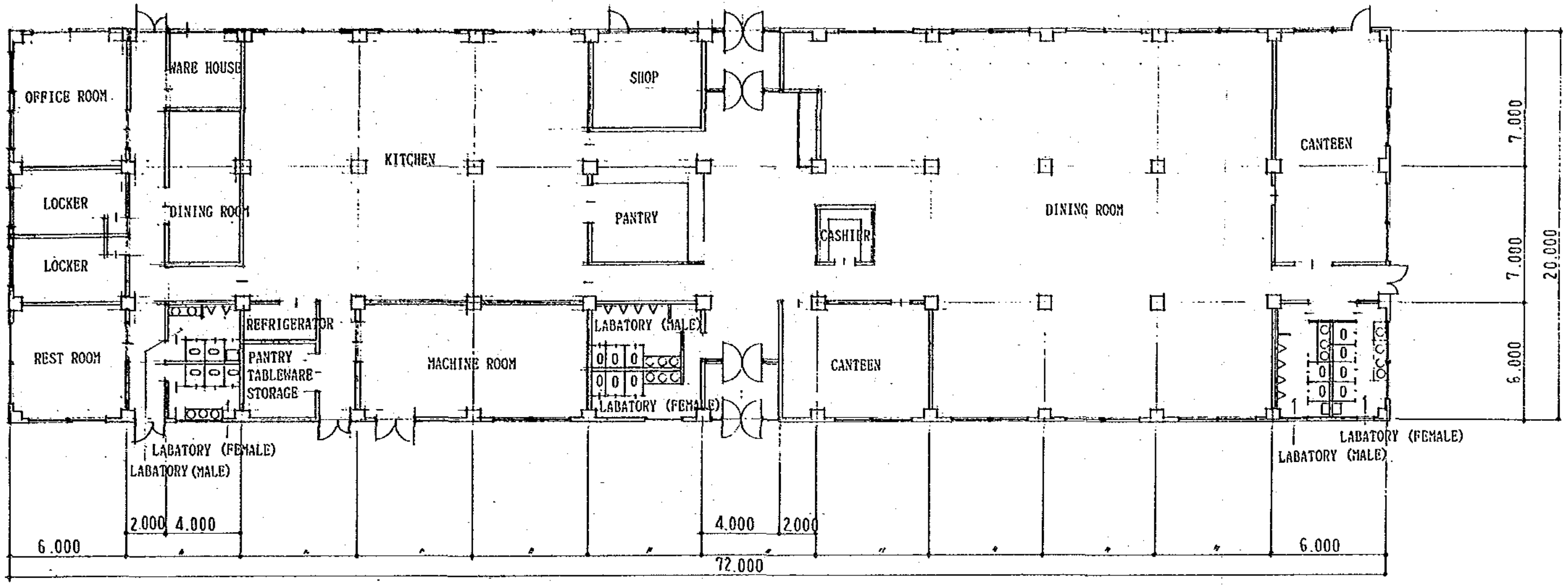
1ST FLOOR PLAN SCALE 1:200



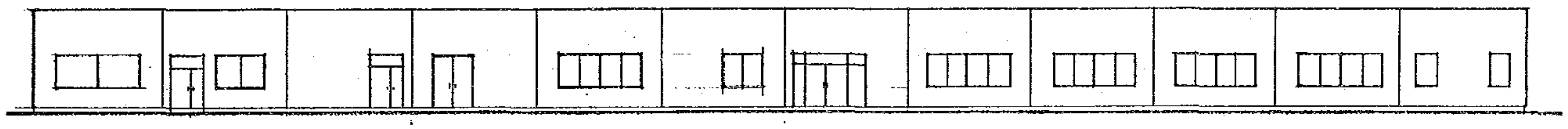
2ND FLOOR PLAN SCALE 1:200

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 11-1-34 Administration Office



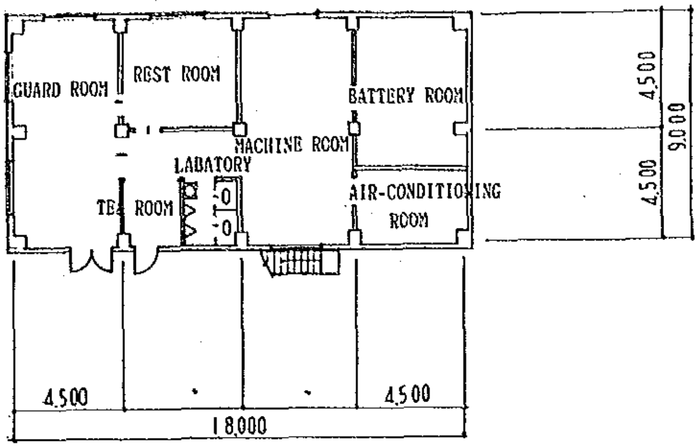
1ST FLOOR PLAN SCALE 1:200



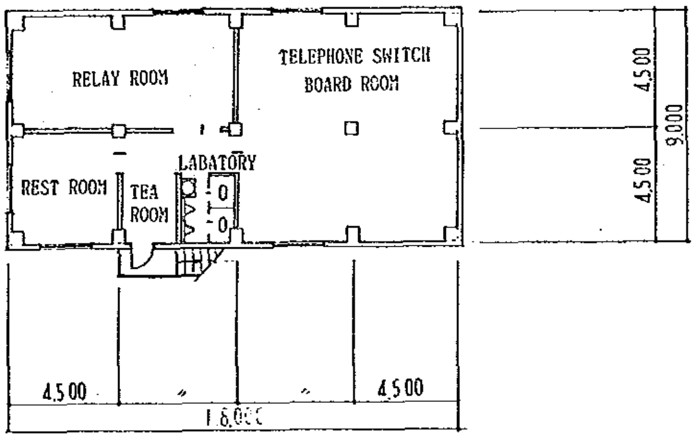
ELEVATION SCALE 1:200

JAPAN INTERNATIONAL COOPERATION AGENCY

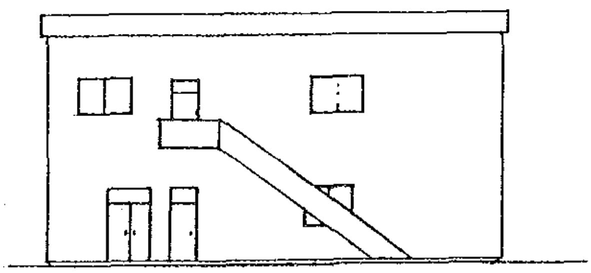
Fig. 11-1-35 Dining Building



1ST FLOOR PLAN SCALE 1:200



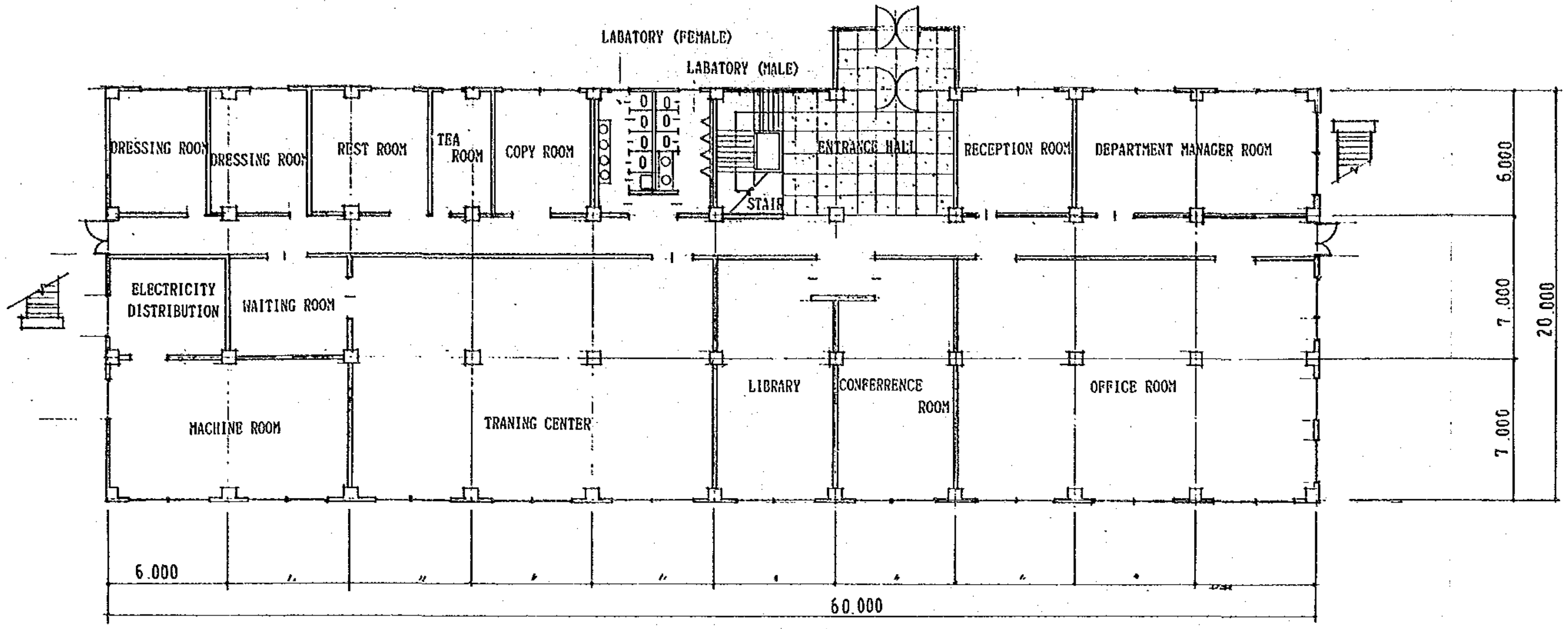
2ND FLOOR PLAN SCALE 1:200



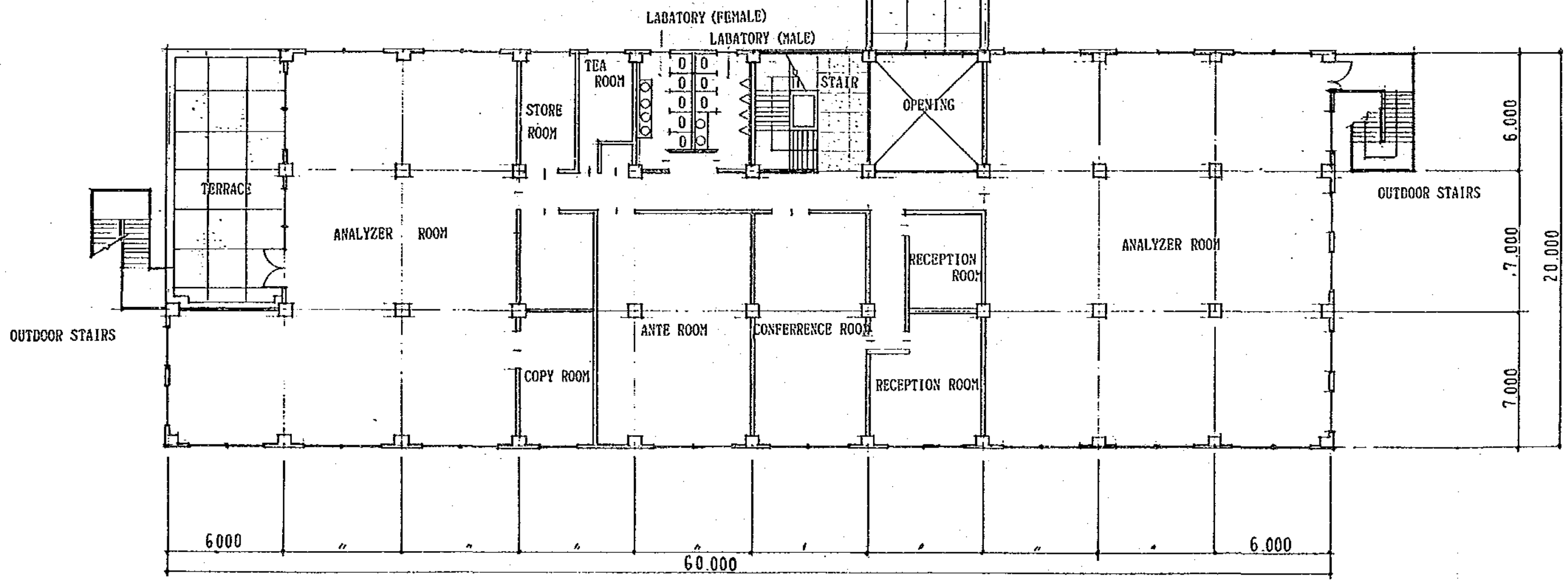
FLOOR PLAN SCALE 1:200

JAPAN INTERNATIONAL COOPERATION AGENCY
Fig. 11-1-36 Gate House

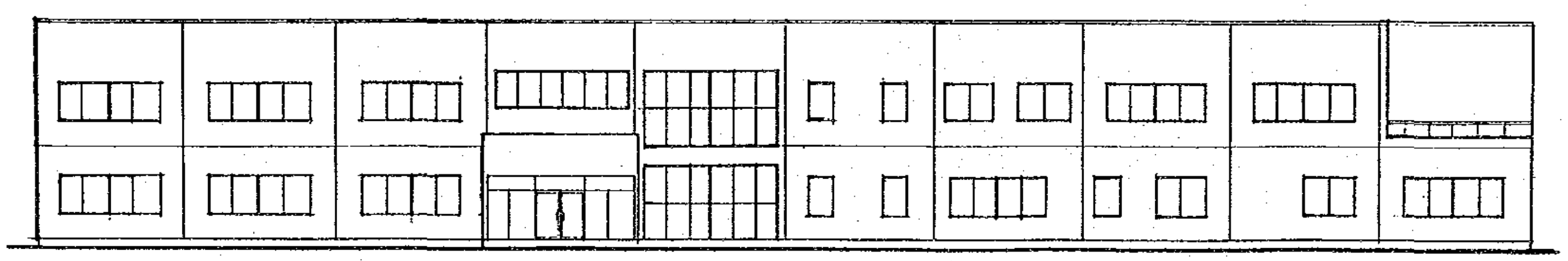
2. Equipment List (Gasification Plant)



1ST FLOOR PLAN SCALE 1:200



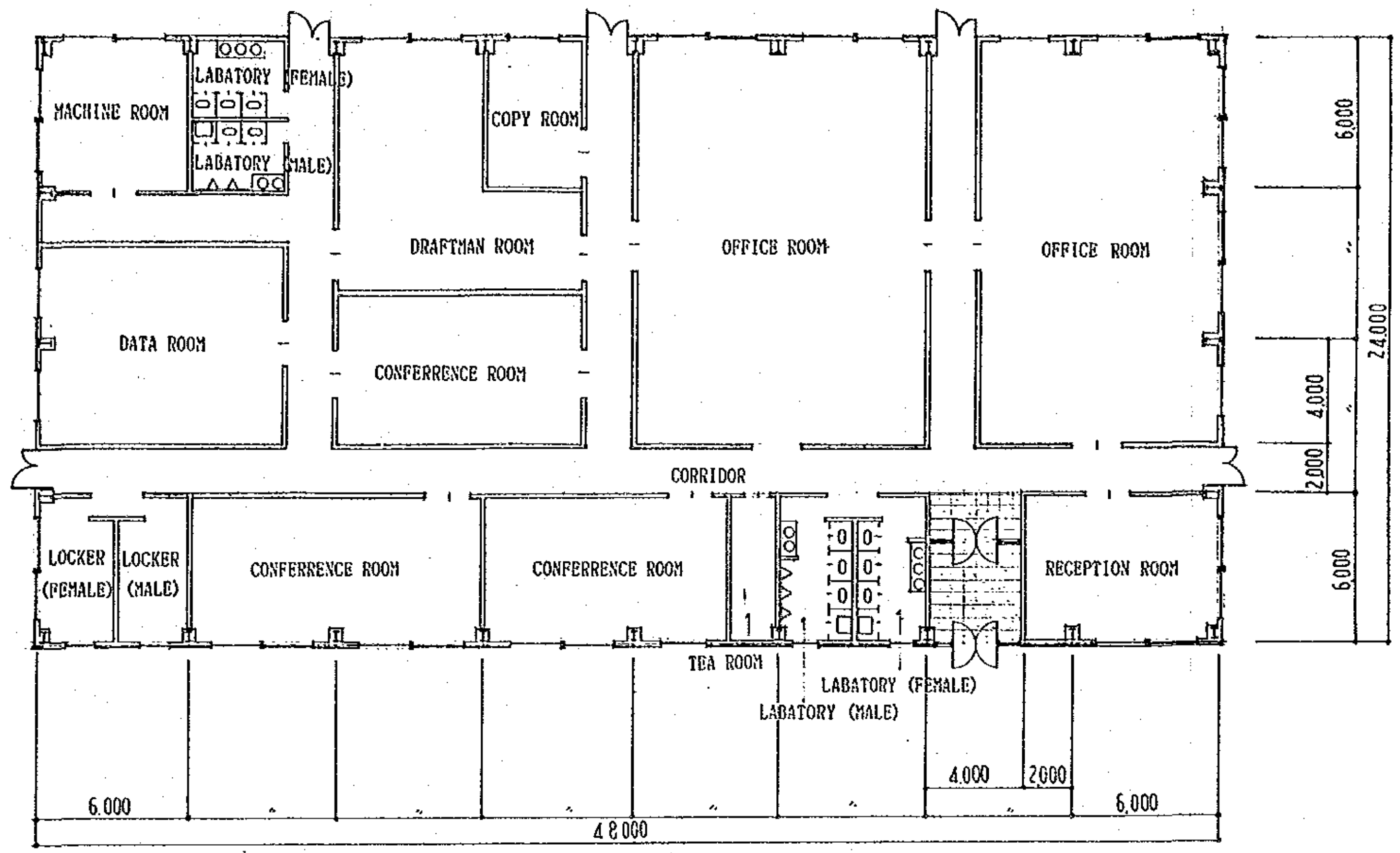
2ND FLOOR PLAN SCALE 1:200



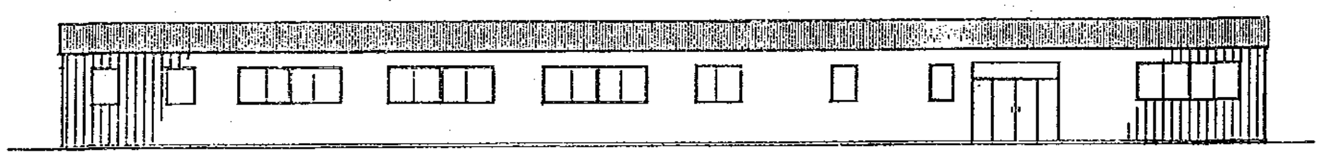
ELEVATION SCALE 1:200

JAPAN INTERNATIONAL COOPERATION AGENCY

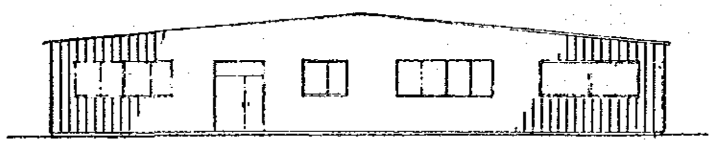
Fig. 11-1-37 Laboratory



FLOOR PLAN SCALE 1:200



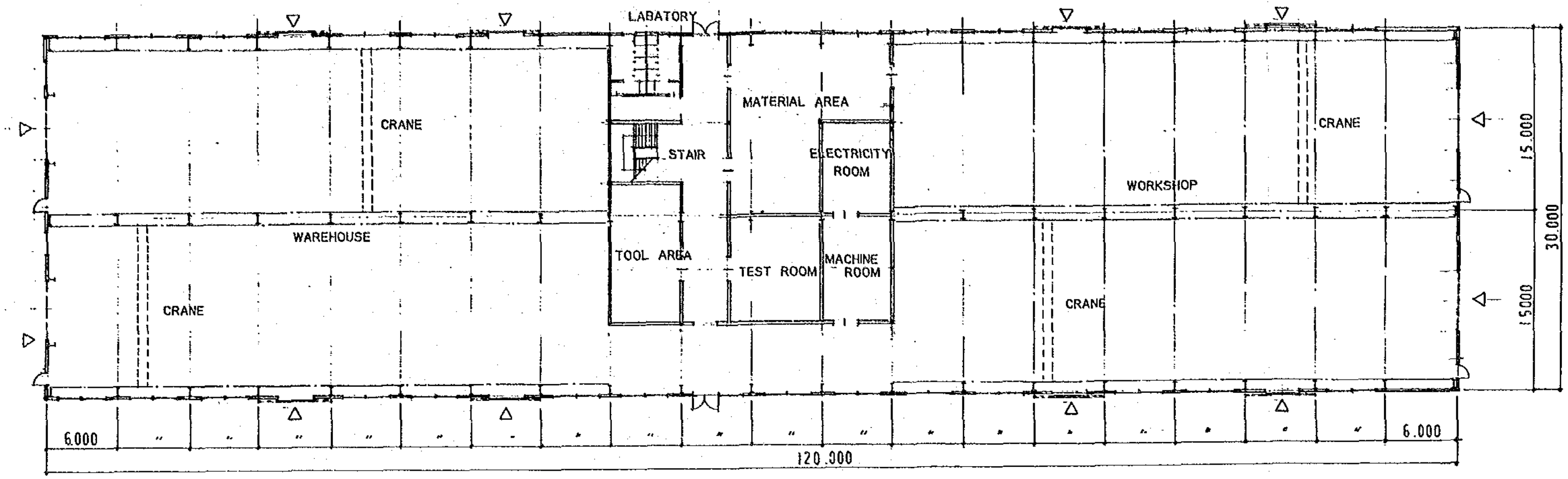
FLOOR PLAN SCALE 1:200



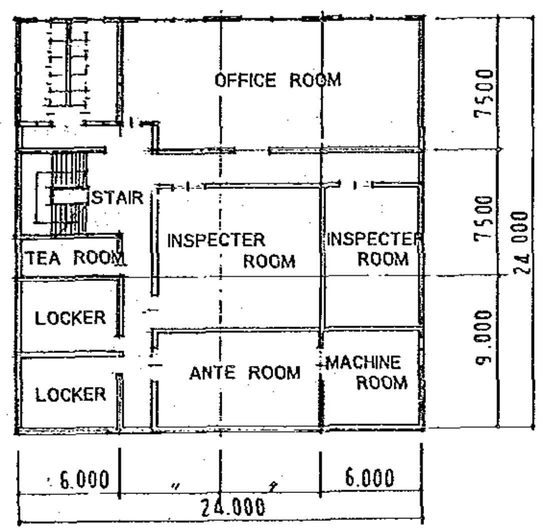
FLOOR PLAN SCALE 1:200

JAPAN INTERNATIONAL COOPERATION AGENCY

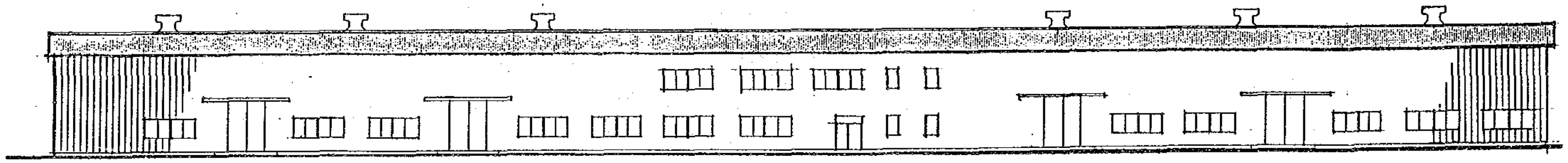
Fig. 11-1-38 Maintenance Office



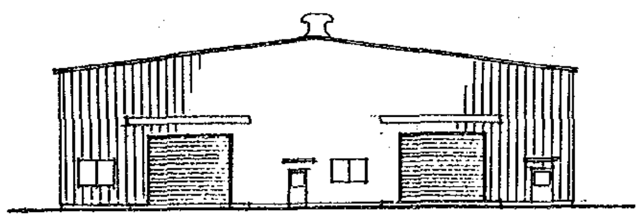
1ST FLOOR PLAN SCALE 1:300



2ND FLOOR PLAN SCALE 1:300



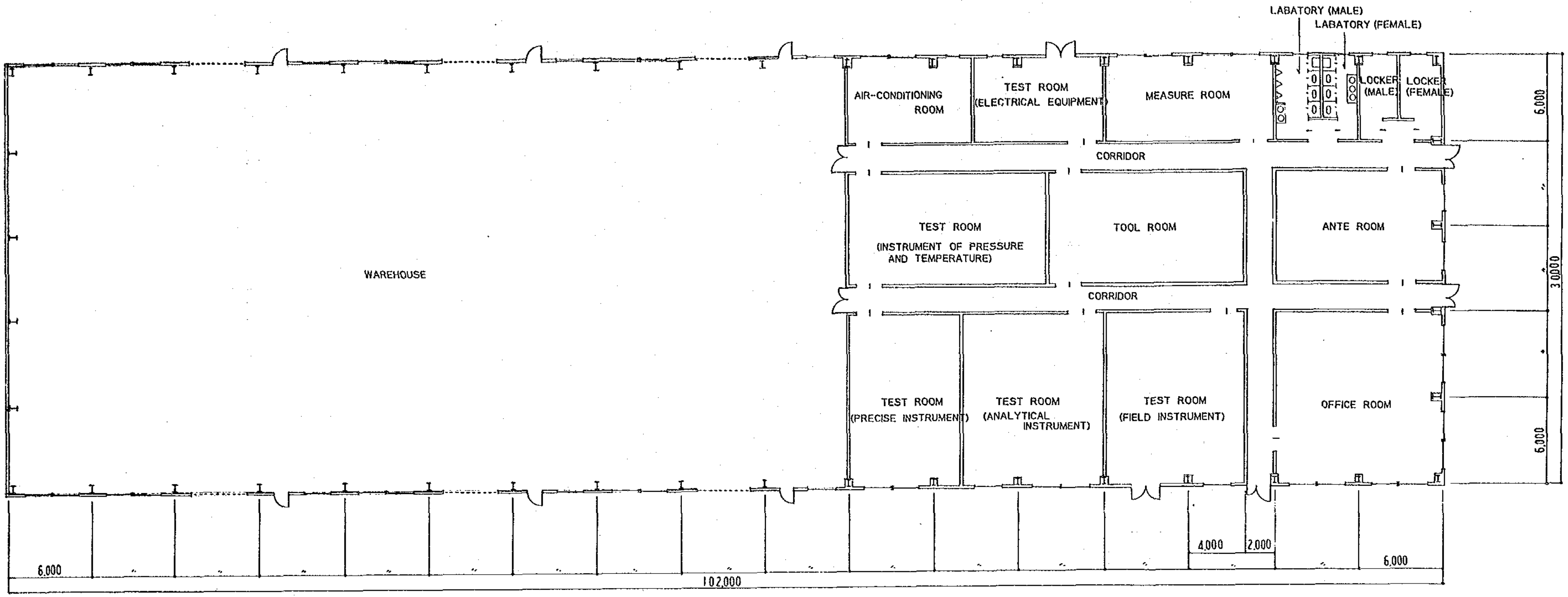
ELEVATION SCALE 1:300



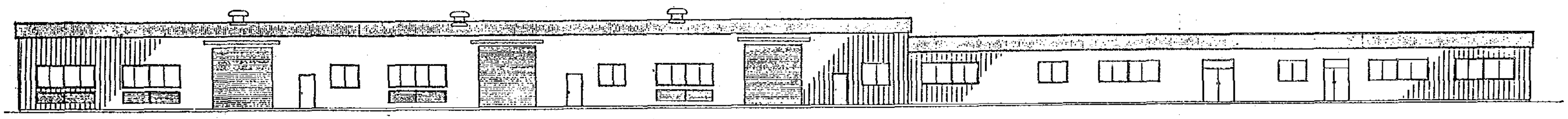
ELEVATION SCALE 1:300

JAPAN INTERNATIONAL COOPERATION AGENCY

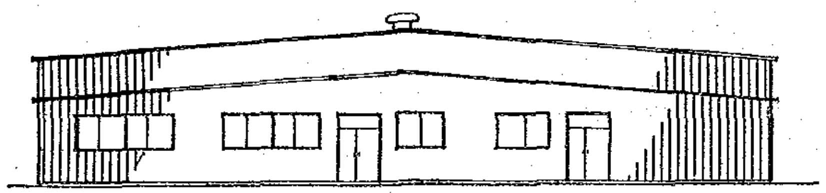
Fig. 11-1-39 Warehouse & Workshop (Mechanical)



FLOOR PLAN SCALE 1:200



ELEVATION SCALE 1:200



ELEVATION SCALE 1:200

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 11-1-40 Warehouse & Workshop (Electrical & Instrument)

PROJECT BANKO PROJECT
TITLE COAL DEWATERING EQUIPMENT

EQUIPMENT LIST (Gasification Plant)

EQUIPMENT ITEM NUMBER	SERVICE	No REQD	TYPE	SPECIFICATION	WEIGHT (ton)			DESIGN		REMARKS
					EREC	TEST	OPN	PRESS Kg/cm^2	TEMP °C	
1-1	No.1 Belt Feeder	2	Belt Conveyor	Belt Width : 1,800	62 T			0	50	Out of supply
				Capacity : 290 t/hr						
				Motor						
1-2	Magnetic Separator	2	Magnet Type	Capacity : 290 t/hr	7.4 T			0	50	
				Magnet : 11.7 KW (DC)						
				Motor (Traverse) : 5 KW						
1-3	Bucket Elevator	2	Belt Type	Capacity : 290 t/hr	90 T			0	100	
				Motor : 50 KW						
1-4	Coal Hopper	2	Cylindrical Cone Type Steel Plate	14,500 ø x 25,200 H (Cylinder Height 13,000 H, Cone Height 12,200 H)	214 T			0	80	
				Volume : 2,820 m^3						
1-5	Coal Feeder	2	Closed Type Chain Feeder	Capacity : 240 t/hr	12 T			0	80	
				Motor : 25 KW						
1-6	Primary Crusher	2	Hammer Mill	Capacity : 240 t/hr	216 T			0	100	
				Grain Size : 40 m/m → 2-3 m/m						
				Motor : 400 KW						

PROJECT BANKO PROJECT
TITLE COAL DEWATERING EQUIPMENT

EQUIPMENT LIST (Gasification Plant)

EQUIPMENT ITEM NUMBER	SERVICE	No REQD	TYPE	SPECIFICATION	WEIGHT (ton)			DESIGN		REMARKS
					EREC	TEST	OPN	PRESS Kg/cm^2	TEMP °C	
1-7	No.2 Belt Feeder	2	Belt Conveyor	Belt Width : 900 mm	140 [illegible]			0	50	
				Capacity : 240 t/hr						
				Motor : 80 KW						
1-8	Dewatering Drum	2	Steam Tube Dryer	Capacity : 240 t/hr	4200 [illegible]			5	200	
				Water Content : 23.1% -> 15%						
				Motor : 490 KW						
1-9	Dust Collector	2	Suction Type Bag Filter	7400 W x 26.3m L x 19m H	370 [illegible]			0	100	
				Capacity : 6,300 m^3/min With Discharge Feeder						
				Motor : 2.2 KW x 8						
1-10	Dust Collector Exhaust Fan	2	Single Suction Turbo Type	Capacity : 6,300 m^3/min	51[illegible]			0.2	80	
				Pressure Head : 450 mm Aq						
				Motor : 1,000 KW						
1-11	Exhaust Stack	2	Steel Plate	3,000 ø x 10,000	14 [illegible]			0	80	

PROJECT BANKO PROJECT
TITLE COAL PULVERIZER AND DRYING EQUIPMENT

EQUIPMENT LIST (Gasification Plant)

EQUIPMENT ITEM NUMBER	SERVICE	No REQD	TYPE	SPECIFICATION	WEIGHT (ton)			DESIGN		REMARKS
					EREC	TEST	OPN	PRESS Kg/cm^2	TEMP °C	
2-1	Coal Feeder	2	Closed Type Chain Feeder	Capacity : 220 t/hr	140 T			0	80	
				Motor : 140 KW						
2-2	Distributor	2	Dumper Adjust	Square Dumper Distributor	17.8 T			0	80	
				Approximate Dimension 5m x 5m x 5m						
2-3	Coal Feeder	2	Closed Type Chain Feeder	Capacity : 150 t/hr x 30m	65 T			0	80	
				Motor : 15 KW						
2-4	Coal Pulverizer	2	Vertical Roller Mill	7,000 W x 7,000 L x 12,200 H	450 T			0.1	300	
				Capacity : 150 t/hr						
				Product Particle Size : 74 μm X 70% Up						
				Product Water Content : 10% under						
				Motor : 1,600 KW						
2-5	Pulverized Coal Collector	2	Suction Type Bag Filter	14.8m W x 26.3m L x 19m H	1000 T			0.1	120	
				Capacity : 600,000 m^3/hr With Discharge Feeder						
2-6	Exhaust Fan	2	Single Suction Turbo Type	Capacity : 10,000 m^3/min	56 T			0.2	80	
				Pressure Head : 500 mm Aq						
				Motor : 1,700 KW						
2-7	Exhaust Stack	2	Steel Plate	4,000 ø X 10,000	19 T			0	80	
2-8	Belt Conveyor	2	Belt Type	Capacity : 150 T/hr	15 T			0	80	
				Motor : 80 KW						

PROJECT BANKO PROJECT
TITLE COAL PULVERIZER AND DRYING EQUIPMENT

EQUIPMENT LIST (Gasification Plant)

EQUIPMENT ITEM NUMBER	SERVICE	No REQD	TYPE	SPECIFICATION	WEIGHT (ton)			DESIGN		REMARKS
					EREC	TEST	OPN	PRESS Kg/cm^2	TEMP °C	
2-9	Bucket Elevator	2	Belt Type	Capacity : 150 t/hr Motor : 80 KW	40 T			0	80	
2-10	No.1 Pulverized Coal Surge Hopper	2	Steel Plate Cylindrical Type	6,000 ø x 10,900 H (Cylindrical Height 5.7m Conical Height 5.2m) Volume : 210 m^3	13.5 T			0	80	
2-11	Pulverized Coal Feed Tank	2	Steel Plate Pressure Vessel	6,000 ø x 10,900 H (Cylindrical Height 5.7m Cone Height 5.2m) Volume : 210 m^3	54.3 T			5	80	
2-12	Pulverized Coal Discharge Feeder	2	Rotary Feeder	Capacity : 210 t/hr Motor : 10 KW Speed Reducer : 25 rpm	0.6 T			5	80	
2-50	Pulverized Coal Discharge Feeder	2	Rotary Feeder	Capacity : 0,61 t/hr Motor : 0,2 KW	0.1T			5	50	
2-51	Pulverized Coal Collector	1	Suction Type Bag Filter	Capacity : 6,000 Nm^3/hr Discharge Feeder Motor : 0.4 KW x 2 Unit	35 T			0.1	50	
2-52	Exhaust Fan	1	Single Suction Turbo Type	Capacity : 6,000 Nm^3/hr Pressure Head : 500 mm Aq Motor : 22 KW	0.4 T			0.1	50	
2-53	Pulverized Coal Conveyor	1	Snake Conveyor	Capacity : 1.4 T/hr Motor : 0.75 KW	5.8 T			0.1	50	