5-2-5 Architectural Facilities

1) Design Conditions for Main Facilities

a. Soil Conditions and Type of Foundation

Boring test with 3 bore holes was carried out at the site in July 1983. (See attached Borehole Logs Data)

The selection of types of foundations for the buildings and equipment should be made on the basis of the boring data.

Severe conditions against settlement and inclining are required of the foundations of the important heavy structures such as the powerhouse, turbine-generator pedestal, boiler, stack and other major equipment.

Therefore, the foundations of the important structures have to be supported by piles driven to the solid bearing stratum with larger than 50 of N-values and thickness of 5 m or more at the depths of GL-20 to - 30 m or deeper.

For detailed study, the results of many more additional boring tests should be used.

As the piles for the above-mentioned soil conditions, the steel pipe piles or the high strength prestressed concrete piles that can penetrate the relatively hard intermediate layers would be suitable, and the latter concrete piles would be superior from the view point of corrosion resistance and cost.

The locally produced concrete piles would not be able to penetrate the intermediate layers and the special method of drilling the hole with the earth drill would have to be resorted to, if these local piles are to be used.

b. Main Materials

a) Concrete

Under water cement will be used for all the building foundations and the super structures on the wharf for protection of salt damage. Portland cement will be used for the super structures of the other buildings.

Compressive strength at 28 days Fc = over 210 kg/cm²

b) Reinforcing bars

Round bars F_Y = over 2,400 kg/cm²

Deformed bars F_Y = over 3,000 kg/cm²

c) Structural steel

Rust proofing measures will be taken to the reinforced concrete buildings due to seawater splash.

Rolled steel shape F_Y = over 2,400 kg/cm²

2) Preliminary Design of Architectural Facilities

a. Powerhouse

a) Plan and Elevation

i. Based on the equipment layout planned by the power plant design department, column span is planned to best suit the equipment and piping layout and to realize good structural design. The height of story is determined in consideration of the height of equipment, piping space, space for maintenance, etc.

ii. The following rooms are planned in accordance with the plant manning program.

i) Shift room, locker room and toilet for operators on the 2nd floor

ii) Shift room, locker room and toilet for instrument maintenance crew, on the 1st floor

iii) Shift room, locker room and toilet for boiler and turbine maintenance crew on the ground floor

iv) Air conditioning equipment room for air-conditioning of the above rooms, central control room and relay room, on the 1st floor

b) Structural design

i. Loads and load combinations

The following loads are considered in the structural design.

i) Dead load

ii) Live load

iii) Wind load

iv) Seismic load

v) Crane load

vi) Active soil pressure

Combinations of loads are in accordance with the standard employed.

Static analysis is made in principle for the stress analysis of structures.

Design of sections of structural members is made in accordance with the standard employed.

ii. Dead load

Dead load is computed, in principle, on the basis of the actual conditions. Aside from the main equipment load and main piping load, the following specific gravity values are used for main materials.

i)	Concrete	2.4 t/m³
ii)	Structural steel	7.86 t/m³
iii)	Soil	2.00 t/m³
iv)	Sand	1.60 t/m³

iii. Live load

Live load includes the load of miscellaneous equipment and miscellaneous piping, and the following values are used for structural frame design with the load at the time of hauling-in of equipment, load of dismantled equipment parts at overhaul and human load.

i)	Roof	100 kg/m²
ii)	Office and shift room	300 kg/m²
iii)	Turbine room and operating floor	1,500 kg/m²
iv)	1st floor and 2nd floor	500 kg/m²
v)	Control room	800 kg/m²
vi)	Steel grating floor	500 kg/m²
vii)	Ground floor	1,000 kg/m²
viii)	Stair and corridor	500 kg/m²

iv. Wind load

The maximum design wind speed of 35 m/sec is adopted, based on the meteorological statistics.

The vertical distribution of wind load and the net pressure coefficient depending upon shape are in accordance with the standard employed.

v. Seismic load

The total lateral force is to be obtained by the total weight above ground level multiplied by 0.05.

The distribution of lateral force at individual levels will be in accordance with the standard employed.

vi. Crane load

A 60 ton travelling crane will be installed in the powerhouse, for overhaul and maintenance of equipment.

The maximum wheel pressure of the crane is obtained by the maximum reaction caused by the dead weight of crane and the approaching distance of the hook. The crane load is treated as a moving load of the maximum wheel pressure, and the impact factor in the vertical, lateral and longitudinal directions is considered based on the standard employed.

vii. As the result of the preliminary design on the basis of the foregoing design load conditions, the quantities of main materials are as follows.

Steel frame	5,700 tons
Concrete	13,000 m^3
Reinforcing bars	1,300 tons
Pile	700 pcs

c) Design of appurtenant facilities

i. Ventilating system

Ventilating facilities satisfying the following conditions will be installed for the turbine-generator room, battery room, coal mill room, belt conveyor room, toilet, kitchen and shower room, with the heat generated by the equipment taken into consideration.

	Frequency of Air Change
Turbine-generator room	More than 10 times/hour
Battery room	More than 13 times/hour
Coal mill room	More than 10 times/hour
Belt conveyor room	More than 5 times/hour
Toilet, kitchen and shower room	More than 10 times/hour

As a result of the preliminary design on the basis of the above design conditions, the turbine-generator room will have the forced ventilating system consisting of the roof ventilating fans of 670,000 m^3/hour capacity and the air supply fans with special inlet air filter for dust and sound proofing.

ii. Air conditioning system

The central control room, relay room, communication equipment room and shift room will be air-conditioned at 21°C and 50% relative humidity.

As a result of the preliminary design, the air conditioning unit of 230,000 kcal/hr of cooling capacity and 29,700 m^3/hr of air volume will be installed.

iii. Others

Sewage treatment facilities will be installed to treat the sewage and rain water drainage for re-use for irrigation of plants in the power plant grounds.

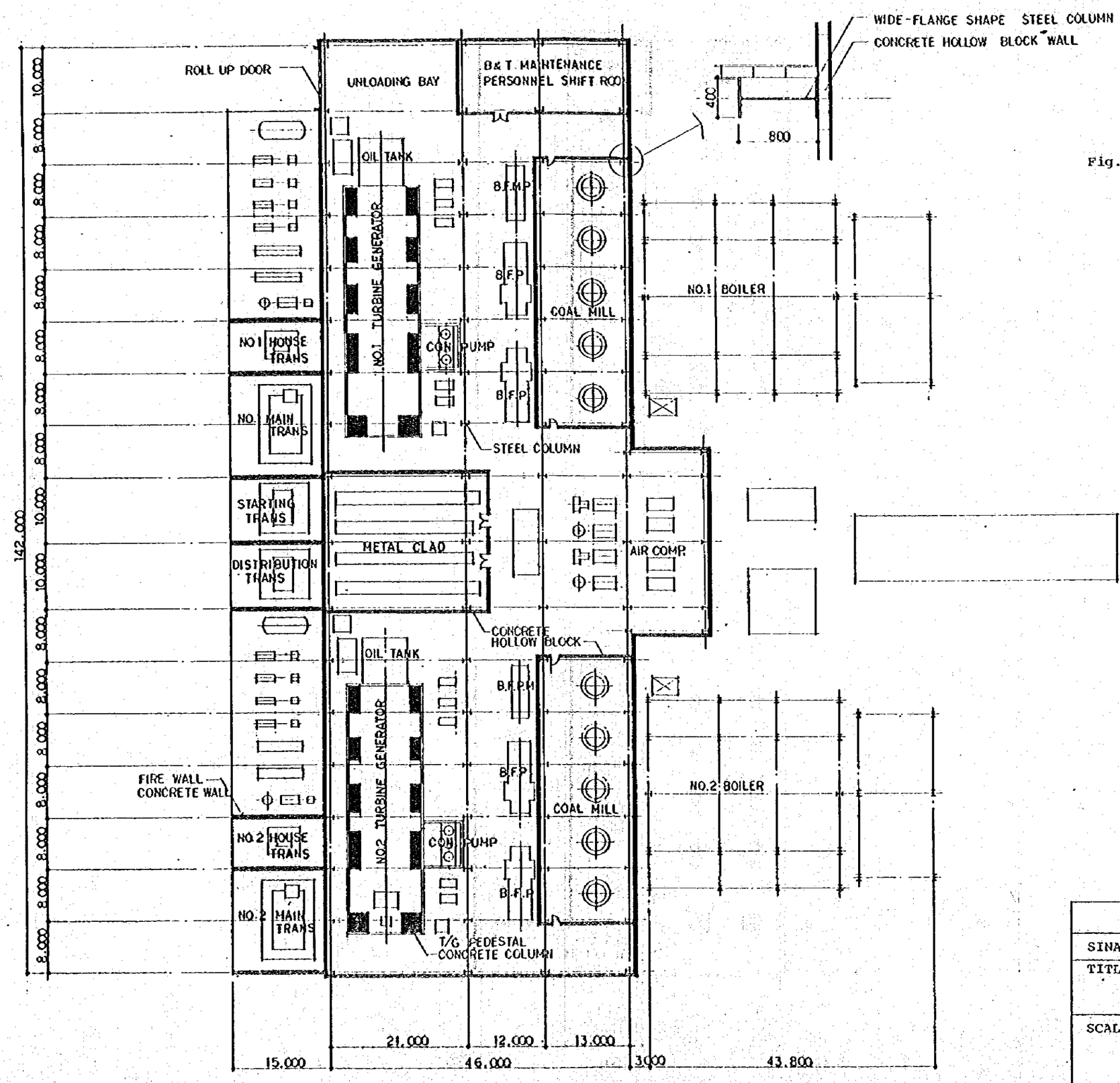


Fig. 5-60 Powerhouse (Ground Floor)

THE ARAB REPUBLIC OF EGYPT	
SINAI COAL-FIRED THERMAL POWER PROJECT	
TITLE POWERHOUSE (GROUND FLOOR)	
SCALE 1/600	DRAWING NO. A - 1

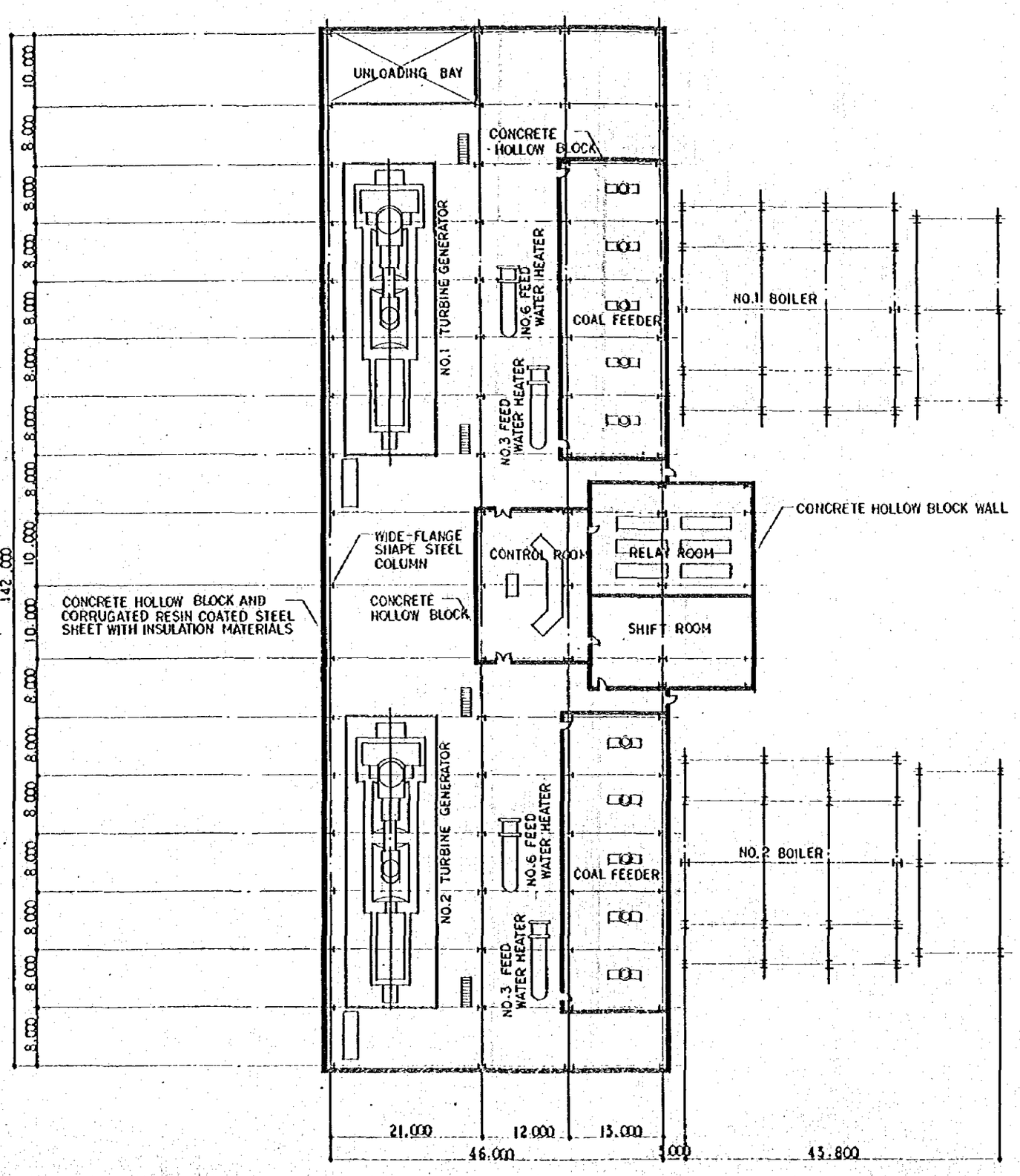
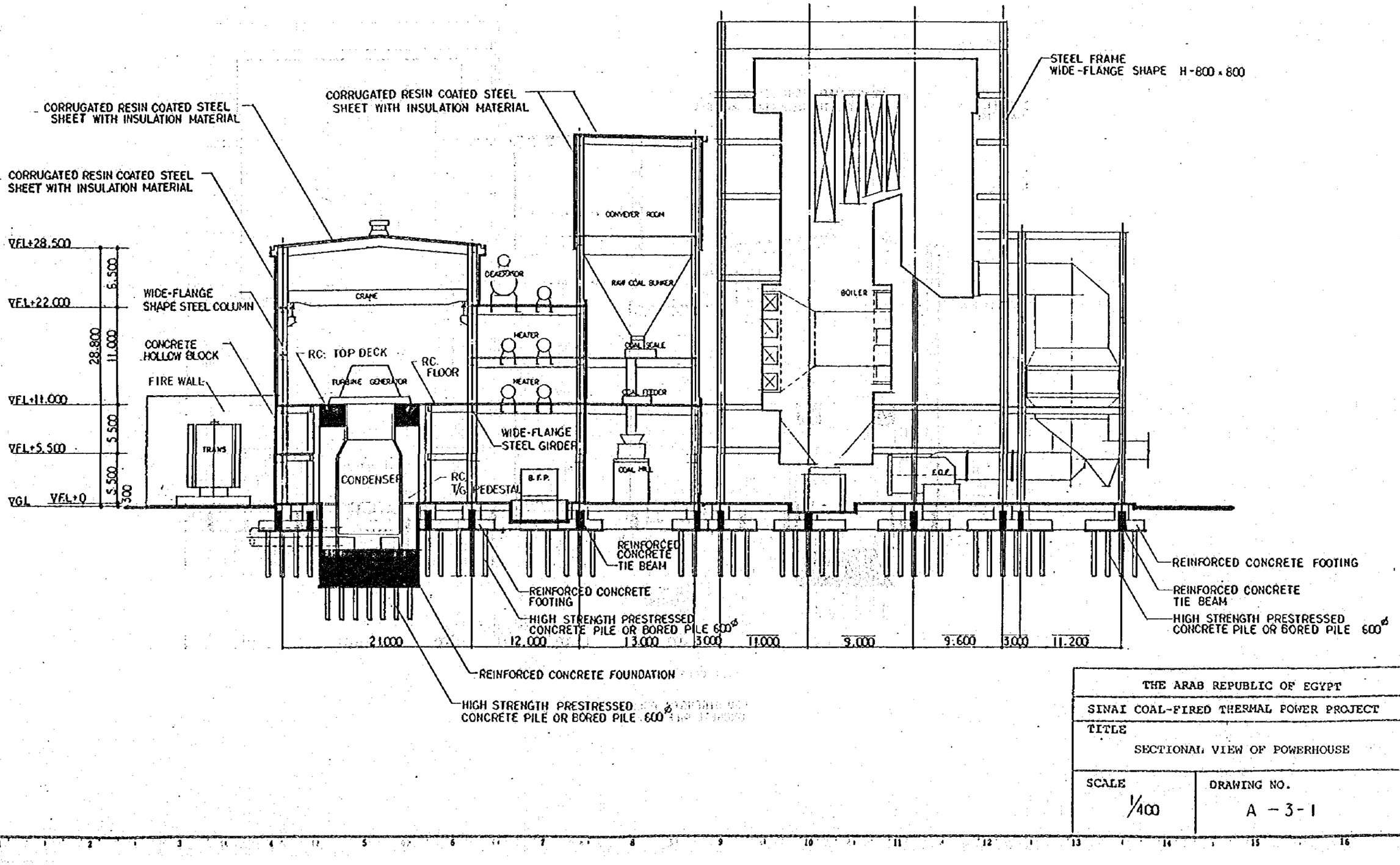


Fig. 5-61 Powerhouse (Operating Floor)

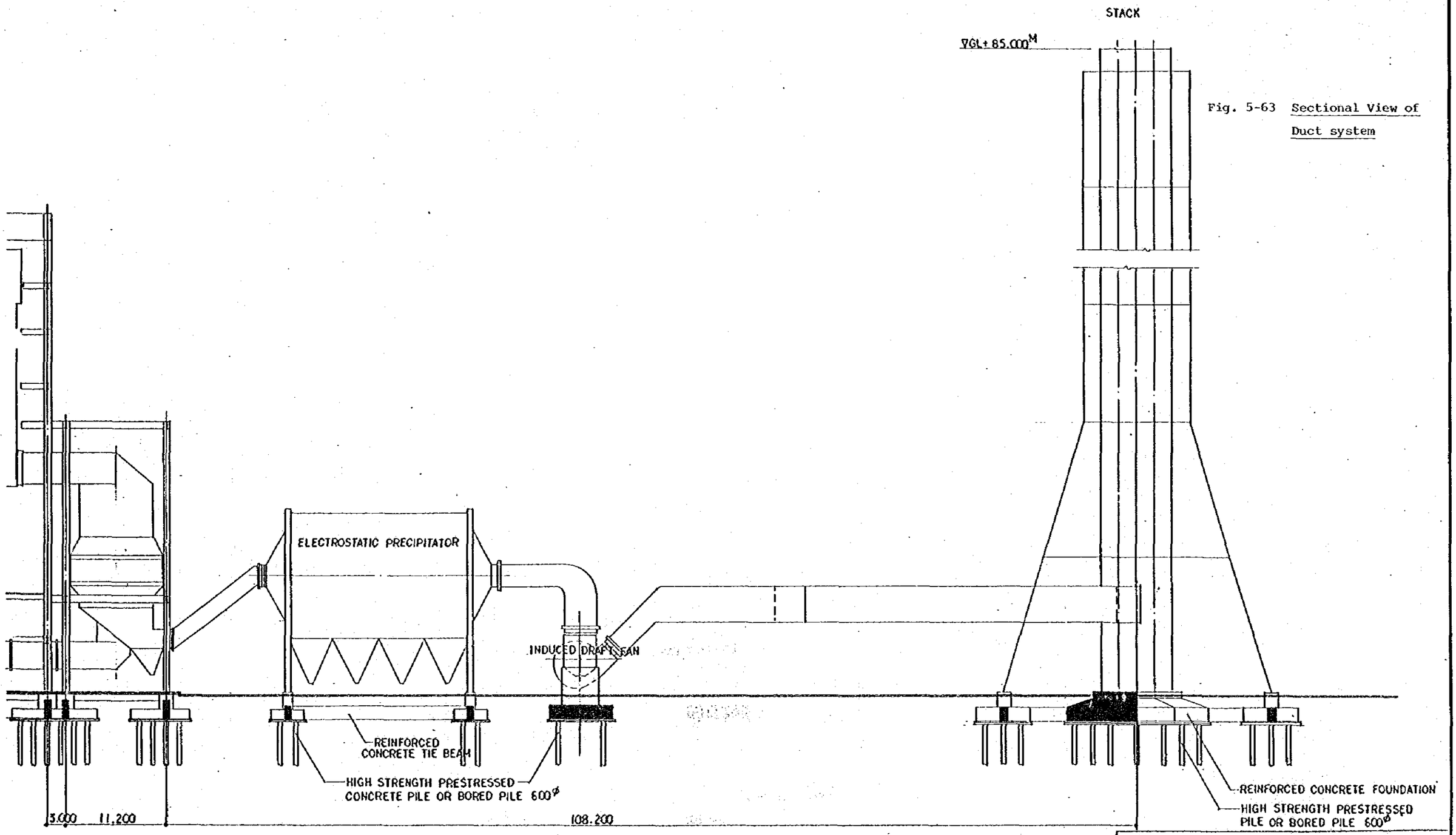
THE ARAB REPUBLIC OF EGYPT	
SINAI COAL-FIRED THERMAL POWER PROJECT	
TITLE: POWERHOUSE (OPERATING FLOOR)	
SCALE: 1/600	DRAWING NO.: A – 2

Fig. 5-62 Sectional View of Powerhouse



THE ARAB REPUBLIC OF EGYPT	
SINAI COAL-FIRED THERMAL POWER PROJECT	
TITLE: SECTIONAL VIEW OF POWERHOUSE	
SCALE: 1/400	DRAWING NO.: A - 3 - 1

Fig. 5-63 Sectional View of Duct system



THE ARAB REPUBLIC OF EGYPT	
SINAI COAL-FIRED THERMAL POWER PROJECT	
TITLE SECTIONAL VIEW OF DUCT SYSTEM	
SCALE 1/400	DRAWING NO. A - 3 - 2

b. Service Building

a) Plan and elevation

Based on the manning program planned by the power plant design department, the following facilities, room and systems are planned to be arranged in the service building.

i. Superintendent room, engineer rooms, conference rooms, locker rooms, shower rooms, toilets, etc.

ii. Chemical laboratory and chemist office

iii. Simulator room and class rooms for training

iv. Dining room and canteen for guests and engineers

v. Medical office for first aid

vi. Mechanical and electrical rooms for airconditioners

vii. Height of stories is planned in consideration of ceiling height and airconditioner duct space

b) Structural design

i. Loads and load combinations

The following loads are considered in the structural design.

i) Dead load

ii) Live load

iii) Seismic load

Combinations of loads are in accordance with the standard employed.

Static analysis is made in principle for the other analysis of structures. Design of sections of structural members is made in accordance with the standard employed.

ii. Dead load

Live load is computed, in principle, on the basis of the actual conditions. The specific gravity is in accordance with that of the powerhouse.

iii. Live load

The following live loads are used for structural design.

i)	Roof	100 kg/m²
ii)	Office	300 kg/m²
iii)	Stairway, corridor and toilet	300 kg/m²
iv)	Simulator room	800 kg/m²

iv. Seismic load

The total lateral force is to be obtained by the total weight above ground level multiplied by 0.05.

The distribution of lateral force at individual levels will be in accordance with the standard employed.

v. As the result of preliminary design based on the above load conditions, the quantity of concrete and materials are as follows.

Concrete	2,100 m³
Reinforcing bars	210 tons

c) Equipment design

i. Ventilating facilities

Ventilating facilities should be equipped with locker room, ariconditioner room, dining kitchen, store room, toilet and shower room in accordance with the following conditions.

Rooms	No. of Ventilation
Locker room	More than 10 times/h
Airconditioner room	More than 18 times/h
Dining kitchen	More than 10 times/h
Storage house	More than 8 times/h
Toilet	More than 10 times/h
Shower room	More than 10 times/h

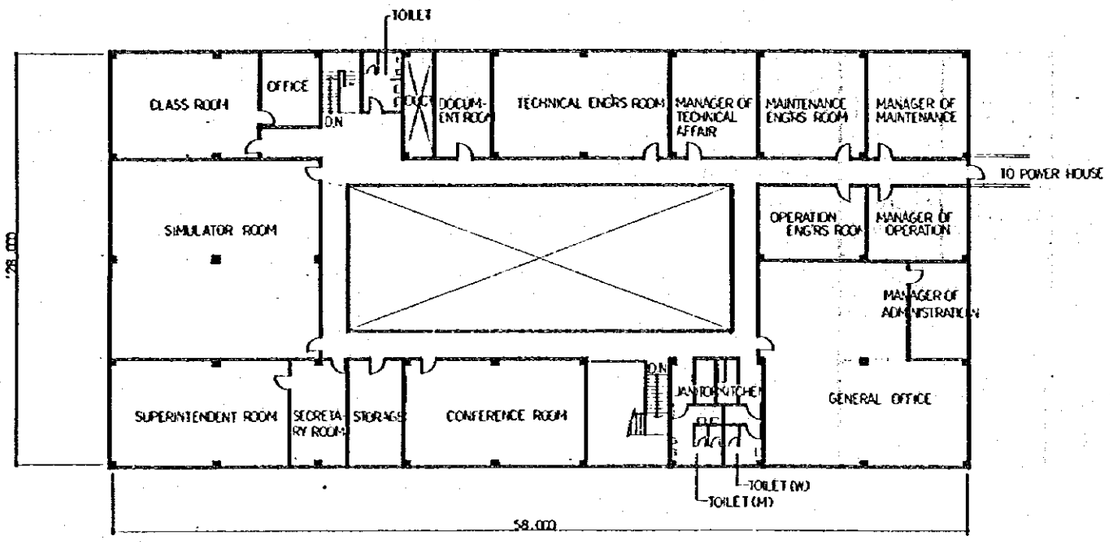
Each room will be equipped with the ventilating fans in accordance with the above conditions.

ii. Airconditioning facilities

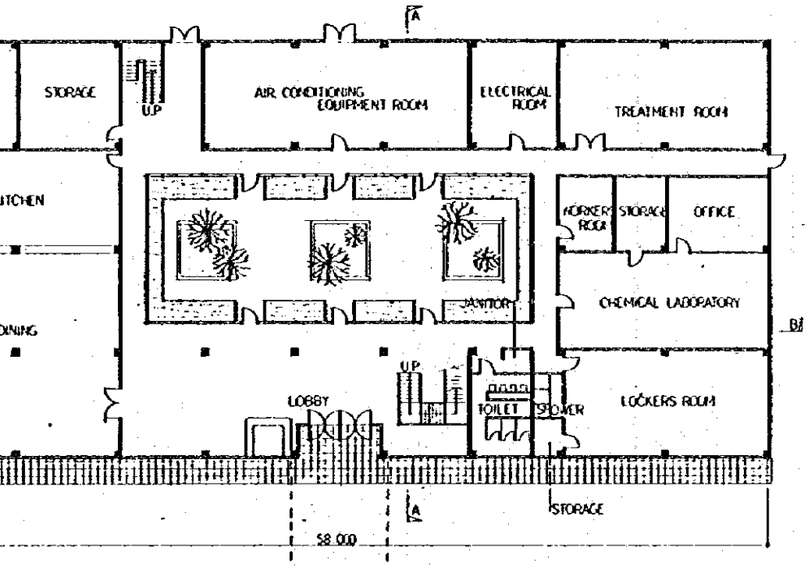
Except the ventilated rooms and houses, airconditioning facilities should be equipped to maintain room temperature and humidity at 25°C and 50% respectively. As the result of preliminary design, airconditioning capacity will be 300,000 kcal/h with air flow of 25,360 m^3/h.

iii. Others

Waste water will be treated by waste water treatment plant so that the waste water can be reusable for watering the plants planted within the power plant compound.

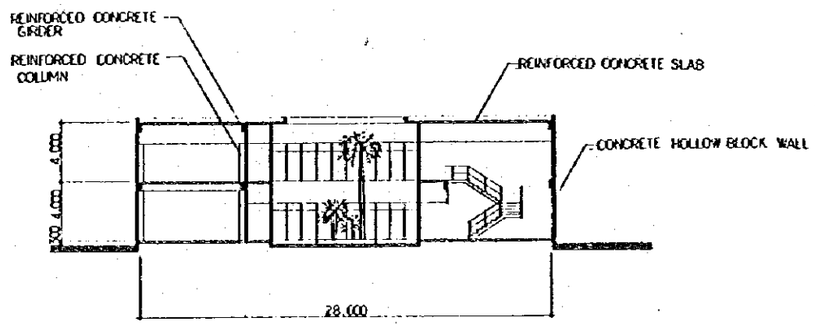


FIRST FLOOR

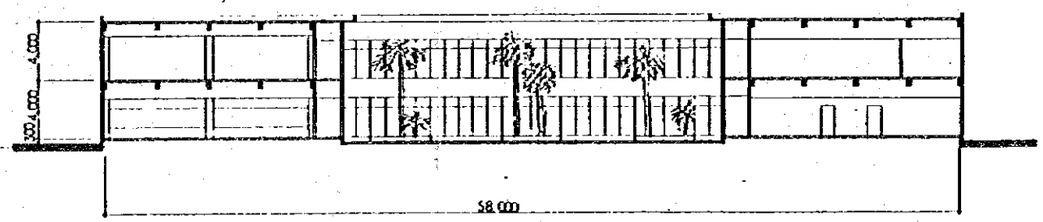


GROUND FLOOR

Fig. 5-64 Service Building



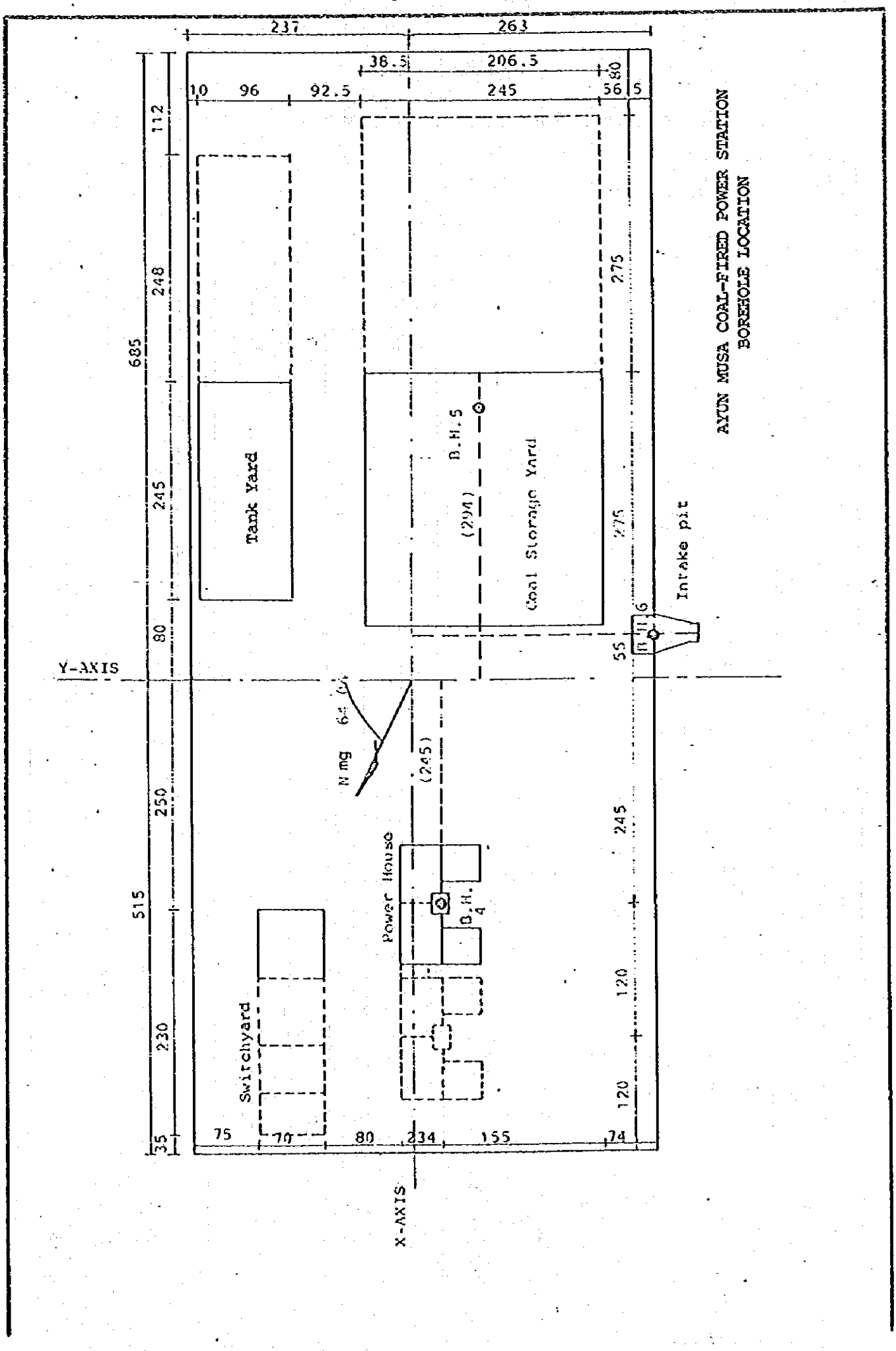
SECTION A-A



SECTION B-B

THE ARAB REPUBLIC OF EGYPT	
SINAI COAL-FIRED THERMAL POWER PROJECT	
TITLE SERVICE BUILDING	
SCALE	DRAWING NO. A – 4

Table 5-18 Borehole Logs


AYUN MUSA COAL-FIRED POWER STATION
BOREHOLE LOCATION
237
263
38.5
206.5
10
96
92.5
245
56
80
5
112
248
245
80
685
515
250
230
35
275
275
Tank Yard
B.H.5
(294)
Coal Storage Yard
Intake pit
B.H.6
55
Y-AXIS
N mg
(245)
Power House
B.H.4
Switchyard
245
120
120
75
70
80
234
155
74
X-AXIS

ARDAMAN - ACE

CONSULTING ENGINEERS IN SOIL MECHANICS, FOUNDATIONS & MATERIALS TESTING

PROJECT : Ayuin Musa Coal Power Station BORE NO. : B-4 SHEET NO. : 2

GROUND LEVEL : 1.67 WATER LEVEL : DATE OF W.L. :

DEPTH m	SECTION	DESCRIPTION	CASING	THICKNESS OF LAYER	SAMPLING DATA NO.	SAMPLING DATA TYPE	SAMPLING DATA SPT. IN VALUE	SAMPLING DATA %RECOVERY	LABORATORY DATA qu kg/cm2	LABORATORY DATA D_{60} mm	LABORATORY DATA D_{10} mm	LABORATORY DATA W/C %	LABORATORY DATA L.L %	LABORATORY DATA P.L %
11		Yellow hard silty clay with limestone fragments		3.75	7	98								
12														
13		Yellow dense clayey silty fine sand			8		50							
14				3.0										
15					9		44							
16		Yellow hard silty clay traces of fine sand										31	41.9	21.1
17					10		24					25.8		
18				3.0		U.S.	4					28.4		
19		Yellow stiff silty clay with traces of fine sand			12		21							
20		Yellowish hard clay with traces of limestone and iron oxides												

X COORDINATE : Y COORDINATE :

ENGINEER :	CHECKED BY :	DRAWN BY :	DATE :
M. Hanna A. Wadie	H Shata	A. Wadie	July 7th. 1983

ARDAMAN - ACE

CONSULTING ENGINEERS IN SOIL MECHANICS, FOUNDATIONS & MATERIALS TESTING

PROJECT : Ayuin Musa Coal Power Station BORE NO.: B-4 SHEET NO.: 3

GROUND LEVEL: 1.67 WATER LEVEL: DATE OF W.L.:

DEPTH m	SECTION	DESCRIPTION	CASING-M	THICKNESS OF LAYER	SAMPLING DATA NO.	TYPE	SPT. IN VALUE	%RECOVERY	LABORATORY DATA qu kg/cm2	D_{60} mm	D_{10} mm	W/C %	L.L %	P.L %
				1.0										
21		Yellowish medium gray silty fine sand										16.2		
22				2.75	13		35			0.08				
23														
24		White calcarious v. stiff silty clay		1.5	14		27					17.3	5	
25		Light gray very stiff calc. silty clay		1.5		U.S	5			0.18		20.1		
26														
27		Yellow silty clay with trace of sand and with iron oxides at 29.0 m.		3.0			78						23	15.3
28														
29					16		62					21.8		
30					17		100			0.6	0.002			

X COORDINATE : Y COORDINATE :

ENGINEER :	CHECKED BY :	DRAWN BY :	DATE :
M. Hanna A. Wadie	H. Shata	A. Wadie	July 7th. 1983

ARDAMAN - ACE

CONSULTING ENGINEERS IN SOIL MECHANICS, FOUNDATIONS & MATERIALS TESTING

PROJECT : Ayuin Musa Coal Power Station BORE NO. : B-4 SHEET NO. : 4

GROUND LEVEL : 1.67 WATER LEVEL : DATE OF W.L. :

DEPTH m	SECTION	DESCRIPTION	CASING - M	THICKNESS OF LAYER	SAMPLING DATA NO.	SAMPLING DATA TYPE	SAMPLING DATA SPT. IN VALUE	SAMPLING DATA % RECOVERY	LABORATORY DATA q_u kg/cm²	LABORATORY DATA D_{60} mm	LABORATORY DATA D_{10} mm	LABORATORY DATA W/C %	LABORATORY DATA L.L. %	LABORATORY DATA P.L %
31		Yellow very dense medium to fine sand with pockets of silty clay		4	18		100							
32														
33					19		100			0.23				
34		Yellowish brown laminated hard silty clay with traces of fine sand with gypsum crystals at 37.5 m and sand at 39 m.		8.5	20		86					21.9		
35														
36					21		41							
37							>100							
38														
39							>100							
40														

X COORDINATE : Y COORDINATE :

ENGINEER :	CHECKED BY :	DRAWN BY :	DATE :
M. Hanna A. Wadie	H. Shata	A. Wadie	July 7th. 1983

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CONSULTING ENGINEERS IN SOIL MECHANICS, FOUNDATIONS & MATERIALS TESTING

PROJECT : Ayuin Musa Coal Power Station BORE NO. : B-4 SHEET NO. : 5

GROUND LEVEL : 1.67 WATER LEVEL : DATE OF W.L. :

DEPTH m	SECTION	DESCRIPTION	CASING - M	THICKNESS OF LAYER	SAMPLING DATA: NO.	TYPE	SPT. IN VALUE	RECOVERY	LABORATORY DATA: qu kg/cm2	D_{60} mm	D_{10} mm	W/C %	L.L %	P.L %
41														
42		Gray very dense sand with traces of gypsum crystals		2.0										
43														
44		Dark gray hard silty clay with interlayers of clay stone and traces of gypsum crystals.												
45														
46				5.0										
47														
48														
49		Gray silty sand with gypsum crystals		1.0										
50		END OF BORING												

X COORDINATE : Y COORDINATE :

ENGINEER :	CHECKED BY :	DRAWN BY :	DATE :
M. Hanna A. Wadie	M. Shalaby	A. Wadie	July 7th. 1983

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CONSULTING ENGINEERS IN SOIL MECHANICS, FOUNDATIONS & MATERIALS TESTING

PROJECT : Ayuin Musa Coal Power Station BORE NO.: B-5 SHEET NO.: 1/5

GROUND LEVEL: 2.4 m WATER LEVEL: DATE OF W.L.:

DEPTH m	SECTION	DESCRIPTION	CASING-M	THICKNESS OF LAYER	SAMPLING DATA				LABORATORY DATA					
					NO.	TYPE	SPT. IN VALUE	%RECOVERY	qu kg/cm2	D_{60} mm	D_{10} mm	W/C %	L.L %	P.L %
		Creamy calcarious fine to med. sandy silt with shells.		0.5										
1		Creamy loose calcarious fine sand		1.0			9							
2		Gray loose fine to medium sand		1.0			7							
3		Yellow compact fine sand with shells		3.0			22							
4		. with dolomite limestone fragments at 5. m depth.					22			0.3	0.14			
5							52							
6		Light gray medium dense sand sand with cemented lumps		1.0			11							
7		Gray very stiff sandy clay		0.5			29							
		Light gray clayey sand.		0.75										
8		Light yellow very dense fine sand with a pocket of light brown clay, some coarse to fine gravel.		0.40			63		0.4					
9							15					39.14		
10		Light gray very stiff silty clay with traces of fine sand and gypsum crystals in a longitudinal pattern.		1.6			23							

X COORDINATE : Y COORDINATE :

ENGINEER :	CHECKED BY :	DRAWN BY :	DATE :
R. F. El-Raheb	M. Shik	R.R.	27/6/1983

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CONSULTING ENGINEERS IN SOIL MECHANICS, FOUNDATIONS & MATERIALS TESTING

PROJECT : Ayuin Musa Coal Power, Station BORE NO.: B-5 SHEET NO.: 2/5

GROUND LEVEL: WATER LEVEL: DATE OF W.L.:

DEPTH m	SECTION	DESCRIPTION Preliminary field description	CASING-M	THICKNESS OF LAYER	SAMPLING DATA NO.	TYPE	SPT. IN VALUE	%RECOVERY	LABORATORY DATA qu kg/cm2	D_{60} mm	D_{10} mm	W/C %	L.L %	P.L %
												24.4		
11		Light yellow coarse sand with gravel.		0.5										
		Light gray very stiff silty clay		0.75			15							
12		Yellow gray very stiff calc. clayey silt.				US_1						32.5	63.2	28
13		Becomes med. and with gravel at 13.0 m.					8							
							16							
14		& med. to soft at 15.0 m		4.5										
15		A layer of fine gravel.					14							
16												23.1		
		Creamy calc. hard silty clay with horizontal and vertical fissures filled with sand and pockets of sand.					52							
17				2.75										
							63							
18		- with thin seams of sand at 18.0 m												
19		Yellow hard laminated calc. silty clay with fine sand in between laminea.					74							
												19.9		
20				1.5										

X COORDINATE : Y COORDINATE :

ENGINEER :	CHECKED BY :	DRAWN BY :	DATE :
R. F. El-Raheb	M.Sh.	R.R.	27/6/1983

ARDAMAN - ACE

CONSULTING ENGINEERS IN SOIL MECHANICS, FOUNDATIONS & MATERIALS TESTING

PROJECT : Ayuin Nusa Coal Power Station BORE NO.: B-5 SHEET NO.: 3/5

GROUND LEVEL: WATER LEVEL: DATE OF W.L.:

DEPTH m	SECTION	DESCRIPTION Preliminary field description	CASING - N	THICKNESS OF LAYER	SAMPLING DATA NO.	TYPE	SPT-'N' VALUE	RECOVERY	LABORATORY DATA q_u kg/cm2	D_{50} mm	D_{10} mm	W/C %	L.L %	P.L %
21		Dark yellow very dense fine sand, traces of silt.		2.25			50/5".							
22		A layer of fine gravel.		0.5										
		Light brown vderu dense fine sand.		0.25			90							
		Brown sandy clay		0.25										
23		Light brown very fine sand.		0.75										
24		Yellow calc. hard laminated clayey silt with very fine sand in between laminea and with gypsum crystals at 29.0 m.		6.0			43						44.4	20
25							34					21		
26												26.45		
27							26							
28							33					26		
29														
30		White calc. clay stone.		1.0			100/2"							

X COORDINATE : Y COORDINATE :

ENGINEER :	CHECKED BY :	DRAWN BY :	DATE :
R. F. El-Raheb	M Shala	R.R.	27/6/1983

ARDAMAN - ACE

CONSULTING ENGINEERS IN SOIL MECHANICS, FOUNDATIONS & MATERIALS TESTING

PROJECT : Ayuin Musa Coal Power Station BORE NO. : B-5 SHEET NO. : 4/5

GROUND LEVEL : WATER LEVEL : DATE OF W.L. :

DEPTH m	SECTION	DESCRIPTION Preliminary field description	CASING- N	THICKNESS OF LAYER	SAMPLING DATA NO.	SAMPLING DATA TYPE	SAMPLING DATA SPT. IN VALUE	SAMPLING DATA RECOVERY	LABORATORY DATA qu kg/cm2	LABORATORY DATA D_{60} mm	LABORATORY DATA D_{10} cm	LABORATORY DATA W/C %	LABORATORY DATA L.L. %	LABORATORY DATA P.L. %
31		Cemented med. sand.		0.75										
		Gray hard silty clay.		0.5			53							
32		Gray cemented sand.		0.75										
33		Gray hard clayey silt with gypsum crystals from 35.0 m to 39.0 m.					100/2"							
34							86					37 31		
35				8.0										
36							54					30 37		
37							26					34	71.6	30.7
38														
39							50/1"					25		
40														

X COORDINATE : Y COORDINATE :

ENGINEER :	CHECKED BY :	DRAWN BY :	DATE :
R. F. El-Raheb	M.S.A.	R.R.	27/6/1983

ARDAMAN - ACE

CONSULTING ENGINEERS IN SOIL MECHANICS, FOUNDATIONS & MATERIALS TESTING

PROJECT : Ayuin Musa Coal Power Station BORE NO. : B-5 SHEET NO. : 5/5

GROUND LEVEL : .... WATER LEVEL : .... DATE OF W.L. : ....

DEPTH m	SECTION	DESCRIPTION Preliminary field description	CASING - M	THICKNESS OF LAYER	SAMPLING DATA NO.	SAMPLING DATA TYPE	SAMPLING DATA SPT. 'N' VALUE	SAMPLING DATA % RECOVERY	LABORATORY DATA qu kg/cm2	LABORATORY DATA D_{50} mm	LABORATORY DATA D_{10} cm	LABORATORY DATA W/C %	LABORATORY DATA L.L %	LABORATORY DATA P.L %
41														
42		Light gray clayey med. sand		2m			100/1"					26.6		
43		Light gray clay stone		1m										
44														
45							50/4"							
46		Light gray hard silty fissured laminated clay with gypsum crystals in fissures and fine sand in laminea.		5m										
47														
48							52							
49														
50		END OF BORING												

X COORDINATE : Y COORDINATE :

ENGINEER :	CHECKED BY :	DRAWN BY :	DATE :
R. F. El-Raheb		R.R.	27/6/1983

ARDAMAN - ACE

CONSULTING ENGINEERS IN SOIL MECHANICS, FOUNDATIONS & MATERIALS TESTING

PROJECT : Ayuin Musa Coal Power Station BORE NO.: B-6 SHEET NO.: 1

GROUND LEVEL: 2.57 WATER LEVEL: DATE OF W.L.:

DEPTH m	SECTION	DESCRIPTION	CASING - M	THICKNESS OF LAYER	SAMPLING DATA NO.	TYPE	SPT. IN VALUE	% RECOVERY	LABORATORY DATA qu kg/cm2	D60 mm	D10 mm	W/C %	L.L %	P.L %
1					2		8							
2					3		29							
3		Yellow calcareous fine silty loose sand some gravel and shells with gypsum crystals at 2.0 m.		7.0	4		10							
4					5		15							
5					6		16							
6					7		12							
7		Yellow dense coarse sand with gravel and shells			8		34							
8					9		36							
9		Gravelly at 9.50 m depth		9.75	10									
10														

X COORDINATE : Y COORDINATE :

ENGINEER :	CHECKED BY :	DRAWN BY :	DATE :
M. Hanna A. Wadie		A. Wadie	16 July 1983

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CONSULTING ENGINEERS IN SOIL MECHANICS, FOUNDATIONS & MATERIALS TESTING

PROJECT : Ayuin Musa Coal Power Station BORE NO.: B-6 SHEET NO.: 2

GROUND LEVEL: 2.57 WATER LEVEL: DATE OF W.L.:

DEPTH m	SECTION	DESCRIPTION	CASING - M	THICKNESS OF LAYER	SAMPLING DATA NO.	SAMPLING DATA TYPE	SAMPLING DATA SPT. 'N' VALUE	SAMPLING DATA %RECOVERY	LABORATORY DATA qu kg/cm2	LABORATORY DATA D_{60} mm	LABORATORY DATA D_{10} mm	LABORATORY DATA w/c %	L.L %	P.L %
11		Yellowish brown very stiff sandy clay with gypsum crystals and coarse gravel			11		30							
12		Yellow fine dense sand with traces of clay ang gravel		3.0	12		47							
15		Light gray stiff clayey silt		2.25										
17		Yellowish gray hard silty clay with traces of fine sand		2.0										
19		Yellow very dense silty fine sand with pockets of clay			16		94							

X COORDINATE : Y COORDINATE :

ENGINEER :	CHECKED BY :	DRAWN BY :	DATE :
M. Hanna A. Wadie	M.S.H.	A. Wadie	

ARDAMAN - ACE

CONSULTING ENGINEERS IN SOIL MECHANICS, FOUNDATIONS & MATERIALS TESTING

PROJECT : Ayuin Nusa Coal Power Station BORE NO. : B-6 SHEET NO. : 3

GROUND LEVEL : WATER LEVEL : DATE OF W.L. :

DEPTH m	SECTION	DESCRIPTION	CASING-M	THICKNESS OF LAYER	SAMPLING DATA NO.	TYPE	SPT-N VALUE	RECOVERY	LABORATORY DATA qu kg/cm2	D50 mm	D10 mm	W/C %	L.L %	P.L %
21		Yellowish gray hard silty clay with traces of fine sand.		3.0	17		45						47	18
23		Yellow v. dense fine sand some clay.		2.5	18		100							
					19		100							
25		Yellowish brown silty clay with traces of sand and gypsum crystals.		8.5	20		42					22.4		
27					21		46					20.7		
28					22		36					27	56	25
30					23		100					22.7		

X COORDINATE : Y COORDINATE :

ENGINEER :	CHECKED BY :	DRAWN BY :	DATE :
M. Hanna A. Wadie	M. Sh.	A. Wadie	

ARDAMAN - ACE

CONSULTING ENGINEERS IN SOIL MECHANICS, FOUNDATIONS & MATERIALS TESTING

PROJECT : Ayuin Nusa Coal Power Station BORE NO. : B-6 SHEET NO. : 4

GROUND LEVEL : WATER LEVEL : DATE OF W.L. :

DEPTH m	SECTION	DESCRIPTION	CASING - N	THICKNESS OF LAYER	SAMPLING DATA NO.	TYPE	SPT. 'N' VALUE	RECOVERY	LABORATORY DATA q_u kg/cm²	D_{60} mm	D_{10} mm	W/C %	L.L. %	P.L. %
31														
32					24		48							
33		Gray hard silty clay with gypsum.			25		100							
34														
35		Becomes yellowish brown at 35 m.		4.5	26		100							
36														
37					27		100							
38		Yellowish gray hard silty clay.			28		50					26		
39												39		
40														

X COORDINATE : Y COORDINATE :

ENGINEER :	CHECKED BY :	DRAWN BY :	DATE :
M. Hanna A. Wadie		A. Wadie	

ARDAMAN - ACE

CONSULTING ENGINEERS IN SOIL MECHANICS, FOUNDATIONS & MATERIALS TESTING

PROJECT : Ayuin Musa Coal Power Station BORE NO.: B-6 SHEET NO.: 5

GROUND LEVEL: WATER LEVEL: DATE OF W.L.:

DEPTH m	SECTION	DESCRIPTION	CASING — N	THICKNESS OF LAYER	SAMPLING DATA: NO.	SAMPLING DATA: TYPE	SAMPLING DATA: SPT. 'N' VALUE	SAMPLING DATA: PRECONSOLIDATION PRESSURE	LABORATORY DATA: q_u kg/cm²	LABORATORY DATA: D_{60} mm	LABORATORY DATA: D_{10} mm	LABORATORY DATA: W/C %	LABORATORY DATA: L.L %	LABORATORY DATA: P.L %
41		With gypsum crystals from 43 m to 48 m.												
42												36.3		
					30		70							
43												41		
				11										
44					31		100							
45														
					32		100							
46														
47														
					33		53							
48														
49		Yellowish brown silty fine sand.		1.5	34		100							
50		END OF BORING												

X COORDINATE : Y COORDINATE :

ENGINEER :	CHECKED BY :	DRAWN BY :	DATE :
M. Hanna A. Wadie		A. Wadie	

5-3 PRELIMINARY DESIGN FOR TRANSMISSION LINE AND SUBSTATION FACILITIES

5-3-1 Transmission Line

1) Overhead Transmission Line between Ayun Musa PS and New Suez SS

a. Outline of Transmission Line

Voltage	:	220 kV
No. of circuit	:	4 circuits (two circuits one tower two routes)
Conductor	:	AAAC 620 mm² x 2
Length	:	40 km

b. Conductor

Maximum allowable temperature rise of conductor is 80°C with the ambient temperature 42°C. The transmission capacity of one circuit is 300 MW in normal condition and 600 MW in emergency case.

AAAC (All Aluminium Alloy Conductor) is the standard of EEA in the sea side area as a salt resistant conductor. There are other kinds of salt resistant conductors; High Strengthened Aluminium Conductor (HAL) and Thermo Resistnace Aluminium Alloy with aluminum coated steel. is

The comparison of construction costs of the above-mentioned three (3) kinds of conductors is shown as follows.

a) Conductor size

i. Conditions of calculation

Max. allowable temp. rise of conductor:	80°C
Max. ambient temp.:	42°C
Min. wind velocity:	0.6 m/sec.
Solar radiation:	0.1 W/cm²

ii. Conductor size

AAAC	:	620 mm² x 2 (1,602 A)
HAL	:	560 mm² x 2 (1,606 A)
TAC/Al.-S	:	410 mm² x 2 (1,619 A)

b) Comparison of Construction Costs

The average span of transmission line is assumed at 350m. The size of steel tower and the type of insulator are changed by the conductor type as follows.

Conductor/Size		Steel Tower Weight (t/10km)	Insulator Size x pc.
AAAC	620 mm² x 2	435	Smog 320 mm x 20
HAL	560 mm² x 2	462	Smog 250 mm x 23
TAC/Al-S	410 mm² x 2	385	Smog 250 mm x 23

The comparison of construction costs per 10 km is shown in Table 5-19. The construction cost of transmission line using AAC is more expensive than that of TAC/Al-S about 35%.

c) Recommendation

To economize the transmission line construction cost, it is desirable to check on the standard of the salt resistant conductor again by EEA.

Table 5-19 Comparison of Construction Cost by Conductor Type (per 10 km)

Unit: 10^6¥

ITEM	HAL $560mm^2 \times 2$	AAAC $620mm^2 \times 2$	TACSR/AW $410mm^2 \times 2$
Tower			
Material	117,533	110,664	97,940
Erection	107,544	101,260	89,620
Subtotal	225,077	211,924	187,564
Insulator			
Material	43,240	101,462	43,240
Erection	1,372	1,372	1,372
Subtotal	44,612	102,834	44,612
Conductor			
Material	123,975	185,179	135,563
Erection	4,667	4,667	4,667
Subtotal	128,642	189,846	140,230
Groundwire			
Material	3,037	3,037	3,037
Erection	291	291	291
Subtotal	3,328	3,328	3,328
Construction	67,559	85,435	63,199
T O T A L	469,218	593,367	438,943

Note: HAL..... High strength AL.
AAAC.... All Al. Alloy Conductor
Tacsr/AW..Thermo resistance AL. with Almo Weld wire

c. Overhead Grounding Wire

One grounding wire for each tower

Wire: 130 mm² compound wire with optical fiber

d. Insulator

Design Condition

Standard voltage for design: 245 kV

Lightning surge voltage : 1,050 kV

Min. clearance distance : 180 cm

Min. leakage distance : 990 cm

No. of insulators for a string : 20 pc 320 mm Smog type

Reason:

Pollution condition of smog insulator : 0.224 mg/cm²

Flush over voltage of insulator per pc: V

$$V = k \times 28/(w/0.1)^{\frac{1}{5}} \times (1.5(K^{\frac{1}{3}} + 2) + 5/8 \times K) \times A$$

(From transmission line standard in Japan JEAC 6001)

where;

K = 0.1 mg/cm² .. factor of unsoluable dust coherence

w = 0.32 mg/cm² .. equivalent salt coherence density

A = 1.50 .. correction factor of 320 mm smog insulator

Then;

V = 16.3 kV/pc

Therefore;

16.3 kV x 20 = 326.0 kV $>$ 245 kV

Minimum clearance distance, 180 cm, is enough for lightning surge voltage, 1,050 kV. The amount of switching surge voltage is (220 kV x 2.8 =) 616 kV. So, its needed minimum clearance distance is enough with 130 cm. Thus, minimum clearance distance of 180 cm is acceptable for design of the steel tower.

2) Transmission Line for Canal Crossing

The interconnecting line from Ayun Musa PS to Unified system must cross the Suez Canal. Existing Suez Canal is one line passage with a width of 288 m, and there is a future expansion plan of another passage with a width of 260 m or more. Canal crossing transmission line should be considered with the future expansion plan for its design. Four alternative plans for the canal crossing were finally studied as follows.

a. Overhead Transmission Line Plan

Two steel towers will be constructed for canal crossing. One is erected at the east side bank about 50 m distance from the canal, and another at the west side of the future extension canal. The span of canal crossing will become 800 m. The height of tower will be 161 m to keep the height of lowest conductor from sea level as 80 m.

b. Cable through Ahmed Hamdi Tunnel

There is an allocated space in the Ahmed Hamdi Tunnel which has a width of 2.1 m at lower part and a height of 2.8 m, and is designed for common use of power cable and water pipe to Sinai penisula. Twelve (12) cables are necessary to transmit 1,200 MW. The allocated space for

power cable is not surficient for the cables. To install cables, it is necessary to replace the existing two water pipes (outer diameter: 60 cm) and additional allocation of space in air ducts. To construct the drawing out ducts of cables at both end of the tunnel, it is necessary to take care of existing facilities, control cables and radio, duct of water pipes. Refer to APPENDIX-C.

c. Cable System using New Duct

A pit will be dug 40 m depth each at both side of the canal, and a tunnel for cables, diameter of 3.6 m and length of 850 m, will be constructed.

Twelve 220 kV, 2,000 mm^2 cables will be installed in the tunnel for four interconnecting lines.

d. Submarine Cable System

Twenty four cables, 220 kV 1,400 mm^2 will be laid at the bottom of the canal. To keep cooling efficiency for the cables, a cable will be laid at aninterval of 2 m. So, the width of cable passage will become 50 m. The construction period of the submarine cables may be farster than that of the extension of canal. Therefore, additional excavation along the future canal sitewill be necessary The additional quantity of excavation is estimated more than 400,000 m^3.

e. Conclusion

Comparison of construction costs and operation characters of each crossing method is shown in Table 5-20. The most cheapest and easiest in operation is the overhead transmission line method. But the Canal Authority rejects the method because of the safty of navigation of the

canal. In other crossing methods by cables, the method which uses Ahmed Hamdi Tunnel is the cheapest one, and also easy for operation. It is recommendable to adopt the method which uses Ahmed Hamdi Tunnel for calbes.

3) Branch Transmission Line from the Existing Transmission Line

The existing transmission line is 220 kV Sakr SS - Suez SS 400 mm² single conductor line two circuits. From the line, New Suez SS will be branched with AAAC 620 mm² single conductor lines.

Table 5-20 (1) Comparison of Construction Cost for T/L

ITEMS	CASE 1 Overhead line	CASE 2 New Duct	CASE 3 Submarine	CASE 4 Ahmed Hamdi Tunnel
Conductor or Cable	620 sq.mmx2/ Phase AAAC	2000sq.mm x1/ Phase OF Cable	1400 sq.mmx2/ Phase OF Cable	2000 sq.mm x1/ Phase OF Cable
No. of circuits	4=	4	4	4
Length (m)	850	1000	1000	2000
Construction Cost(mil.¥)				
Steel Tower	318	-	-	-
Tunnel	-	1624	-	-
Excavation	-	-	5000	400
Civil Work	-	1200	310	100
Oil Box	-	-	480	-
Duct Both End	-	240	230	200
Cable or Conductor	90	503	1480	1008
Cable Head	-	120	240	120
Oil Tank	-	90	190	98
Trough & others	-	180	80	520
Bushing	-	720	720	720
Arrester	-	60	60	60
Optical Fiber	-	240	240	240
Water pipe replace	-	-	-	900
Erection	520	804	1200	840
TOTAL	928	5743	10230	4528
Construction Work	Lowest Conductor clearance from sea level : 80 m Tower's height : 188 m	Depth of pit (both side) : 50 m Tunnel length: 800 m Diam. of the inside tunnel : 3 m ϕ	Additional excavation length : 500 m width : 250 m deepest point: 40 m	Replace the water pipes. Two circuits lay in the air ducts, the others lay in the centrel duct.
Construction Period	10 months	26 months	40 months	8 months
Operation	No problem	No problem	If a trouble occures, it is very difficult to repair Cables	No problem

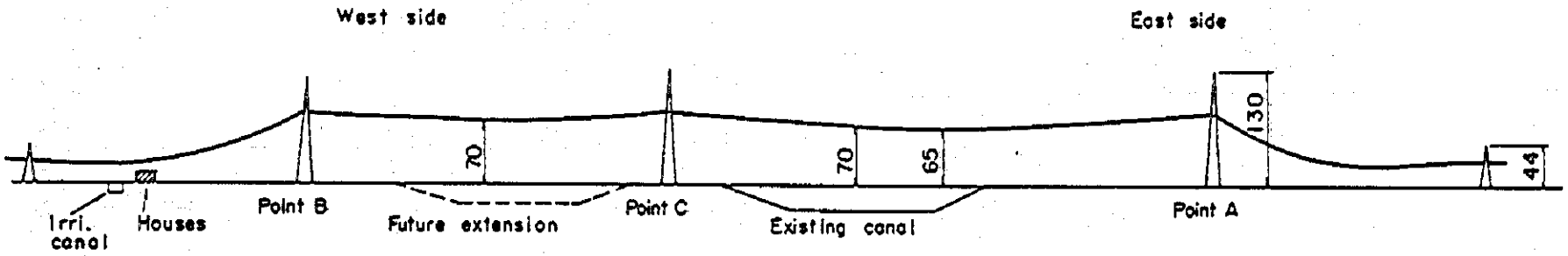
Table 5-20(2) Comparison of Construction Cost for T/L

ITEMS	CASE 5-1	CASE 5-2	CASE 5-3	CASE 6	CASE 7
	New Duct 2 circuits	Ahmed Hamdi Tunnel 2 Cir.	Submarine 2 circuits	(CASE 5-1)+ (CASE 5-2)	(CASE 5-2) + (CASE 5-3)
Conductor or Cable	2000 sq.mm 1/ Phase OF Cable	2000 sq.mmx1/ Phase OF Cable	1400 sq.mm x2/ Phase OF Cable	2000sq.mm x1/ Phase OF Cable	2000sq.mm & 1400sq.mm OF
No. of circuits.	2	2	2	4	4
Length (m)	1000	2000	1000	1000 & 2000	1000 & 2000
Construction Cost(mil.¥)					
Steel Tower	-	-	-	-	-
Tunnel	830	-	-	830	-
Excavation	-	200	2500	200	2700
Civil Work	700	60	200	760	260
Oil Box	-	-	290	-	290
Duct Both End	150	100	120	250	220
Cable or Conductor	252	504	740	756	1244
Cable Head	60	60	120	120	180
Oil Tank	48	48	48	96	96
Trough & others	90	260	73	350	333
Bushing	360	360	360	720	720
Arrester	30	30	30	60	60
Optical Fiber	120	120	120	240	240
Water pipe replace	-	100	-	100	100
Erection	450	440	720	990	1160
TOTAL	3020	2282	5771	5372	7603

Fig. 5-65 CANAL CROSSING TOWER (PRELIMINARY DRAWING)

UNIT: meter

CASE A Three (3) Towers



CASE B Two (2) Towers

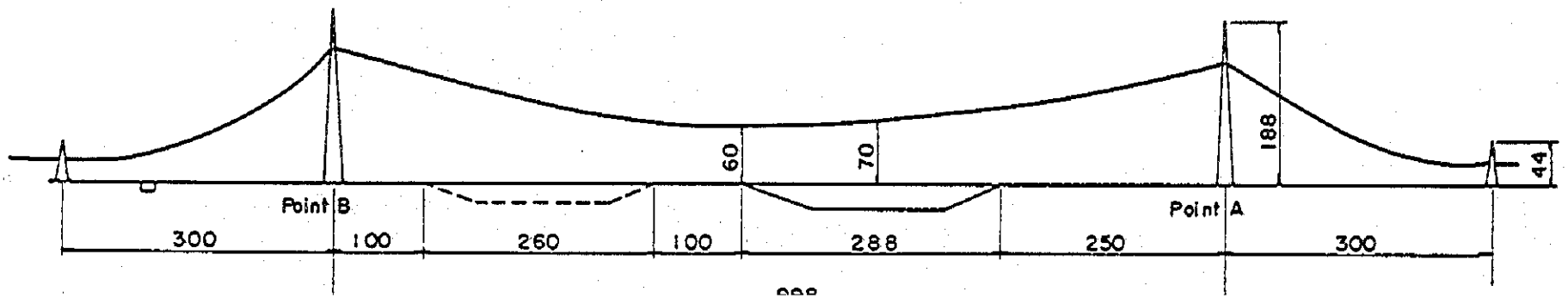
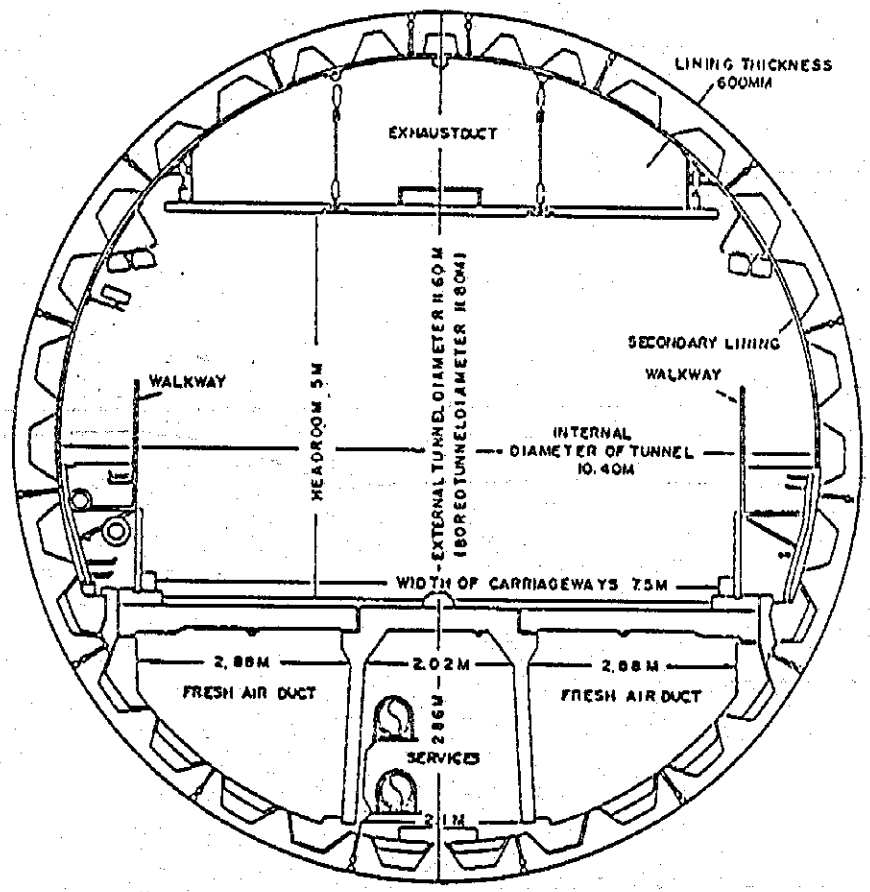


Fig. 5-66 Cross-section of Ahmed Hamdi Tunnel



Scale unit: cm

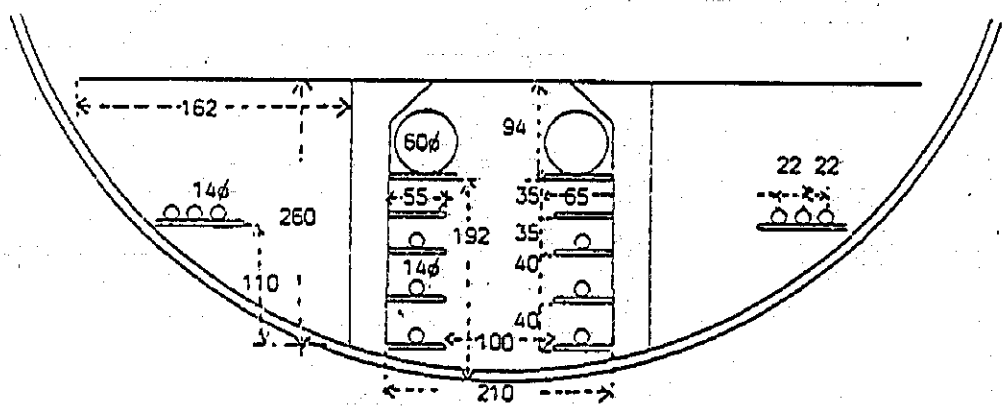


Fig. 5-67 Case New Duct.
220kV OF Cable 2,000mm^2 1/phase, 4 circuit

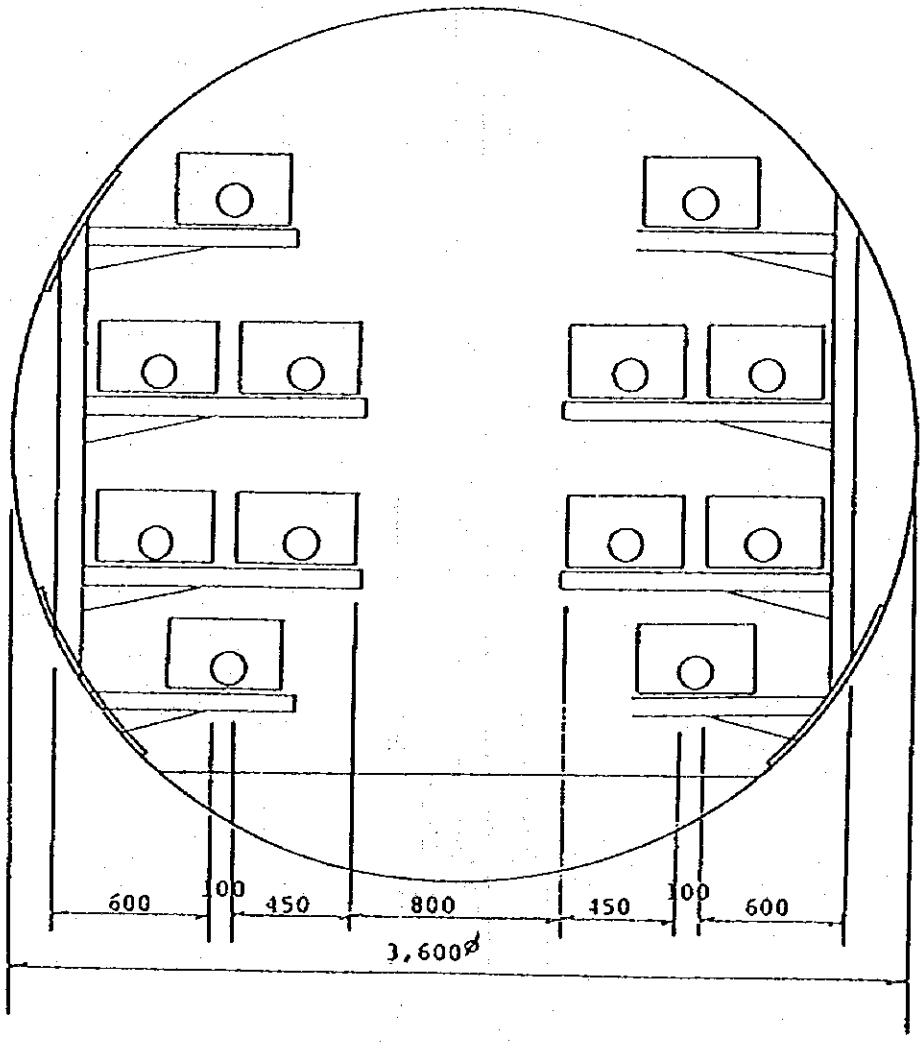
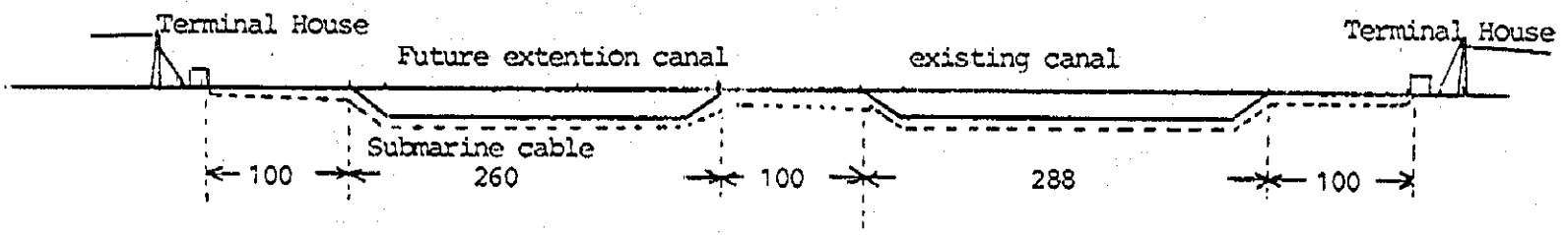


Fig. 5-68 Figure of Cable layout



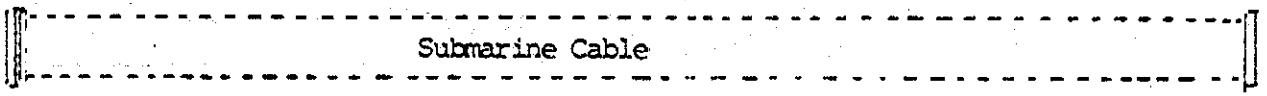
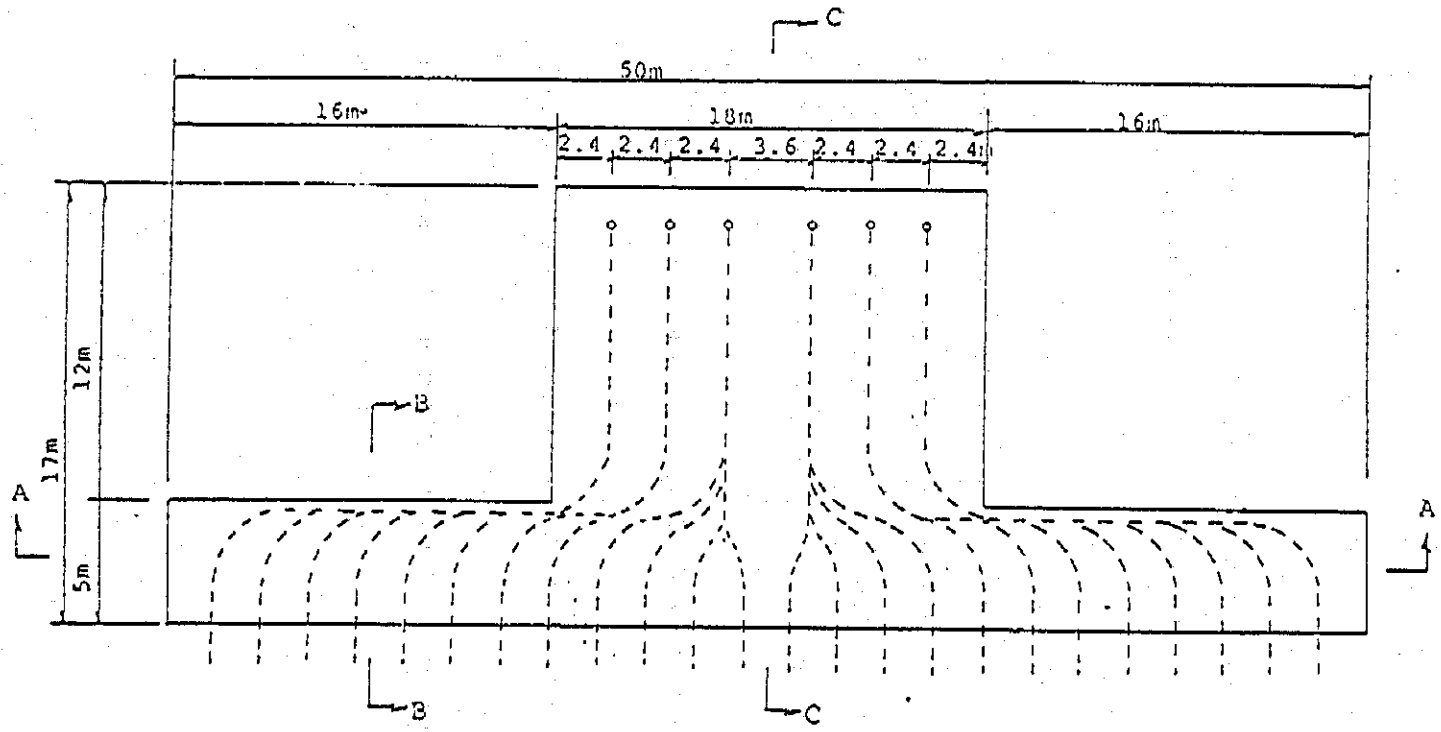
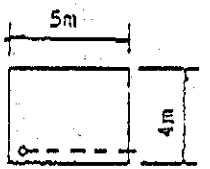


Fig. 5-69 Figure Dragin Duct for 220 kV 2 Circuit Submarine Cable

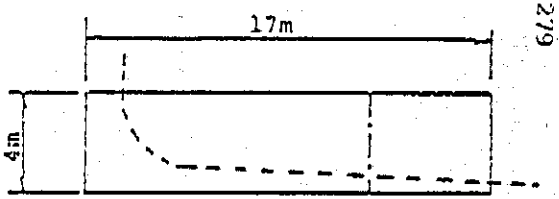
Plane figure



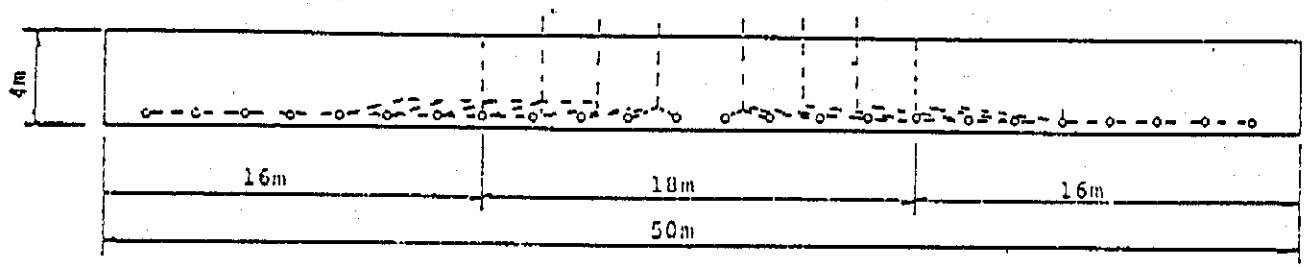
Vertical Section " B-B "



Vertical Section " C-C "



Vertical Section " A-A "



5-3-2 Substation

1) New Suez Substation

The substation will be constructed as an interconnecting station between Ayun Musa PS and a unified power system. But, as long as Ayun Musa PS's output is 600 MW only, the substation will be operated as a 220 kV switching station.

a. No. of 220 kV line

For Ayun Musa PS : four circuits

For branch point on the existing line: four circuits

b. Busbar Configuration

Double busbar system incorporating with EEA's tie circuit breaker system will be adopted and a circuit breaker is used for one line.

c. Protective Relay System

Two protection systems are installed for each circuit. a micro wave system and an optical fiber system are used for signal communication on Ayun Musa line. The power line carrier system is only used for Sakr SS and Suez SS line.

Fault localizer and fault recorder sets will be installed.

Relay maintenance set, station and portable types, will be procured.

The same type of protective relays used at Sakr SS and Suez SS, counter substation for branch line, shall be procured.

d. Future Extension Plan

When Ayun Musa PS becomes 1,200 MW station, one 500 kV line and two 500/220 kV transformers will be installed. For the 220 kV lines, the space for additional 6 circuits of drawing out line will be provided.

e. Others

Residential houses for employee will be constructed in the site.

5-3-3 Communication Facilities

1) Microwave Communication System

The microwave routes from the energy center to Ayun Musa PS are two ways as shown in Fig. 5-70. One is via Manayef SS and Abu Sultan PS, and another is via Abu Zaabal SS and Sakr SS. Facilities needed for two alternative plans are shown in Table 5-21.

Table 5-21 Communication Facilities for Microwave

Name of Station	Outputt	Dia. of Antena	Height of Tower
FIRST PLAN			
Abu Sultan PS	1 W	3 m	50 m
Repeater Station	1 W	2.4 m	30 m
	1 W	4 m x 2	30 m
Ayun Musa PS	1 W	3 m x 2	70 m
SECOND PLAN			
Sakr SS	1 W	8 m	120 m
Repeater Station	1 W	8 m	120 m
	1 W	3 m	120 m
New Suez SS	1 W	3 m	80 m
	1 W	3 m	80 m
Ayun Musa PS	1 W	3 m	105 m

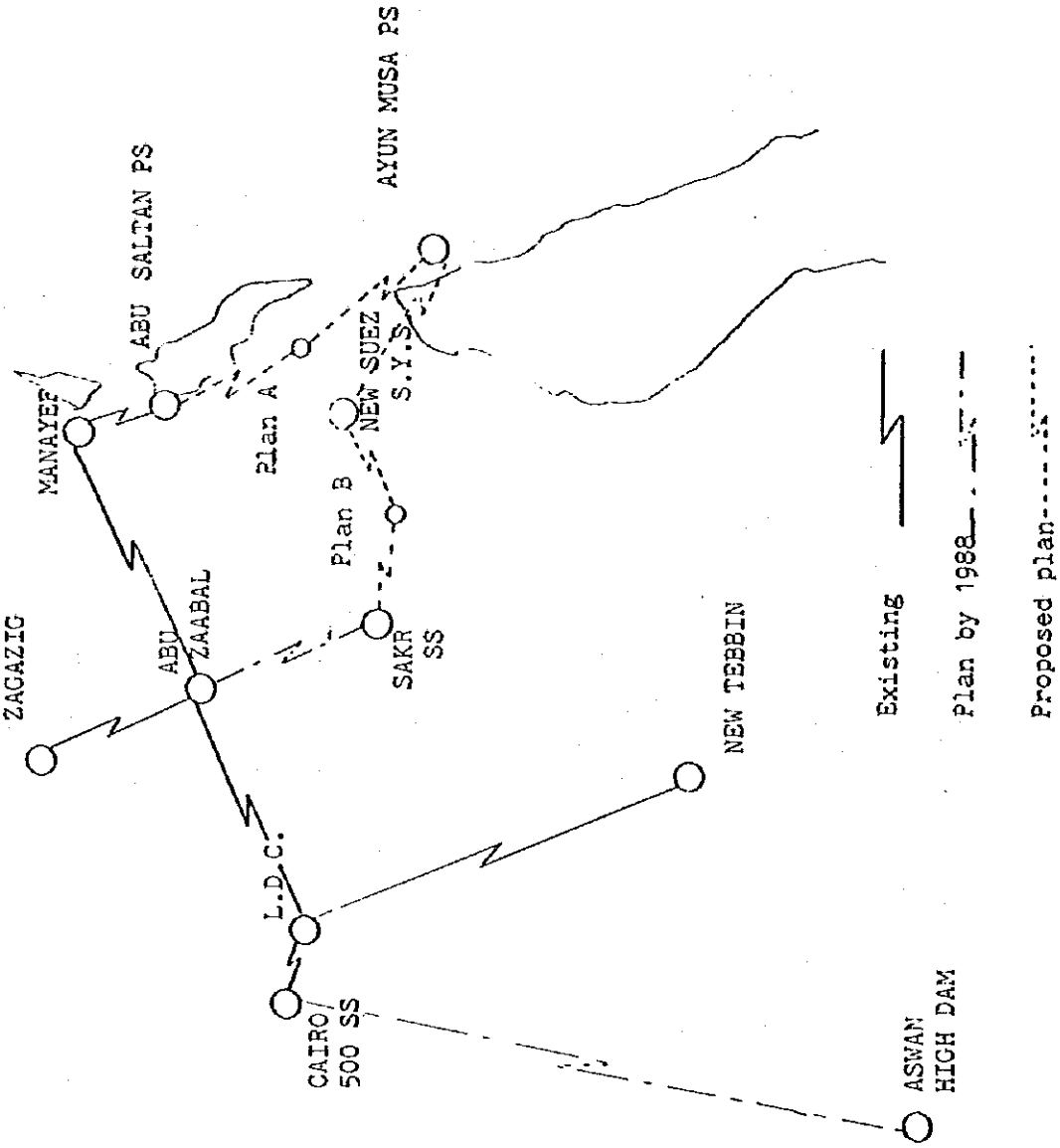


Fig.5-70 MICRO CHANNEL ROUTE FOR CAIRO--SUEZ AREA

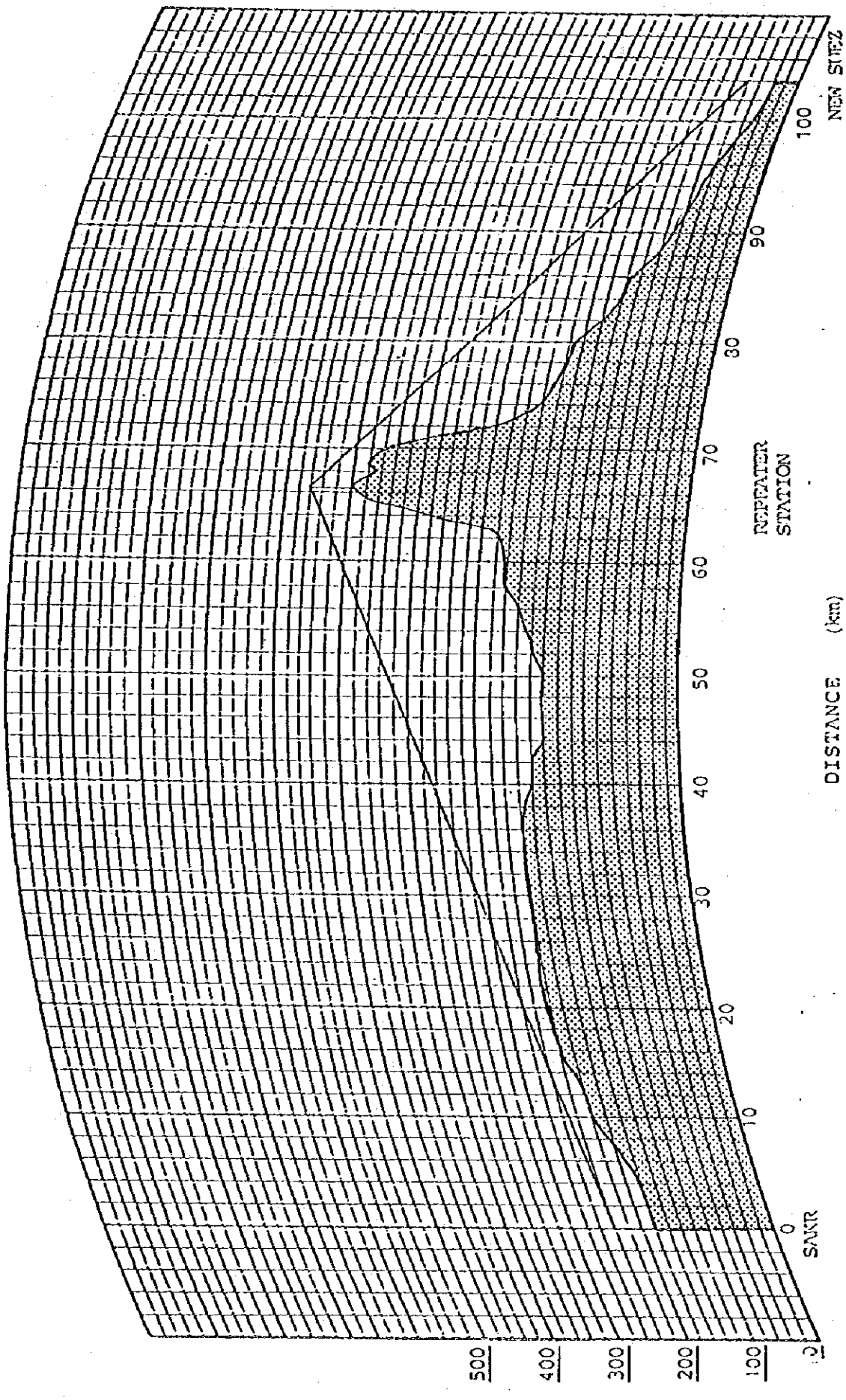


Fig. 5-74 FIGURE OF VISTA FOR SAMR SS ··· NEW SUEZ SS CHANNEL

The 2nd plan is more expensive than the 1st plan. But, the data communication between Ayun Musa PS and Abu Sultan PS depends on a single route of micro channel in the 1st plan. In the 2nd plan, two different microwave routes for the two power stations will be established. In future, therefore, the system formed in the 2nd plan will be easy to making a loop system for both the channels with higher reliability of operation.

Considering the reliability and future extension, the system in the 2nd plan is recommendable.

2) Power Line Carrier Facilities

a. Between New Suez Substation and Suez Tr. Substation

"Inter-circuit coupling PLC" system is used for protectional signal, voice and data transmission system.

b. Between New Suez SS and Sakr SS

Existing sets of Suez SS for Sakr SS will be transfered to New Suez SS and used as a set of communication for Sakr SS. But an additional channel will be installed to the existing set for the protectional relay signal.

c. Optical communication system between Ayun Musa PS and New Suez SS

The interconnecting lines include a 2 km cable system. And the load flow on the line is very heavy even in normal conditions. To prevent the electro-magnetic induction to the carrier communication system, the optical communication system shall be used between Ayun Musa PS and New Suez SS.

3) Instruments for Maintenance and Testing

Portable instruments for maintenance and testing for microwave and power line carrier set should be installed at Ayun Musa PS and New Suez SS.

CHAPTER 6

SPECIFICATIONS OF MAJOR FACILITIES

(1st Stage 300 MW x 2 Units)

CHAPTER 6 SPECIFICATIONS OF MAJOR FACILITIES

6-1 POWER GENERATING FACILITIES

Outline of the specifications for major facilities will be as follows:

6-1-1 Power Plant

1) Boiler

a. Boiler Proper

a) Type	:	Either natural or forced circulation drum-type, sub-critical, reheat, outdoor type
b) Maximum continuous rating (MCR)	:	Suitable capacity with 300 MW net output at the high voltage side of the step-up transformer (220 kV)
c) Steam conditions		
Main steam pressure at boiler outlet	:	Corresponding pressure Pressure drop between steam generator and turbine inlet less than 4% atmosphere
Main steam temperature at boiler outlet	:	541°C
Reheated steam pressure at RH outlet	:	Corresponding pressure Pressure drop between reheater and stop valve less than 10% atmosphere
Reheated steam temperature at RH outlet	:	541°C
d) Number of unit	:	2 units/plant

e) Fuel : Coal and oil

f) Draft system : Balanced draft system

b. Boiler Auxiliaries

a) Air preheater

Type : Vertical, regeneration type

Number : 2 sets/unit

b) Steam air preheater

Type : Fin-tube type

Number : 2 sets/unit

c) Boiler feed water pump

Turbine-driven boiler feed water pump

Capacity : 55%

Number : 2 sets/unit

Motor-driven boiler feed water pump

Capacity : 55%

Number : 1 set/unit

d) Soot-blowers

Type : Air-jet type

Number : 1 set/unit

e) Draft equipment

Forced draft fan

Type : Turbo vane, motor-driven

Number : 2 sets/unit

Induced draft fan

Type : Scirroco type, motor-driven

Number : 2 sets/unit

f) Coal firing equipment

Coal burners

Number : 1 lot/unit

Mill

Type : Vertical bowl mill motor-driven

Number : 5 sets/unit

Primary air fan

Type : Centrifugal type

Number : 2 sets/unit

g) Oil firing equipment

Oil burner

Number : 1 lot/unit

Heavy oil pump

Type : Screw type motor-driven

Number : 3 sets/unit

h) Light oil firing equipment

Number : 1 lot/unit

i) Compressed air equipment

Instrument air compressors

Type : Water-cooled oil-less type

Number : 2 sets/unit

House service air compressors

Type : Water-cooled oil-less type

Number : 1 set/plant

Sootblowing air compressors

Type : Water-cooled type

Number : 3 sets/plant

j) Dust collector

Type	:	Electrostatic type
Number	:	1 set/unit

k) Ash handling equipment

Bottom ash

Type	:	Water sluice type
Number	:	1 set/unit

Fly ash

Type	:	Vacuum type
Number	:	1 set/unit

Ash handling pump

Type	:	Vertical, motor-driven
Number	:	2 sets/unit

l) Stacks

Type	:	Steel-made collective type (for 2 units)
Number	:	1 lot/plant

m) Desalination plant

Type	:	Steam type
Number	:	1 lot/plant

n) Water treating equipment

Number	:	1 lot/plant

o) Waste water treating plant

Number	:	1 lot/plant

p) Fire Fighting System : 1 lot/plant

2) Turbine

a. Turbine Proper

a) Type : Reheat, condensing, tandem compound type

b) Rated output at generator sent out : Suitable capacity with 300 MW net output at the high voltage side of the step-up transformer (220 kV)

c) Steam conditions

Main steam pressure at turbine inlet : 169 kg/cm²

Main steam temperature at turbine inlet : 538°C

Reheated steam temperature at IP turbine inlet : 538°C

d) Number of unit : 2 units/plant

e) Rated condenser vacuum : 710 mmHg

f) Rated speed : 3,000 rpm

b. Turbine Auxiliaries

a) Condenser equipment

Condenser

Type : Surface type

Number : 1 set/unit

Cooling water Temperature : 27°C

Cooling water pump

Type : Vertical, motor-driven

Number : 2 sets/unit

Condensate pump

Type : Vertical, motor-driven

Capacity : 50% MCR

Number : 3 sets/unit

Condenser cleaning device

Number : 1 lot/unit

Seawater electrolysis facility

Number : 1 lot/unit

b) Feed water heater

LP heater

Type : Horizontal surface type

Number : 4 sets/unit

Deaerator

Type : Horizontal surface type

Number : 1 set/unit

HP heater

Type : Horizontal surface type

Number : 3 sets/unit

c) Bearing cooling water equipment

Number : 1 lot/plant

d) Overhead travelling crane

Number : 1 lot

3) Electrical Equipment and Control System

a. Electrical Equipment

a) Generator

i. Generator Proper

i) Type : Horizontal-shaft, totally enclosed, hydrogen cooled type

ii) Capacity : about 400 MVA

iii) Number of unit: 2 units/plant

iv) Power factor : 0.8

v) Short-circuit ratio : 0.58

vi) Rated voltage : about 18.3 kV or appropriately

vii) Number of phase: 3

viii) Frequency : 50 Hz

ix) Number of pole: 2

x) Rated speed : 3,000 rpm

ii. Generator auxiliaries: 2 sets

i) Exciter

Type : Static excitation

ii) Isolated phase bus

Type : Self-cooled continuous grounding

iii) PT and SA

Type : Self-standing, phase isolated type

iv) Neutral grounding device

Type : Pole transformer, 2ry resister type

v) Automatic voltage regulator

Type : Quick-response excitation system

vi) Hydrogen cooler system

Type : Water cooled type

b) Transformers

i. Main transformer with off-load tap changer

Type	:	3-phase, OFAF, outdoor type
Capacity	:	about 380 MVA
Number	:	1 set/unit
Voltage	:	18.3 kV or appropriately/230 kV

ii. House transformer with off-load tap changer

Type	:	3-phase ONAF, outdoor type
Capacity	:	about 25 MVA
Number	:	1 set/unit
Voltage	:	18.3 kV or appropriately/6.9 kV

iii. Starting transformer with on-load tap changer

Type	:	3-phase, ONAF, outdoor type
Capacity	:	about 30 MVA
Number	:	1 set/plant
Voltage	:	Primary 220 kV ±25 kV
		Secondary 6.9 kV

iv. Aux. transformer

Type	:	3-phase AN indoor dry type
Capacity	:	about 1,500 kVA
Number	:	7 sets/plant
Voltage	:	6.6 kV/380 V

c) Station service power supply switchgear equipment

i. 6.9 kV switchgear

Type	:	Metal-clad, draw-out, indoor type, 3-pole single throw, magnetic-blast breaker

ii. 380 V switchgear

Type	:	Metal-clad, 3-pole single throw, draw-out, indoor type

iii. Motor control center

Type : Steel sheet, self-supporting, collective switchgear panel type

iv. 220 V distribution panel

d) Uninterrable power supply unit

Voltage : AC 120 V 1-phase

CVCF : 2 sets/unit

e) DC system

Voltage : DC 125 V

Battery : 1 set/unit

Charger : 3 sets/plant

f) Cable

i. Power cable

ii. Control cable

iii. Instrument cable

g) Emergency generating facilities

Type : Package type gas turbine driven

Number : 1 set/plant

Rating:

Gas turbine : 17,500 kW (at 40°C)

Generator : 35,000 kVA 6.6 kV or appropriately

Fuel : Light oil

h) Hydrogen Generator System: 1 set/plant

b. Control System

a) Control panel : 1 set/unit

i. BTG control panel

ii. Auxiliary control panel

iii. Electrical control panel

iv. Local control panel

b) Control equipment : 1 set/unit

i. Automatic boiler control system

ii. Automatic burner control system

iii. Turbine automatic starting system

iv. Automatic synchronizing system

v. Sequential control system

vi. Data logger system

vii. Local loop control system

c. Station Service Communication System

a) Telephone sets : 200

b) Automatic exchange : 200 circuits

c) Power source : 1 set

d) Paging system : 1 set

e) Alarm system : 1 set

d. Lighting Facilities

a) Indoor lighting facilities

b) Outdoor lighting facilities

4) Fuel Handling Facilities

a. Coal Handling

Storage capacity	:	about 335,000 tons (full load operation of 600 MW for 60 days)
Unloader	:	1,300 t/h x 2 sets
Stacker/reclaimer	:	3,200 t/h/1,200 t/h x 1 set
Stacker	:	3,200 t/h x 1 set
Reclaimer	:	1,200 t/h x 2 sets
Conveyor		
Unloading conveyor	:	1,600 t/h x 2 systems
Stacker conveyor	:	3,200 t/h x 3 lines
Reclaimer conveyor	:	1,500 t/h x 2 lines
Supply conveyor (incl. conveyor house)	:	1,500 t/h x 1 line 600 t/h x 2 lines 1,500 t/h x 2 systems 500 t/h x 2 systems
Mix bin	:	300 t x 2 sets
Screen	:	500 t/h x 2 sets
Crusher	:	75 t/h x 2 sets

b. Heavy Oil

Loading arm	:	1 set
Unloading facilities (Air separator, strainer, flow meter)	:	1 set
Unloading pump	:	1,000 kℓ/h x 1 set
Storage tank	:	36,000 kℓ x 3 sets

c. Light Oil

Unloading facilities (Strainer, flow meter)

Bulldozer (Coal storage yard) : 1 set

Bulldozer (Coaler): 1 set

Storage tank

Bulldozer

(Cool storage yard): 50 k/ x 1 set

Bulldozer (Coaler): 5 k/ x 1 set

5) 220 kV Switchyard in Ayun Musa Power Station

a. Main Equipment

a) 240 kV SF_6 circuit breaker, with built-in bushing current transformer (outdoor use, puffer-type)

For main transformer, starting transformer, distribution transformer and transmission line : 16 units

Rated voltage : 240 kV

Rated current : 2,000 A

Rupturing capacity: 40 kA

b) 240 kV Disconnecting switch (outdoor use)

i. For main transformer, starting transformer, distribution transformer, bus section and transmission line (pneumatic operating type)

Pantograph type : 12 units

Horizontal center break type : 24 units

Rated voltage : 240 kV

Rated current : 2,000 A

Rated short-time current : 40 kA

ii. For lightning arrester (outdoor use, manual operating type)

Horizontal center break type : 4 units

Rated voltage : 240 kV

Rated current : 1,200 A

Rated short-time current : 31.5 kA

iii. 220 kV bus earthing device (outdoor use, manual operating type) single-phase : 6 units

Rated voltage : 240 kV

Rated short-time current : 31.5 kA

c) Capacitance potential device

i. For 220 kV bus

(single-phase) : 6 units

Rated voltage

Primary : $220/\sqrt{3}$ kV

Secondary : $110/\sqrt{3}$ V

Tertiary : 110 V

Rated burden

Secondary : 500 VA

Tertiary : 100 VA

ii. For 220 kV line

(single-phase) : 4 units

Rated voltage

Primary : $220/\sqrt{3}$ kV

Secondary : $110/\sqrt{3}$ V

Rated burden

Secondary : 50 VA

d) Power transformer with on-load tap changer for distribution, three-phase outdoor type

: 1 unit

Rated capacity : 40 MVA

Rated voltage

Primary : 220 kV ±25 kV

Secondary : 22 kV

Cooling system : ONAF

e) Lightning arrester, gaplass type

: 12 units

Rated voltage : 210 kV

Nominal discharge

current : 10 kA

f) 24 kV metal clad switchgear

i. Main circuit switchgear: 1 set

Rated voltage : 24 kV

Rated current : 1,200 A

Repturing

capacity : 20 kA

ii. Feeder circuit switchgear: 4 sets

Rated voltage : 24 kV

Rated current : 600 A

Interrupting current : 20 kA

iii. Auxiliary metal clad switchgear: 1 set

Contained grounding type potential transformer and lightning arrester

b. Other Equipment

a) Supervisory control panel, operator-console desk, 220 kV system panel and auxiliary panels

b) AC power source (station service panels)

c) DC power source (battery and battery charger)

d) Outdoor steel structure and bus support

e) Hot-line insulator washing apparatus

Water screen type washing apparatus (water tank, pumping set, nozzle, piping and control board)

f) 220 kV conductor

Aluminium pipe conductor (180 ø x 10 t, 100 ø x 6 t) and hard-drawn aluminium conductor (HAL 510 mm²)

g) 220 kV insulator

Suspension insulators and station post insulators

h) Air compressor (air reservoir and control panel)

i) Control cable, 22 kV power cable and optical fiber cable

j) Ground mat materials (annealed copper wire 100 mm² and conductor)

k) Communication system

Optical fiber communication terminal set: 2 sets

Automatic exchange: 200 cct 1 set

DC power source

48 V 20 A 210 AH : 1 set

24 V 300 A 1,000 AH : 2 sets

Information transmission unit

63 W C.D.T : 1 unit

15 W C.D.T : 1 unit

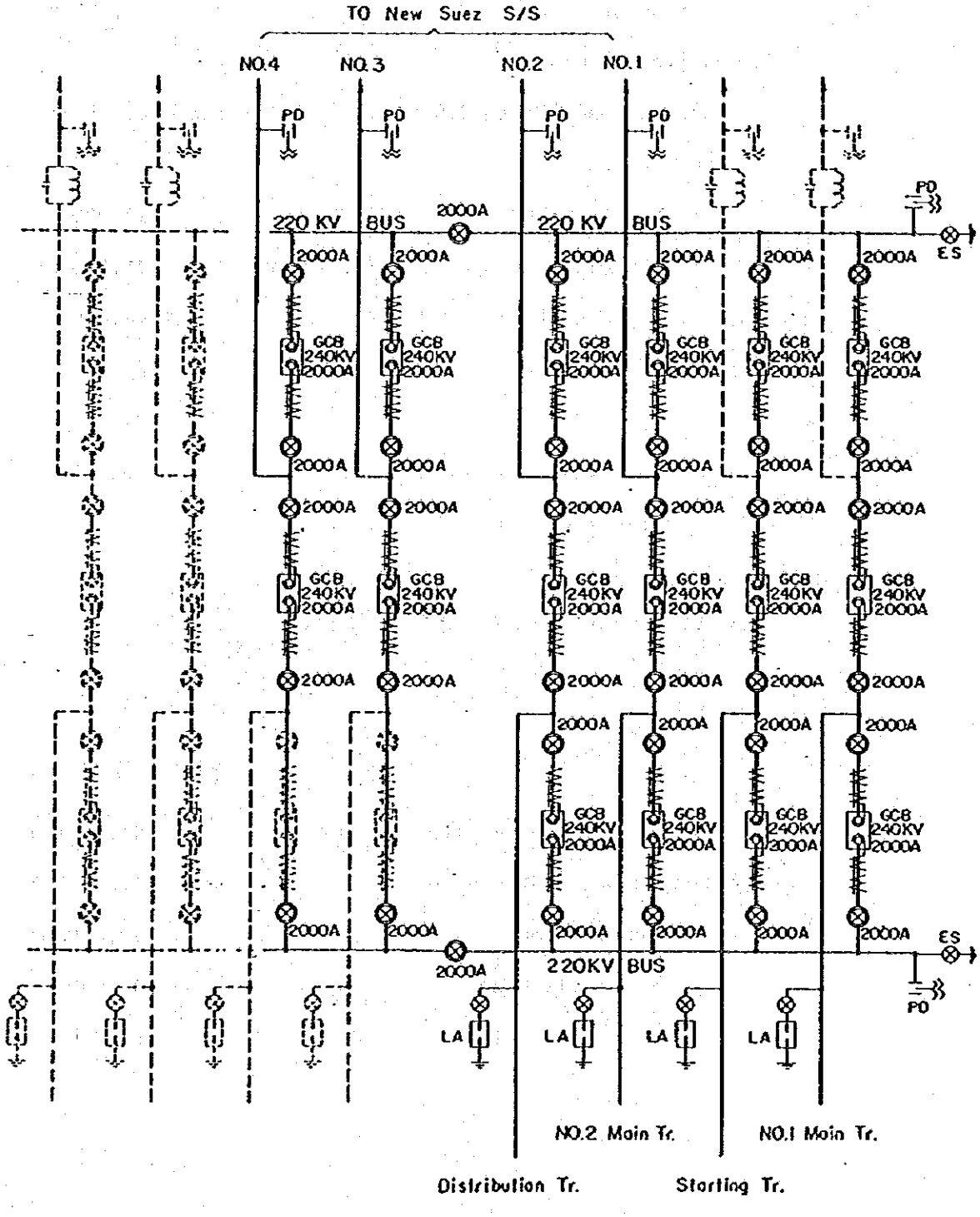
Wireless telephone

2 GHz PCM 0.2 W 24 CH: 2 units

Steel tower, 105 m : 1 set

Ayun Musa P/S Outdoor Switchyard

Single line Diagram



6-1-2 Civil Facilities

1) Land Reclamation

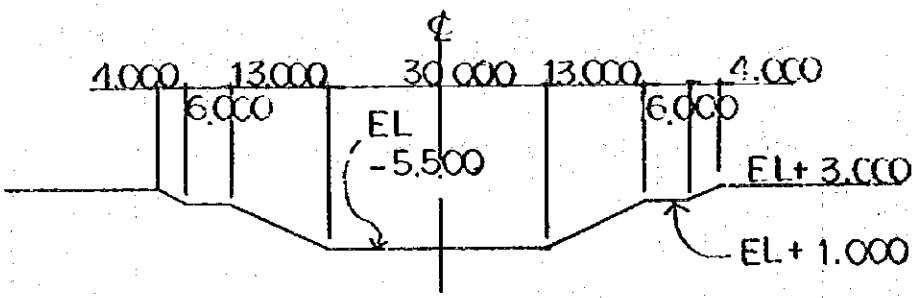
Area of Land Reclamation (1,200 m x 500 m)	600,000 m²
Compacted Fill	1,400,000 m³
Protection of Slope	14,000 m²
Asphaltic Pavement	
Access Road (Width 4.000 m x 2 lanes with green belt in between)	
L = 1,625.000 m	13,000 m²
Road in Plant (Width 8.000 m, 12.000 m)	41,000 m²
Specified Ground Level	EL +4.000

2) Circulating Water System

a. Inlet

Bottom level of inlet channel EL-5.500

Dimensions of inlet channel



Required Discharge (for 1,200 MW)	61.4 m³/s
Length of inlet channel	1,472.000 m
Rubble stone	32,000 m³
Stone pitching	131,000 m²
Compacted fill	81,000 m³

b. Intake Pumping Pit

Bottom slab of intake pumping structure	EL-5.500
Reinforced concrete	
30.800 m x 21.400 m x 10.500 m	
(Length) (Width) (Depth)	
Level of top slab	EL+4.000
Gate	8 pcs
Bar screen	4 pcs
Travelling screen	4 pcs
Sheet type wing wall	19.000 m x 20.000 m
Excavation	25,000 m^3
Concrete	2,900 m^3

c. Circulating Water Pipe Line

Level of circulating water pipe line	EL+0.580
Width of Excavation	12.000 m
Material of circulating water pipe line	
Core type prestressed concrete pipe	
(ϕ = 2.000 m, t = 0.110 m)	
Length of pipe line = 700 m	
Excavation	71,000 m^3
Gravel	9,600 m^3
Backfill	30,000 m^3

d. Discharge Culvert (for 1,200 MW)

Reinforced concrete	
12.700 m x 4.500 m x 250.000 m	
(Width) (Depth) (Length)	
Level of bottom slab	EL+0.000
Level of top slab	EL+4.000

Discharge channel

16.000 m x 4.000 m x 300.000 m

(Width) (Depth) (Length)

Retaining wall

Height	4.000 m
Slope	1 : 0.5
Level of footing	EL+0.000
Level of top	EL+4.000
Excavation	35,000 m³
Concrete	2,400 m³

e. Discharge Weir

EL±0.000 (Upstream)

16.000 m x EL+1.000 x

(Width) (Weir) EL-1.000 (Downstream)

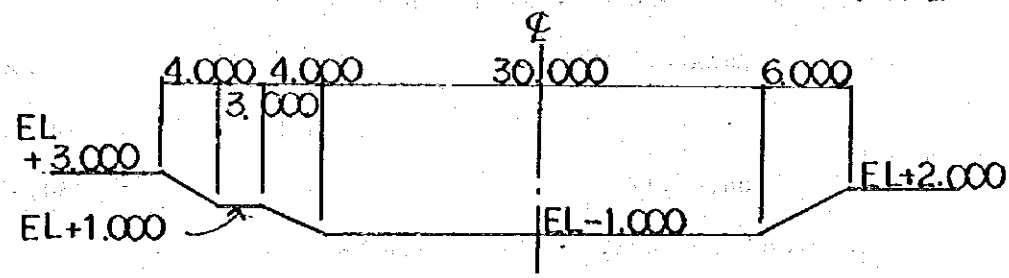
Sheet type wing wall 16.000 m, 18.000 m

(left bank, right bank)

f. Outlet

Bottom level of outlet channel EL-1.000

Dimensions of outlet channel L=600.000 m



Excavation	20,000 m³
Compacted fill	17,000 m³
Stone pitching	30,000 m²

3) Fuel Oil Storage Tank Foundation & Oil Dyke

a. Heavy Oil Storage Tank Foundation

Diameter of ring wall	ϕ 54.160 m
Dimensions of ring wall	0.400 m x 0.900 m
	(Width) (Height)
Thickness of asphaltic pavement	t = 0.050 m
Thickness of oil sand	t = 0.100 m
Slope of mound	i = 1/120, 1/20
Drain pipe	ϕ = 0.050 m, @1.500 m
Depth of displacement	2.000 m
Excavation	13,000 m³
Concrete	180 m³
Gravel	5,000 m³
Compacted soil	10,000 m³

b. Oil Dyke

Reinforced concrete

2.000 m x 0.300 m x 800.000 m

(Height from GL) (Width) (Length)

Expansion joint	One (1) per 20.000 m
Excavation	3,000 m³
Concrete	1,200 m³

c. Intermediate Dyke

Compacted fill (Width of bottom 3.000 m x Width of top 1.000 m x Height 0.800 m)	L = 200.000 m
Asphaltic pavement above compated fill	t = 0.050 m
Compacted fill	300 m³
Gravel	70 m³
Asphaltic pavement	30 m²

4) Coal Handling & Coal Storage Yard

a. Coal Handling (Conveyer foundation, berth to coal storage yard)

L = 3,100.000 m

Excavation	37,000 m³
Concrete	20,000 m³

b. Coal Storage Yard

Area of coal storage yard 420,000 m x 300,000 m

Stacker and reclaimer foundation

Compacted fill shall be made between original surface and EL+4.000 m.

20.000 m x 2.000 m x 4 lanes

(Wdith of foundation) (Height of compacted fill)

Ballast (EL+4.500 m)

Stacker foundation 10.000 m x 380.000 m x 1 lanes

(Width) (Length)

Reclaimer and stacker-reclaimer foundation

12.000 m x 380.000 m x 3 lanes

(Width) (Length)

Compacted fill	110,000 m³
Ballast	10,000 m³
Concrete	2,400 m³

5) Ash Disposal Facility

a. Planned Ash Disposal (600 MW for ten (10) years)

Level of dyke for ash pond	EL+4.000
Rubble dyke sloping type (ash pond)	L = 2,700 m

Slope of rubble 1 : 1.2, Stone pitching 1 : 2.0

Area of ash pond	950,000 m²

Volume of ash pond (EL+4.000)	3,700,000 m³
Rubble	27,000 m³
Stone pitching	22,000 m²
Compacted fill	165,000 m³
Concrete pavement	14,000 m²
Water-proofing sheet	40,000 m²

b. Planned Ash Disposal (Reference)

600 MW for two (2) years

1,200 MW for eight (8) years

Level of dyke for ash pond	EL+4.000
Rubble sloping type (ash pond)	L = 2,190 m
Slope of rubble 1:1.2, stone pitching 1:2.0	
Area of ash pond	1,616,000 m²
Volume of ash pond (EL+4.000)	6,198,000 m³
Rubble	21,000 m³
Stone pitching	18,000 m²
Compacted fill	140,000 m³
Concrete pavement	12,000 m²
Water-proofing sheet	34,000 m²

c. Planned Ash Disposal (Reference)

600 MW for two (2) years

1,200 MW for twenty eight (28) years

Level of dyke for ash pond	EL+4.000
Rubble sloping type (ash pond)	L = 6,000 m
Slope of rubble 1:1.2, stone pitching 1:2.0	
Area of ash pond (EL+4.000)	4,819,000 m²

Voluem of ash pond	14,908,000 m³
Rubble	46,000 m³
Stone pitching	48,000 m²
Compacted fill	402,000 m³
Concrete pavement	42,000 m²
Water-proofing sheet	95,000 m²

d. Unloading Jetty

Level of unloading jetty	EL+3.000
Length of unloading jetty	L = 50.000 m
Concrete block type jetty	
Rubble	10,000 m³
Stone pitching	9,000 m²
Dredge	28,000 m³

6) Miscellaneous Works

a. Lighting Pole Foundation

In the coal storage yard	10 pcs
Road in the plant	One (1) per 40.000 m

b. Ash Sluicing Pipe Foundation

Concrete pipe ϕ0.350 m x 5 lines

L = 600.000 m x 5 lines

c. Cable Trench

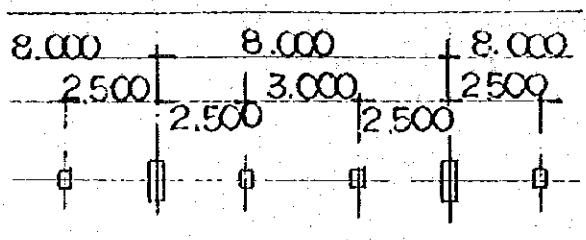
Reinforced concrete (with conver)

2.000 m x 1.500 m x 1,500.000 m

(Width) (Depth) (Length)

d. Oil Pipeline Foundation

L = 4,000 m



e. Neutralization Pit

25.000 m x 40.000 m x 1.700 m

(Width) (Length) (Depth)

f.	Demineralized Water Tank Foundation	ø8.240 m
g.	Raw Water Tank Foundation	ø14.160 m
h.	Desalination Plant Foundation	22.000 m x 25.000 m
i.	Landscaping	34,000 m²
j.	Gravel Pavement	t = 0.100 m, Area: 20,000 m²

6-1-3 Harbor facilities

1) Berthing Facilities

a. Kind of Harbor Facilities

Kind of Facilities	Size of Ship	Number of Berth	Length of Berth	Water Depth	Width of Berth
Coaler berth	60,000 DWT	1	300 m	EL-16 m (C.D.L -14.855 m)	25 m
Oil tanker berth	5,000 DWT	1	140 m	EL-8.5 m (C.D.L -7.355 m)	10 m
Small craft berth	500 GT	1	50 m	EL-5 m (C.D.L -3.855 m)	5 m

b. Height of Wharf Crown

a) Coaler wharf : EL+3 m

b) Oil tanker wharf : EL+3 m

c) Small craft wharf : EL+2 m

c. Structure Type of Mooring Facilities

a) Coaler wharf

Open-type wharf with coupled battered piles

Materials: Steel pipe pile

Upper parts of the piles (above LWL -1 m) will be covered with fiber grass reinforced plastic (F.R.P) for corrosion prevention, and other parts (from LWL -1 M to GL -1 m) will be protected with corrosion preventive paint and electrolytic protection, or other corrosion preventive method equivalent to the above method will be made.

b) Oil tanker wharf

Gravity quaywall (Concrete block type)

c) Small craft wharf

Gravity quaywall (concrete block type)

2) Channel and Basin

a. Channel

a) Water depth : EL-16 m (C.D.L. -14.855 m)

b) Width : 200 m

c) Length : 1,300 m

d) Area : About 320,000 m²

e) Side slope : 1:3

b. Anchorage Basin

a) Coaler ship

i. Water depth : EL-16 m (C.D.L. -14.855 m)

ii. Area : About 500 m x 550 m
= 275,000 m²

ii. Side slope of dredged area : 1:3

b) Oil tanker

i. Water depth : EL-8.5 m (C.D.L. -7.355 m)

ii. Area : About 350 m x 380 m
= 133,000 m²

iii. Side slope of dredged area : 1:3

c) Small craft

i. Water depth : EL-5 m (C.D.L. -3.855 m)

ii. Area : About 140 m x 150 m
= 21,000 m²

iii. Side slope of dredged area : 1:3

3) Causeway

a. Length of causeway : 2,700 m

b. Height of causeway crown : EL+3 m

c. Width of causeway : 20 m

4) Beacon, Range Light and Buoy

a. Beacon : 5 sets (2 sets on the chnnel inlet, 2 sets on the channel end and 1 set on the bend point at the middle of the channel)

b. Range Light : 2 poles (on the shoreline and land on the center line of the channel)

c. Buoy light : 8 sets (Bend points of basin) (2 sets without light)

5) Others

a. Water hydrant : 5 pionts (3 points on the coaler wharf, 1 point on the oil tanker wharf and 1 point on the small craft wharf)

b. Lighting facilities for night works on the causeway and berth : 1 set

c. Electric power source for repair works of ships : 1 set

d. Harbor administration office : 1 (100 m^2)

e. Miscellaneous warehouse : 1 (150 m^2)

f. Communication system between powerplant and berth : 1 set

g. Fire boat : 1 (50 ton class)

6-1-4 Architectural Facilities

1) Powerhouse

a. Building Area, Floor Area and Building Volume

Turbine-generator bay	:	2,990 m² (height 30 m)
Heater bay	:	1,280 m² (height 24 m)
Control bay	:	1,230 m² (height 18 m)
Bunker bay	:	1,380 m² (height 43.5 m)
Total building area	:	6,880 m²
Total floor area	:	19,730 m²
Building volume	:	142,020 m³ (excl. bunker bay)
		51,320 m³ (bunker bay)
Total building volume	:	193,340 m³

b. Substructure

a) Pile	:	High strength prestressed concrete pile or bored pile
		ϕ = 600 mm
		Bearing Capacity 120 t/pile
		Number of pile 700 piles
b) Foundation	:	Reinforced concrete, concrete tie beam
		Excavation Volume 53,000 m³
		Concrete Volume 11,000 m³

c. Superstructure

a) Frame	:	Steel structure
		Weight of steel structure
		5,700 ton

b) Roof : Corrugated resin coated steel sheet with insulation material and partly reinforced concrete structure, asphalt water-proofing

c) Floor : Reinforced concrete structure, tile and mortar finish and partly steel grating floor

Concrete Volume 2,000 m^3

d) Exterior wall : Corrugated resin coated steel sheet with insulation materials and partly Hollow concrete block, and sand textured coating

e) Interior wall : Hollow concrete block, paint on plastered and partly metal partition wall

f) Ceiling : Suspended ceiling, acoustic board, asbestos board and partly exposed concrete

d. Appurtenant Facilities

a) Air conditioning System: Air conditioning unit

Cooling capacity 230,000 kcal/h

Air volume 29,700 m^3/h

b) Ventilating system : Ventilating unit and roof ventilating fan

Ventilating unit 4 sets

Capacity 187,000 m^3/h/set

c) Water supply, drainage, sanitary and hot water supply system

d) Lightening Lod

e) Elevator system : 2 sets

Lifting capacity : 1,000 kg

Capacity : 15 persons

2) Service Building

a. Floor Area

Ground floor	:	1,370 m²
First floor	:	1,370 m²
Total floor area	:	2,740 m²

b. Substructure : Reinforced concrete, spread foundation

Excavation volume 3,000 m³

Concrete volume 700 m³

c. Superstructure

a) Structural frame : Reinforced concrete structure

b) Roof : Reinforced concrete structure, asphalt water-proofing

c) Floor : Reinforced concrete structure, tile and mortar finish

Concrete volume 1,400 m³

d) Exterior wall : Hollow concrete block, sand textured coating

e) Interior wall : Hollow concrete block, paint on plastered and partly metal partition wall

f) Ceiling : Suspended ceiling, acoustic board, asbestos board

d. Appurtenant Facilities

a) Air conditioning system: Air conditioning unit
Cooling capacity 300,000 kcal/h
Air volume 25,360 m^3/h

b) Ventilating system

c) Water supply, drainage, sanitary and hot water supply system

d) Lighting, wall receptacle and other electric system

e) Fire fighting system

f) Kitchen facilities

3) Auxiliary Buildings

Buildings	Houses	Structure	Total floor area	Quantities of major material		Air conditioning	Ventilating	Lighting	Water & hot water supply	Sanitary
				Concrete	Structural Steel					
Electric, instrument & control maintenance workers house	1	Reinforced concrete structure	390m^2	250m^3		o	o	o	o	o
Coal handling workers house	1	Reinforced concrete structure	340m^2	220m^3		o	o	o	o	o
Store house	4	Reinforced concrete structure	1,380m^2	700m^3		o	o	o	o	o
Coal handling control house and coal reduction house	1	Steel structure	3,200m^2	240m^3	380 t	o	o	o		
Seawater electrolysis house	1	Reinforced concrete structure	50m^2	30m^3		o		o		
Switchyard control house	1	Reinforced concrete structure	450m^2	300m^3		o		o		
Machine shop	3	Steel structure	900m^2	270m^3	80 t	o	o	o	o	o
Water treatment control house	1	Reinforced concrete structure	75m^2	40m^3		o		o		
Fire fighting pump house	1	Reinforced concrete structure	75m^2	40m^3			o	o		
Cylinder house	1	Reinforced concrete structure	100m^2	50m^3			o	o		
Guard house	3	Reinforced concrete structure	300m^2	150m^3		o		o	o	o
Oil fence house and harbor workers house	1	Reinforced concrete structure	90m^2	45m^3		o	o	o	o	o
Garage	1	Reinforced concrete structure	440m^2	150m^3				o		
Bulldozer house	2	Reinforced concrete structure	75m^2	40m^3				o		
Intake pump house	1	Steel structure	220m^2		50 t		o	o		
Lube oil storage house	1	Reinforced concrete structure	100m^2	50m^3			o	o		
Oil pump house	3	Reinforced concrete structure	150m^2	75m^3			o	o		
Neutralization control house	1	Reinforced concrete structure	50m^2	25m^3		o		o		

4) Major Equipment Foundations

Major equipment foundations will be made by reinforced concrete and will be supported by high strength prestressed concrete pile or bored pile.

a. Turbine-Generator Foundation

Excavation volume	:	3,000 m³
Pile	:	Dia. 600 ø
		Bearing capacity 120 t/pile
		Quantity 200 piles
Concrete volume	:	7,000 m³

b. Boiler Foundation

Excavation volume	:	15,000 m³
Pile	:	Dia. 600 ø
		Bearing capacity 120 t/pile
		Quantity 650 piles
Concrete volume	:	8,000 m³

c. Stack Foundation

Excavation volume	:	7,000 m³
Pile	:	Dia. 600 ø
		Bearing capacity 120 t/pile
		Quantity 70 piles

5) Planning of Residential Quarters

Housing, recreation facilities and community service facilities for power plant personnel and their families will be planned. (Construction cost of residential quarters will be excluded in the construction cost of this project.)

a. Housing

Type A	6 flats	150 - 170 m²/flat
Type B	132 flats	100 - 110 m²/flat
Type C	162 flats	80 - 90 m²/flat
Total	300 flats (for 300 MW x 2 units)	

In the future expansion of power generating facilities, it is necessary to expand housing 250 - 300 flats more.

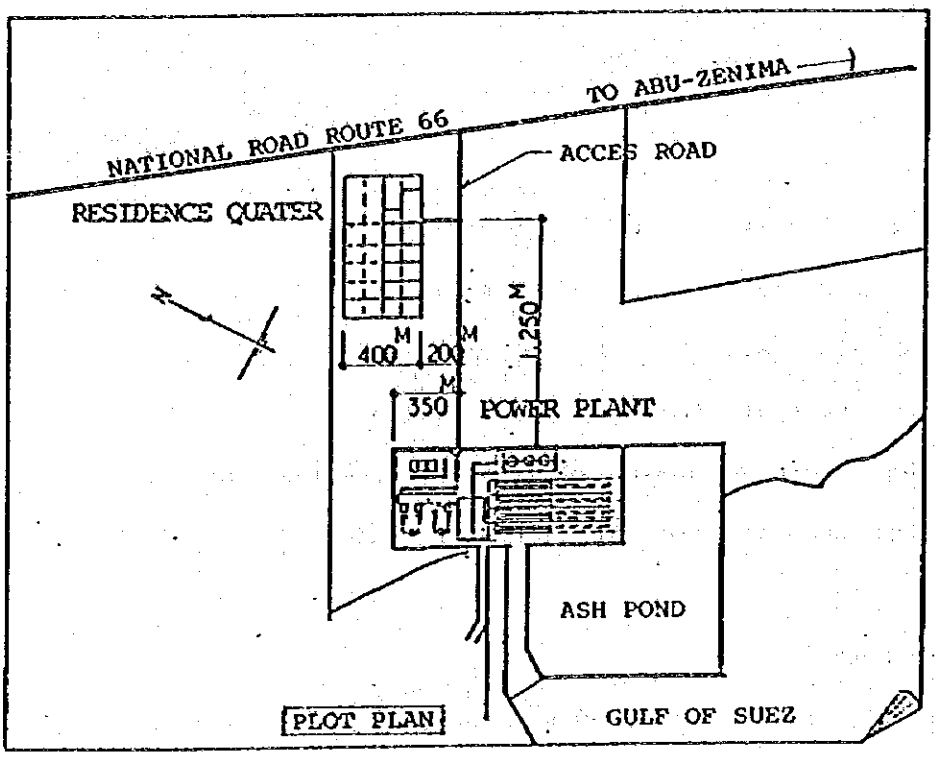
b. Community Service

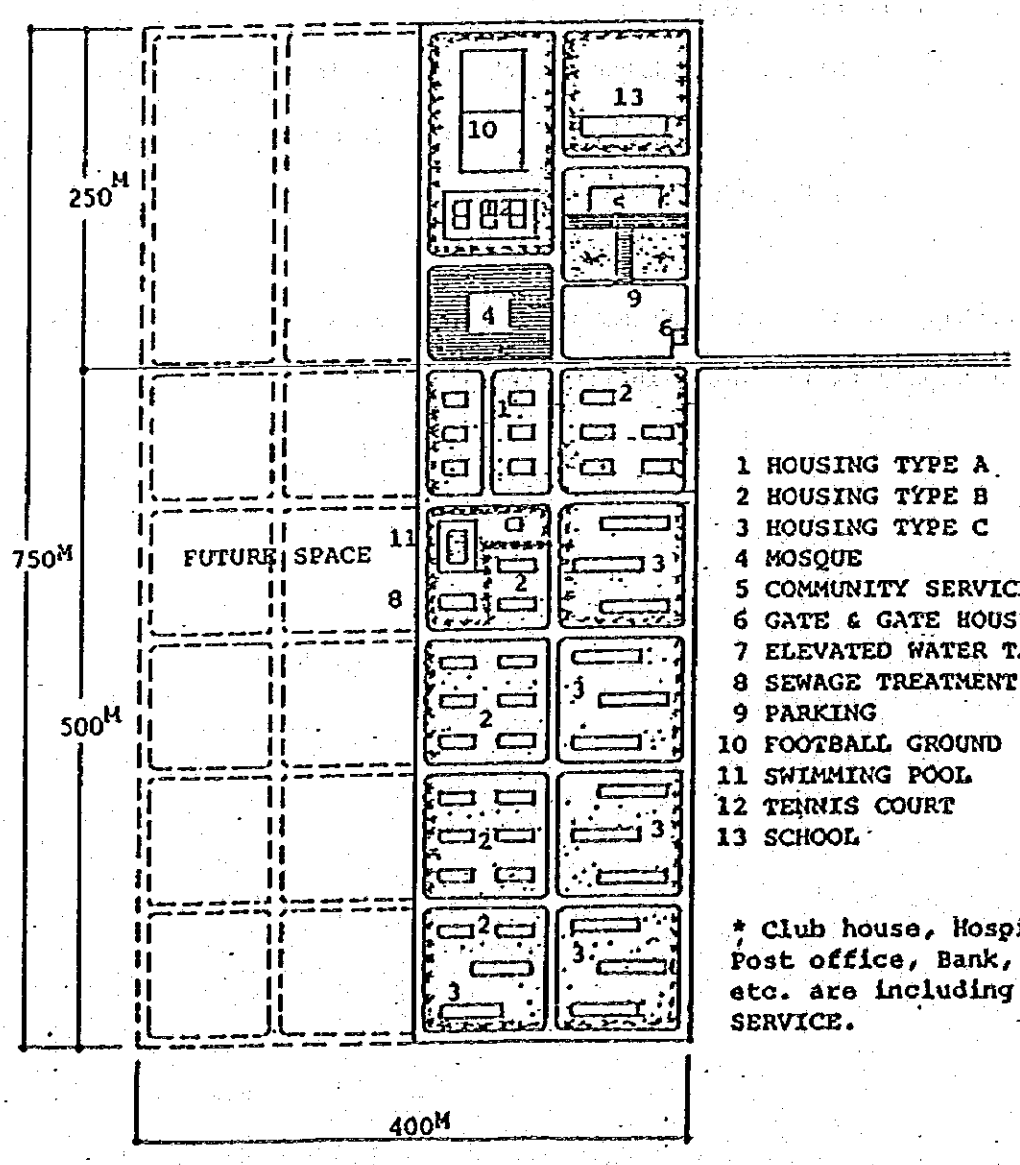
Hospital, post office, shop, bank, school, mosque, park, etc. will be planned for community.

c. Recreation Facilities

Athletic facilities such as tennis court, football ground, swimming pool, etc. and club house with accommodations for guests will be planned.

Public facilities such as road, waterworks, sewage, electric power supply facilities, lighting facilities will be planned.





1 HOUSING TYPE A
2 HOUSING TYPE B
3 HOUSING TYPE C
4 MOSQUE
5 COMMUNITY SERVICE
6 GATE & GATE HOUSE
7 ELEVATED WATER TANK
8 SEWAGE TREATMENT PLANT
9 PARKING
10 FOOTBALL GROUND
11 SWIMMING POOL
12 TENNIS COURT
13 SCHOOL

* Club house, Hospital, Shop, Post office, Bank, Guest room, etc. are including to COMMUNITY SERVICE.

6-2 TRANSMISSION LINE SYSTEM

6-2-1 Transmission Line

1) 220 kV Overhead Transmission Line

a. Facility

Voltage	:	220 kV
Conductor	:	AAAC 620 mm² x 2
No. of circuits	:	4 circuits
Length	:	40 km
Steel tower	:	2 circuits/tower
Insulators	:	320 mm Fog type insulators 20 pc/string
Ground wire	:	130 mm² compound wire with optical fiber

b. Steel Tower (see: Figs. 6-1, 6-2 and 6-3)

	Height	Weight	No. of Towers
A type tower (tangential)	44.4 m	14.3 t	188
B type tower (light angle)	43.6 m	16.3 t	12
C type tower (heavy angle)	43.6 m	18.4 t	14
D type tower (dead end)	43.6 m	22.9 t	8
Total			222

2) Canal Crossing Cable

a. Facility

Voltage	:	220 kV
Conductor	:	OF cable 2,000 mm²
No. of circuits	:	4 circuits
Length	:	2 km

3) 220 kV Branch Line

a. Facility

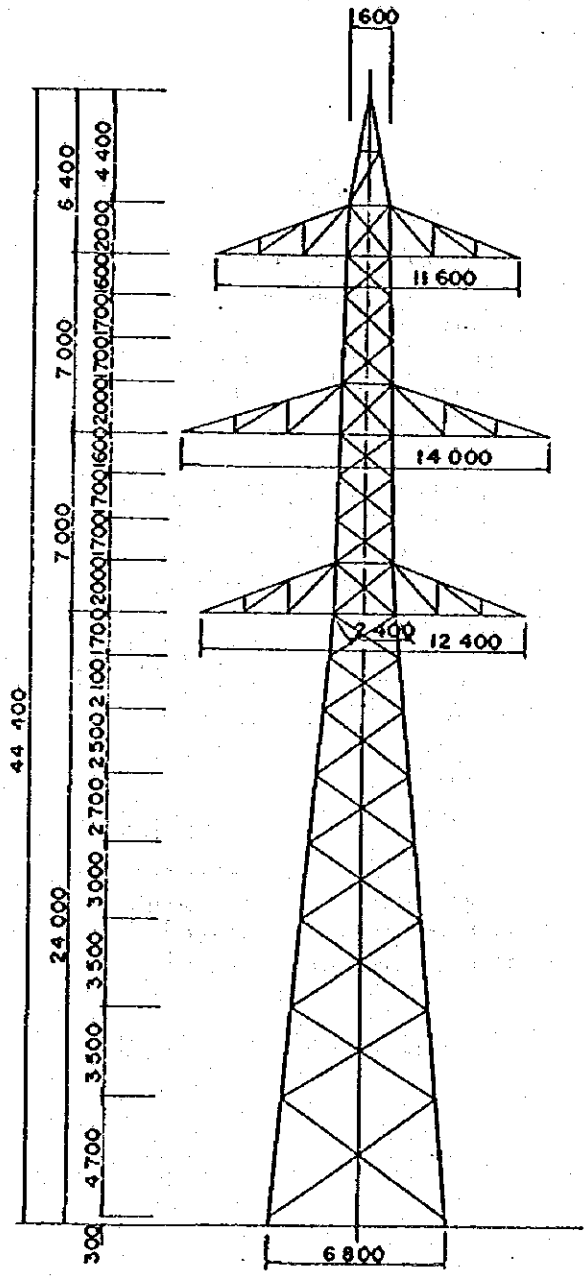
Voltage	:	220 kV
Conductor	:	AAAC 620 m² x 1
Length	:	1.5 km
No. of circuits	:	4 circuits
Steel tower	:	2 circuits/tower
Insulators	:	320 mm Fog type 20 pc/string
Ground wire	:	108 mm² Zn coated steel strand wire

b. Steel Tower

A type tower	Height:	44.4 m, Weight: 10.9 t, 6 pcs.
D type tower	Height:	43.6 m, Weight: 17.0 t, 4 pcs.

Fig 6-1
220KV AAAC 620mm²x2 : two circuits A Type

220KV 2cct A Type



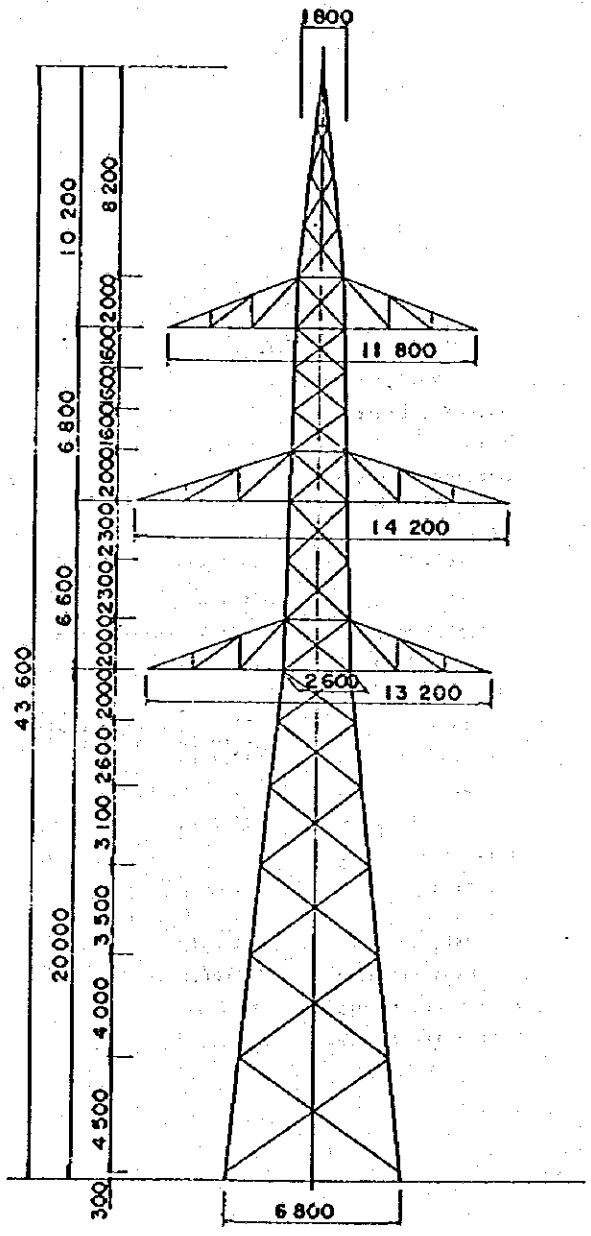
220 kV 2 cct A Type

Design condition

No. of circuits	2
Span	350 m
Horizontal angle	3°
Vertical angle	0.1 ↑
Conductor	
Size	AAAC 620 mm² x 2
Dia	28.1 mm
Weight	1674 kg/km/one cond.
Max. tension	5500 kg
Gr. Wire	
Size	130 mm² Composund wire with Optical fiber
Dia	17.4 mm
Weight	785.8 kg/km
Max. tension	3200 kg
Insulator	
Type	320 mm Socg 20 pc 1 string
Weight	880 kg/m each
Wind pressure	200kg/each
Wind pres. to wire	80 kg/m²
Wind pres. to tower	255 kg/m²

Fig 6-2
220 KV AAAC 620mm² x 2 : two circuits Tower : B&C Type

220 KV 2cct C Type



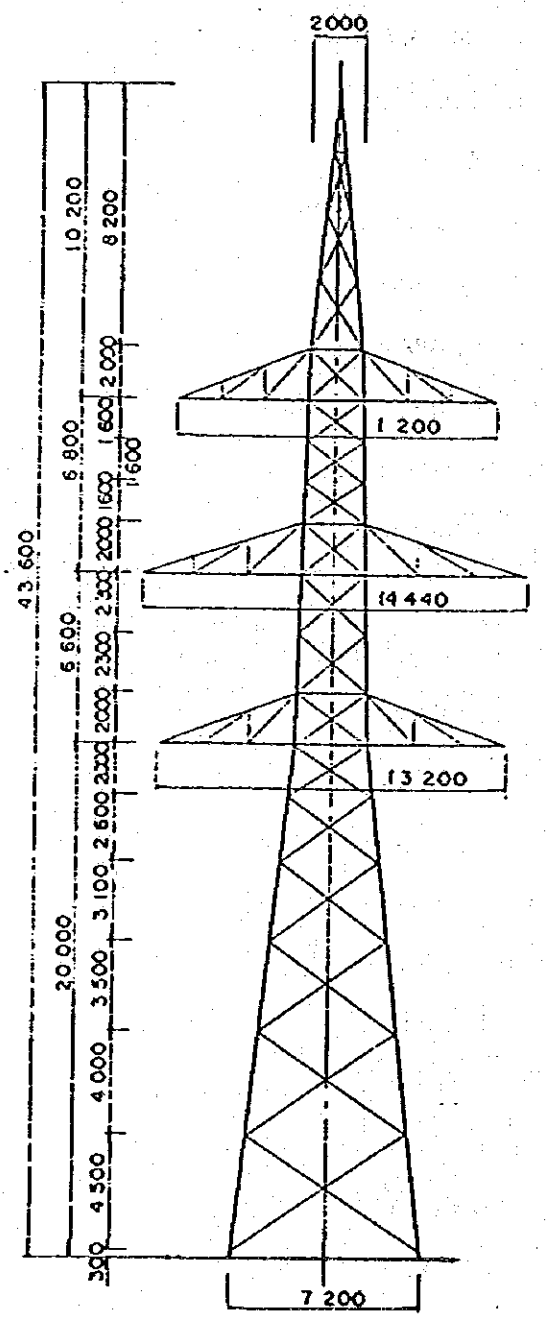
220 kV 2 cct B & C Type
Design Condition

No. of circuit	2
Span	350 m
Horizontal angle	30°
Vertical angle	0.1 I
Conductor	
Size	AAAC 620 mm² x 2
Dia	28.1 mm
Weight	1674 kg/km/one cond.
Max. tension	5500 kg
Gr. Wire	
Size	130 mm² Compound wire with Optical fiber
Dia	17.4 mm
Weight	785.9 kg/km
Max. tension	3200 kg
Insulator	
Type	320 mm Saog 20 pc 2 string
Weight	2200 kg/each
Wind pressure	560 kg/each
Wind pres. to wire	80 kg/m²
Wind pres. to tower	255 kg/m²

Fig 6-3

220KV AAAC 620mm^2 x 2 : two circuits D Type

220KV 2cct D Type



220 kV 2 cct D Type	
Design Condition	
No. of circuit	2
Span	350 m
Horizontal angle	Dead end
Vertical angle	0.1 I
Conductor	
Size	AAAC 620mm^2 x 2
Dia	28.1 mm
Weight	1674 kg/km/one cond.
Max. tension	5500 kg
Gr. Wire	
Size	130 mm^2 Compound wire with Optical fiber
Dia	17.4 mm
Weight	785.9 kg/km
Max. tension	3200 kg
Insulator	
Type	320 mm Sang 20 pc ℓ string
Weight	2200 kg/each
Wind pressure	580 kg/each
Wind pres. to wire	90 kg/m^2
Wind pres. to tour	255 kg/m^2

6-2-2 New Suez Substation

1) Main Equipment

a. 240 kV SF_6 gas circuit breaker, with built-in bushing current transformer (outdoor use, Puffer-type)

a) For transmission line : 8 units

Rated voltage : 240 kV

Rated current : 2,000 A

Rupturing capacity: 40 kA

b) For bus coupler : 1 unit

Rated voltage : 240 kV

Rated current : 4,000 A

Rupturing capacity: 40 kA

b. 240 kV Disconnecting Switch (outdoor use)

a) For transmission line : 8 units

(pneumatic operating type)

Horizontal center break type, with earthing switch

Rated voltage : 240 kV

Rated current : 2,000 A

Rated short-time current : 40 kA

b) For bus (pneumatic operating type)

- Pantagraph type : 16 units
- Horizontal center break type : 4 units

(45-degree angle installation)

Rated voltage : 240 kV

Rated current : 2,000 A

Rated short-time current : 40 kA

c) For bus coupler (pneumatic operating type)

Pantograph type : 4 units

Rated voltage : 240 kV

Rated current : 4,000 A

Rated short-time current : 40 kA

d) For bus section (pneumatic operating type)

Horizontal center break type : 2 units

Rated voltage : 240 kV

Rated current : 4,000 A

Rated short-time current : 40 kA

e) 220 kV bus earthing device

(outdoor use, manual operating type)

single phase : 12 units

Rated voltage : 240 kV

Rated short-time current : 31.5 kA

c. Capacitance Potential Device

a) For 220 kV bus (single phase): 12 units

Rated voltage

Primary : $220/\sqrt{3}$ kV

Secondary : $110/\sqrt{3}$ V

Tertiary : 110 V

Rated burden

Secondary : 500 VA

Tertiary : 100 VA

b) For 220 kV line (single phase): 12 units

Rated voltage

Primary : $220/\sqrt{3}$ kV

Secondary : $110/\sqrt{3}$ V

Rated burden

Secondary : 50 VA

2) Other Equipment

a. Supervisory control panel, operator-console desk, 220 kV system panel and auxiliary panels

b. AC power source (station service panels and service transformer)

c. Emergency diesel generator (battery starting system)

d. DC power source (battery and battery charger)

e. Outdoor steel structure and bus support

f. 220 kV conductor

Aluminium pipe conductor (180 ø x 10 t, 120 ø x 8 t)

Refer to APPENDIX-B.

g. 220 kV insulator

Suspension insulators and station post insulators

h. Air compressor (air reservoir and control panel)

i. Ground mat materials (annealed copper wire 100 mm^2 and connector)

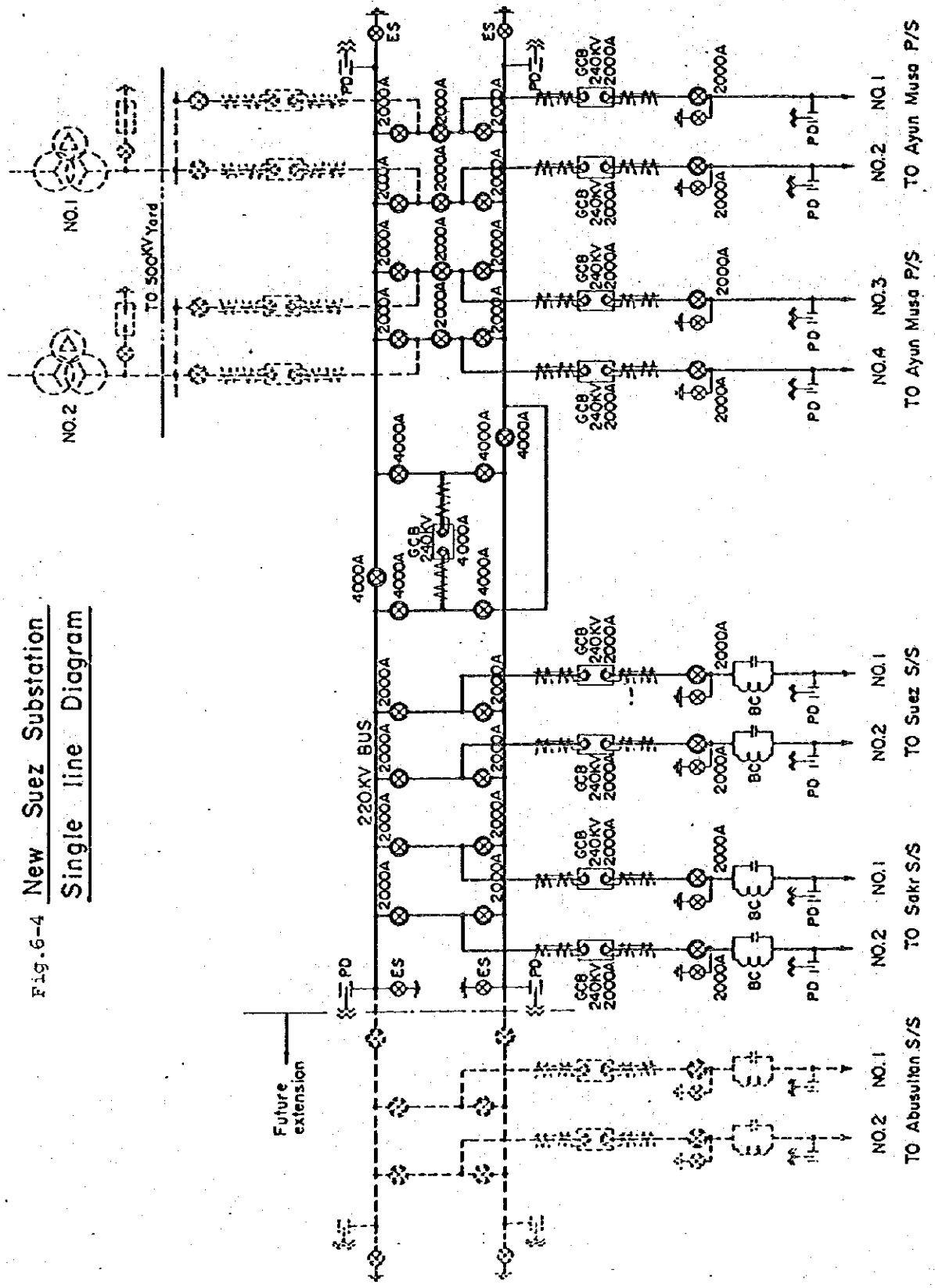
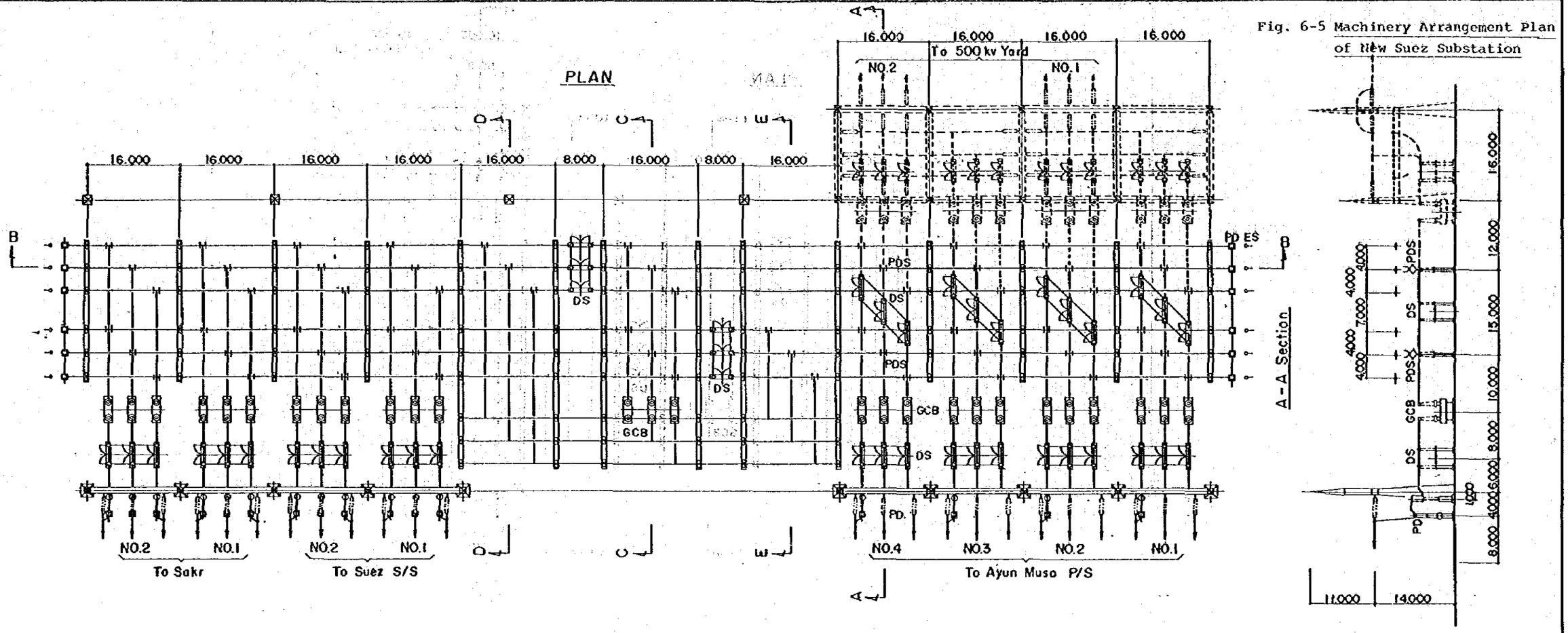
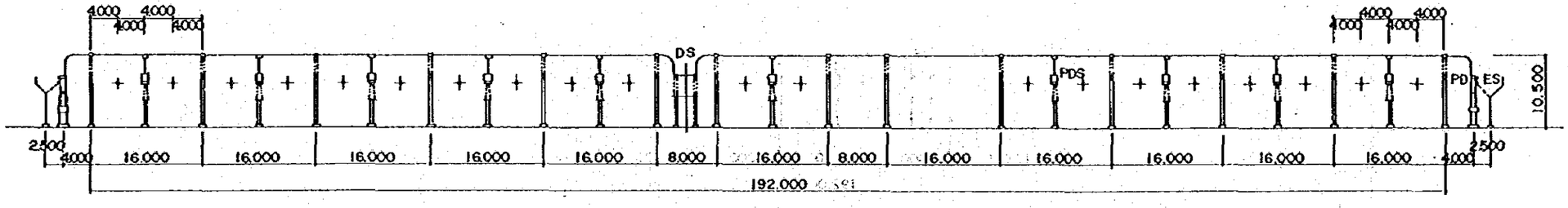


Fig.6-4 New Suez Substation
Single line Diagram

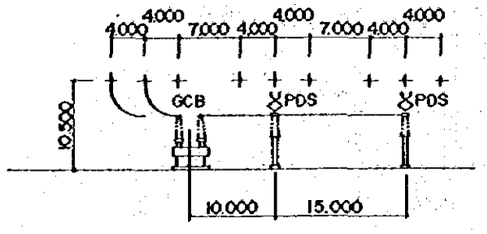
Fig. 6-5 Machinery Arrangement Plan of New Suez Substation



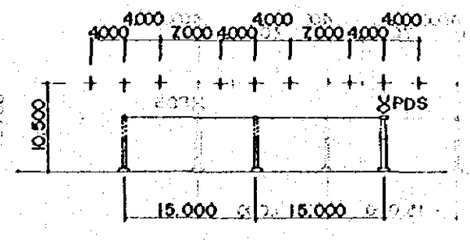
B - B Section



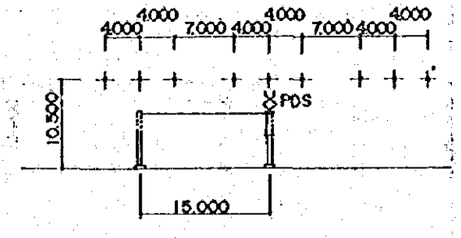
C - C Section



D - D Section



E - E Section



SCALE 0 10 20 30 40M

THE ARAB REPUBLIC OF EGYPT	
SINAI COAL-FIRED THERMAL POWER PROJECT	
TITLE: MACHINERY ARRANGEMENT PLAN OF NEW SUEZ SUBSTATION	
SCALE	DRAWING NO. E - 1

6-2-3 Protecting Relay System

1) For Ayun Musa PS Line

a. Main Relay

#1 set Transient comparison or phase comparison based on wave deflection with micro wave system

#2 set Directional comparison distance relay with power line carrier system (three steps)

Distance relay.. Full scheme, No any switching is accepted earlier in zone or type of fault. Multi measuring scheme

b. Reclosing Relay System (one shot)

Three phase reclosing system (dead time adjustable up to 6 sec.)

c. Back-up Relay

Directional over current relay with voltage restraint

d. Others

a) A protection scheme of circuit breaker failure

b) Over-voltage relay blocked with reactive power

c) Low voltage relay

2) For Sakr SS and Suez Tr. SS Line (Other side's relay sets are same.)

a. Main Relay

#1 set Transient comparison or phase comparison with power line carrier system

#2 set Directional comparison distance relay with power line carrier system (Three steps)

b. Reclosing Relay System (one shot)

Three phase reclosing system (dead time adjustable up to 6 sec.)

c. Back-up Relay System

Directional over current relay with voltage restraint

3) For Bus Coupler Circuit Breaker

High speed differential relay and over current relay with voltage restraint

4) For Bus Protection

One protection scheme for bus protection

5) Fault Recorder Sets with sequential chart recorder

6) Fault Localizer

Pulse ejector system and impulse detecting system

7) Continuous Monitoring of Relay System

8) Testing instrument sets at protecting relay room and portable one

6-2-4 Communication Equipment

1) Micro Wave System

a. Location of Site

Frequency : 2 GHz

Name of station	Distance (km)	Elevation (m)
Sakr SS		180
	66.2	
Repeater station		500
	32.3	
New Suez SS		70
	23.0	
Ayun Musa PS		5

b. Equipment

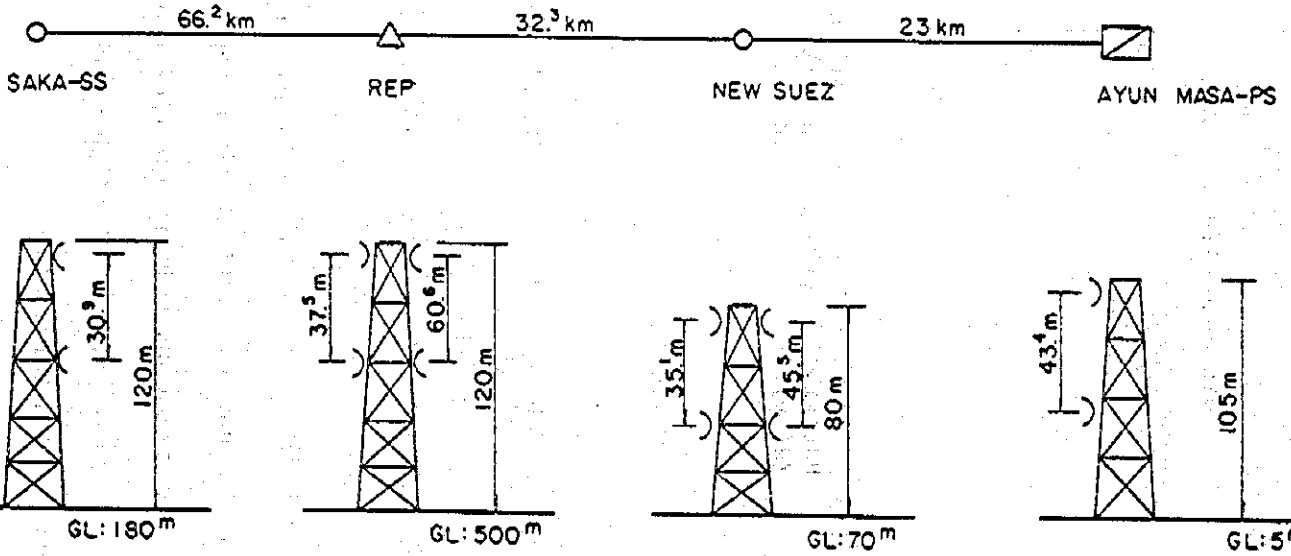
Name of Station	Steel Tower (m)	Parabola Antena	Micro Set	Feeder (m)	D.C. source Battery (24 V)	D.C. source Charger	Exchanger Battery (48 V)	Exchanger Charger
Sakr SS	120	8 mø x 2	2	270	-	-	-	-
Repeater station	120	8 mø x 2 3 mø x 2	2 2	410	14V 7.5kAh		-	-
New Suez SS	80	3 mø x 2 3 mø x 2	2 2	360	500Ah x 2	150 A	108 Ah	20 A
Ayun Musa P.S.	105	3 mø x 2	2	405	500Ah x 2	150 A	210 Ah	50 A

2) Optical Communication System

Most parts of optical fiber are contained in ground wires of transmission lines. To use the optical fiber for signal transmission is mainly to avoid an induced interference from the heavy loaded cable system. PCM-1.5 M 12 channel is used for signal transmission at both terminals.

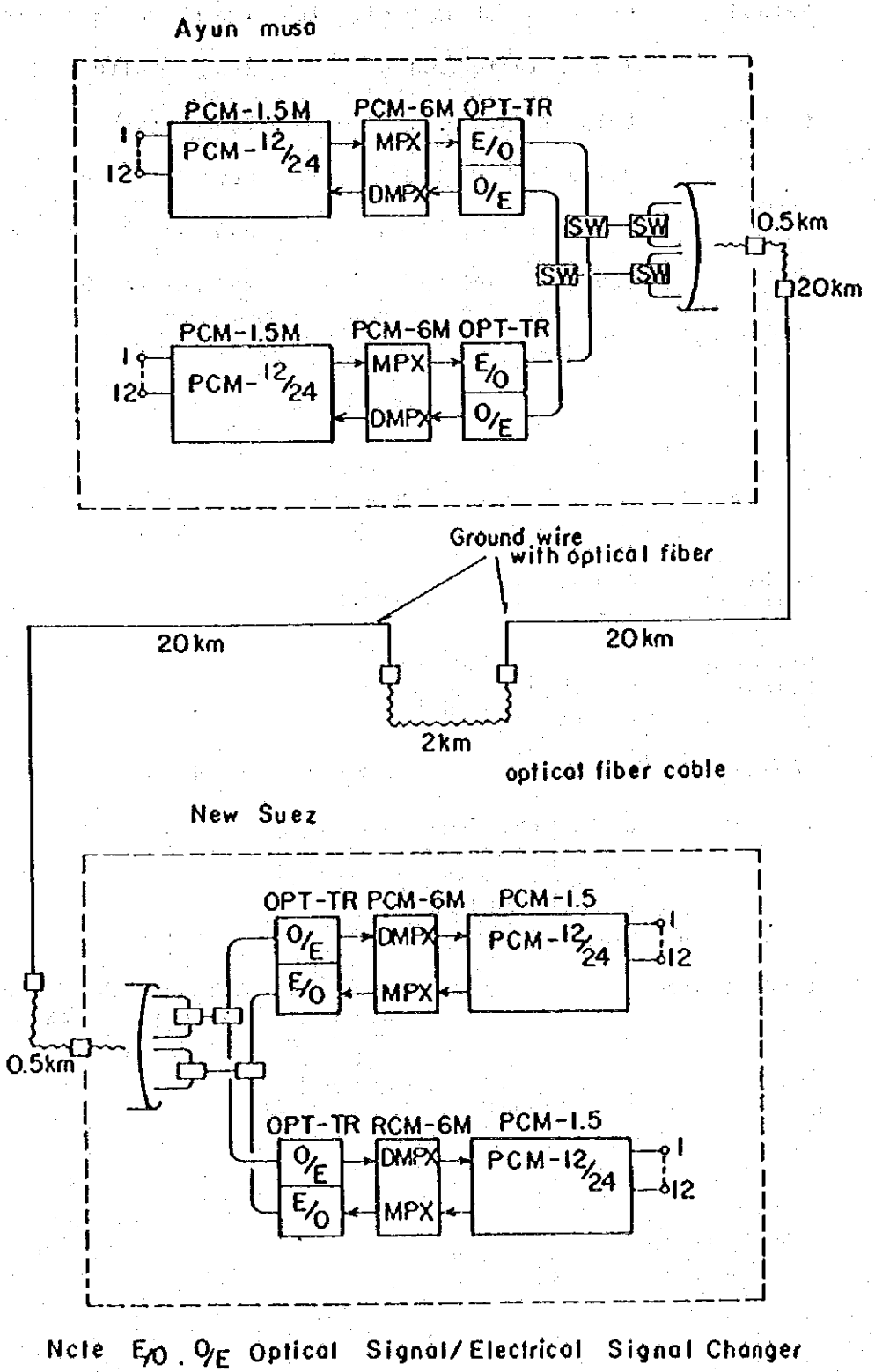
Item	Ayun Musa PS	New Suez SS	Ahmed Hamdi Tunnel
PCM-12 channel	2	2	
Optical transmitter	2	2	
Optical fiber cable	0.5 km	0.5 km	2 km
Optical fiber in the groundwire	40 km x 2		

Fig 6-6 MICRO-WAVE COMMUNICATION SYSTEM



	SAKA SS	REP		NEW SUEZ (B)		AYUN MUSA PS	REMARK
		TO SAKA	TONE SUEZ (B)	TO REP	TO AYUN MUSA PS		
Out Put	1 W (30 dBm)	1 W (30 dBm)	1 W (30 dBm)	1 W (30 dBm)	1 W (30 dBm)	1 W (30 dBm)	
Dia. of ANTENA	8mφx2	8mφx2	3mφx2	3mφx2	3mφx2	3mφx2	
Length of FEEDER	SF-50-13 270m	SF-50-13 220m	SF-50-13 190m	SF-50-13 185m	SF-50-13 175m	SF-50-13 230m	
Received Input	-38. dBm	-38. dBm	-47. dBm	-47. dBm	-45. dBm	-45. dBm	
RELIABILITY	99.9999954		99.9999934		99.9999943		
Hight of TOWER	120m	120m	120m	80m	80m	105m	

Fig. 6-7 Optical fiber system



Note E/O . O/E Optical Signal/Electrical Signal Changer

2) Power Line Carrier

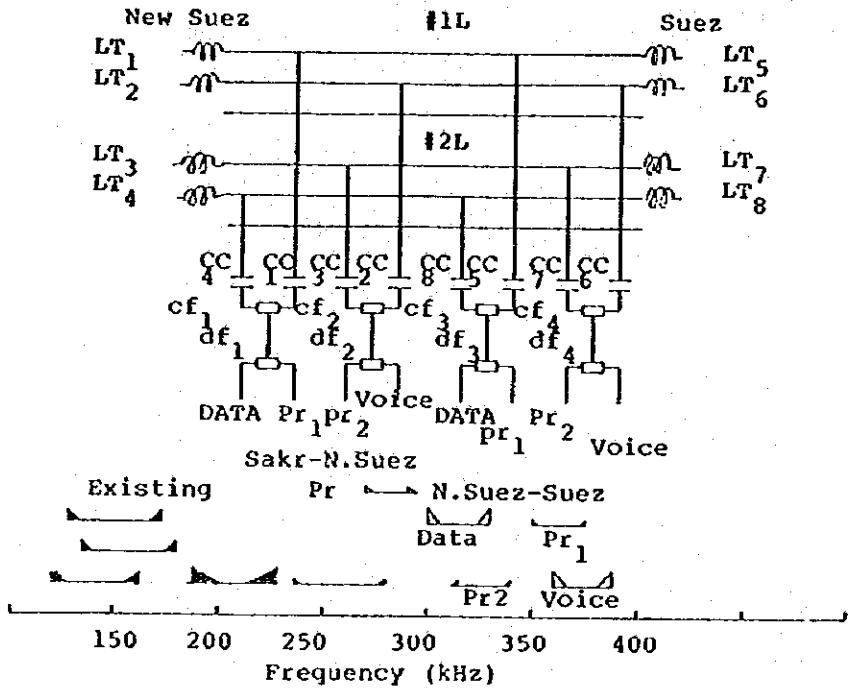
a. Design of Channel

Section:	New Suez SS - Suez SS	New Suez SS - Sakr SS
Method	One phase of each circuit (two metalic ch.)	Two phase each circuit (two metalic ch.)
Channel	Data 2 ch. Voice 2 ch. Protection Ry. 2 ch	Transfer the existing Suez SS to Sakr SS set Addition of Ry. ch. 1 ch.
Band of Frequency	300 kHz - 390 kHz	250 kHz - 300 kHz

b. Equipment

		New Suez SS	Suez Tr Station	Sakr SS
Coupling Filter	600:75 ohm 175 - 450 kHz	3	2	-
Division Filter	HF, LF 350 kHz	1	1	-
	HF, LF 340 kHz	1	1	-
	HF, LF 300 kHz	1	-	1
Coaxial Cable		1,200 m	400 m	-
PLC set	2 ch. broad band output 27 dBm	2	2	-
	1 ch. broad band output 27 dBm	3	2	1
Power source		Common with micro set	Common with micro set	Common with existing set

Fig. 6-8 PLC Layout



CHAPTER 7

PROJECT COST

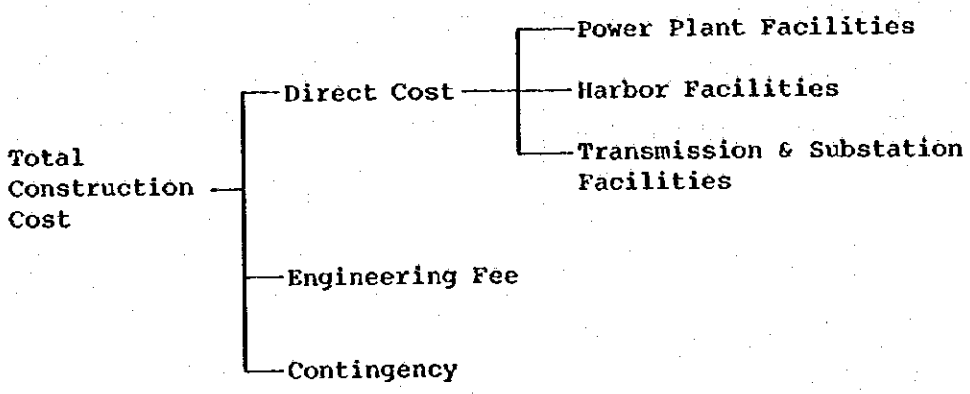
(1st Stage 300 MW x 2 Units)

CHAPTER 7. PROJECT COST

7-1 BASIC CONCEPTION OF CONSTRUCTION COST ESTIMATE

1) The construction cost will be estimated in consideration of the weighted year of construction period.

2) The construction cost are composed of the following categories.



3) The construction costs are divided according to domestic currency requirements and foreign currency requirements, with the former including wages for domestic laborers, cost of engineers and technicians required for construction supervision, construction materials such as cement, aggregate, lumber, domestic fuel, etc., which can be produced in Egypt, and domestic transportation costs of imported equipment and materials. All other items are listed up as foreign currency requirements.

4) It is assumed that construction will be undertaken by contractors on a turn-key basis according to the specifications which are prepared by consultants under an engineering services contract concluded between EEA and consultants.

During the construction, the consultants are to assist EEA in the performance of supervisory work on the Project.

5) Procurement of funds required for construction will be carried out by EEA, the owner, with foreign currency requirements will be borrowed from international financing institutions and domestic currency requirements borrowed from domestic financing institutions.

7-2 SCOPE AND CONDITIONS FOR CONSTRUCTION COST ESTIMATE

1) The Scope of the Project

This Project consists of coal-fired thermal power plant of 300 MW x 2 units, harbor for imported coal, transmission lines from power plant site to interconnecting line and other necessary equipment.

That is to say, the following equipment will be included in this Project.

Access road, land reclamation, embankment, intake and discharge facilities of condenser cooling water system, seawater desalination facilities, boiler, turbine-generator and auxiliaries equipment, coal unloading and transportation facilities, ash treatment equipment, waste water treatment equipment, fuel oil facilities, coal storage yard, ash disposal pond, service building, central shop, warehouse, transmission line facilities, substation facilities, communication facilities, etc.

The minimum required facilities for future extension of 600 MW plant, namely, land reclamation, coal unloading facilities and intake and discharge facilities are considered.

2) Conditions for Construction Cost Estimate

a. The scope of construction cost estimate is summed up necessary costs for the Project with the limits as indicated below.

a) Expenses for acquisition of land required for construction and for various kinds of indemnities required accompanying construction have not been listed up. However, the cost of leveling the land acquired is included.

b) Duties and other taxes on imported equipment and materials, taxes on engineering fees, and income tax of foreign engineers are considered to be exempted and are not listed up.

c) The expenses required for procedures to be taken by EEA, the owner, for loan from financing institution are not included.

d) The expenses required for coal transportation facilities such as truck, coal cargo, etc., and construction cost of road for coal transportations are excluded.

e) Cost for coaler and tanker of imported coal and fuel oil transportation are excluded. Accordingly, cost of facilities are listed up pier, unloading facilities, handling facilities from pier to coal storage yard and oil transportation facilities to oil storage tank.

f) Offices required for construction and operation, access road for construction, spare parts, automobiles and a canteen are included, but staff housing, a guest house, schools are excluded.

b. Conditions for Calculation

a) Foreign Currency Portion

Price in Japan as of 1983 are used as basis and price increases up to the time of weighted year of construction period are considered. And ocean freight from Japan to Egypt is considered.

b) Domestic Currency Portion

Prices in Egypt as of 1982 are taken as reference basis and price increase up to the time of construction are considered.

c) Fuel costs required for trial operation are not included in the construction costs assuming they will be offset by electric power produced in trial operation.

d) The exchange rates for currencies are taken to be the following.

US$ 1.00 = L.E. 0.823

US$ 1.00 = 230 yen

L.E. 1.00 = 279.5 yen

e) Contingencies, about 4% for foreign currency and 5% for domestic currency of direct construction cost and 10% of engineering fee are listed on the assumption that these expenses are to be disbursed on the occasion of change in design for unavoidable reasons.

f) As an engineering fee, about 1.1% of direct construction costs are considered as being required for salaries, overhead costs, fee, and for direct expenses such as travelling and communications.

g) Conditions for fund requirement are as follows:

Foreign currency:

- For 80%, an interest rate of 4% and a repayment period of 30 years including grace period of 5 years
- For 20%, an interest rate of 9% and a repayment period of 15 years including grace period of 5 years

Local currency:

- An interest rate of 8% and a repayment period of 15 years including grace period of 3 years

h) Payment Conditions

i. Imported Equipment Cost

20% at conclusion of contract, 70% at lading on board, 10% on completion

ii. Construction Cost

90% of contracted amount paid out on a piece rate, 10% on completion

iii. Engineering Fee

These costs are allocated in proportion to man-month to be estimated according to work quantities by year.

7-3 CONSTRUCTION COST ESTIMATION

Construction cost estimation based on the conditions described in Section 7.1 and 7.2 is as shown in Table 7-1, total construction cost will be 510.4 x 10^6 LE. Budget for each phase and budget for each year are shown in Table 7-2 and Table 7-3, respectively.

Table 7-1 Construction Cost

Unit: x 10^6 LE (x 10^6 US$)

Items	F.C.		L.C.		Total	
1. Generating Facilities						
1) Equipments	262.0	(318.3)	-		262.0	(318.3)
2) Erection	42.2	(51.3)	19.6	(23.8)	61.8	(75.1)
3) Civil works	10.4	(12.6)	18.3	(22.2)	28.7	(34.8)
4) Architectural works	34.0	(41.3)	16.1	(19.6)	50.1	(60.9)
5) Harbor facilities	28.3	(34.4)	7.6	(9.2)	35.9	(43.6)
Sub-total	376.9	(457.9)	61.6	(74.8)	438.5	(532.7)
Unit Construction Cost [LE/kW (US$/kW)]	-	-	-	-	730.8	(887.8)
2. Transmission Lines and Substation						
1) Transmission lines	25.6	(31.1)	7.5	(9.1)	33.1	(40.2)
Unit Construction Cost [10^3 LE/km (10^3 US$/km)]	-	-	-	-	760.9	(924.1)
2) Substation	10.8	(13.1)	2.3	(2.8)	13.1	(15.9)
Sub-total	36.4	(44.2)	9.8	(11.9)	46.2	(56.1)
3. Engineering Fee	5.4	(6.6)	-	-	5.4	(6.6)
4. Total (1 + 2 + 3)	418.7	(508.7)	71.4	(86.7)	490.1	(595.4)
5. Contingency	16.7	(20.3)	3.6	(4.4)	20.3	(24.7)
6. Grand Total (4 + 5)	435.4	(529.0)	75.0	(91.1)	510.4	(620.1)

Table 7-2 Budget for Each Phase

Unit: x 10^6 LE (x 10^6 US$)

Items	F.C.		L.C.		Total	
1st Phase	63.4	(77.0)	24.1	(29.3)	87.5	(106.3)
2nd Phase	207.5	(252.1)	32.6	(39.6)	240.1	(291.7)
3rd Phase	164.5	(199.9)	18.3	(22.2)	182.8	(222.1)
Total	435.4	(529.0)	75.0	(91.1)	510.4	(620.1)

Table 7-3 Budget for Each Year

Unit: x 10^6 LE (x 10^6 US$)

	F.C.		L.C.		TOTAL	
1984	4.0	(4.9)	1.2	(1.5)	5.2	(6.4)
1985	54.0	(65.6)	8.2	(10.0)	62.2	(75.6)
1986	121.6	(147.8)	19.0	(23.0)	140.6	(170.8)
1987	183.9	(223.4)	29.5	(35.8)	213.4	(259.2)
1988	58.7	(71.3)	15.9	(19.4)	74.6	(90.7)
1989	13.2	(16.0)	1.2	(1.4)	14.4	(17.4)
TOTAL	435.4	(529.0)	75.0	(91.1)	510.4	(620.1)

Table 7-4 Generating Cost for the Project

Item	Unit	Formula	Value
A. Unit Capacity	MW		320 x 2
B. Availability	%		80
C. Annual Gross kWh	$x10^6$ kWh	Ax8.760xB/100	4,485.1
D. Station Service Loss (kW)	%		6.25
E. Annual Available Energy at P/S Tr. End	$x10^6$ kWh	Cx(1-D/100)	4,204.8
F. Plant Efficiency	%		39
G. Construction Cost including T/L	$x10^6$LE		510.4
H. Fuel Calorific Value	kcal/kg		6,500
I. Fuel Consumption	$x10^3$ ton	$\frac{860xC}{F \times H} \times 100$	1,521.5
J. Unit Price of Fuel	LE/ton		4.9
K. Fuel Cost	$x10^6$ LE	$IxJx10^{-3}$	7.5
L. Operation Maintenance Cost	$x10^6$ LE	Gx0.02	10.2
M. Administration Cost	$x10^6$ LE	Gx0.005	2.6
N. Depreciation	$x10^6$ LE	G/30	17.0
O. Annual Cost	$x10^6$ LE	K+L+M+N	37.3
P. Generating Cost at P/S Tr. End	Millimes/kWh	$O/Ex10^3$	8.87
Q. T/L and D/L Loss	%		12
R. Salable Energy at Consumer End	$x10^6$ kWh	Ex(1-Q/100)	3,700.2
S. Salable Unit Price	Millimes/kWh	33.646x0.7	23.55
T. Revenue/kWh	Millimes/kWh	S-P	14.68
U. Annual Revenue	$x10^6$ LE	$RxTx10^{-3}$	54.3

CHAPTER 8

EXECUTION OF THE PROJECT

(1st Stage 300 MW x 2 Units)

CHAPTER 8. EXECUTION OF THE PROJECT

8-1 PROJECT SCHEDULE

In performance of the Project, the following overall construction schedule will be considered.

8-1-1 Period of Preparatory Works for Execution of the Project

Immediately after the completion of the Feasibility Report, preparatory works such as procurement of finances, employment of a consultant, preparation of tender documents, tendering/contracting and other necessary official procedures will be needed. It will take about 13 (thirteen) months from the application of project finance to the award of contracts.

8-1-2 Construction Schedule

The Project will be divided into three phases.

In the first phase, construction of harbor facilities, power plant site reclamation works, detailed design of main equipments and materials of power plant for 300 MW X 2, foundation works of boiler, turbine and generator, and construction of powerhouse for No.1 Unit and New Suez Substation will be carried out.

In the second phase, erection works of two 220 kV outgoing transmission lines out of 4 lines as well as erection and installation works, and civil and architectural works for No. 1 Unit and foundation works and construction of powerhouse for No.2 Unit will be carried out uninterruptedly.

In the third phase, the erection works, civil and architectural works for No. 2 Unit, and erection works of the remaining two 220 kV outgoing transmission lines will be carried out following the second phase. The construction schedule for the Project is shown in Table 8-1 and 8-2.

8-1, 8-2, it takes 44 months from the first phase contract to the taking-over of the first unit, and 50 months from the first phase contract to the taking-over of the second unit, and the major events for each phase are summarized as follows:

1) First Phase

a. Harbor Facilities

Major Events	After First Phase Contract Signing
Dredging start	7 months
Piling start	14 months
Completion	38 months

b. Detailed Design for Power Plant, BTG Foundation and Powerhouse

Major Events	After First Phase Contract Signing
Foundation works start	9 months
Completion	43 months

c. New Suez Substation

Major Events	After First Phase Contract Signing
Foundation star	13 months
Completion	32 months

2) Second Phase

a. Power Plant (1st Unit)

Major Events	After First Phase Contract Signing
Drum lifting	22 month
Initial firing (Light off)	35 months
Steam admission	37 months
Operating test start	37 months
Commissioning (of 1st unit)	41 months
Taking over	44 months

b. Transmission Line

Major Events	After First Phase Contract Signing
Foundation start	9 months
Erection start	17 months
Stringing start	24 months
Completion	30 months

3) Third Phase

a. Power Plant (2nd Unit)

Major Events	After First Phase Contract Signing
Drum lifting	28 months
Initial firing (Light off)	41 months
Steam admission	43 months
Operating test start	43 months
Commissioning (of 2nd unit)	47 months
Taking over	50 months

b. Transmission Line

Major Events	After First Phase Contract Signing
Foundation start	23 months
Erection start	30 months
Stringing start	39 months
Completion	45 months

4) The consultant will render the engineering services through the entire period of the Project until its completion after signing consultancy agreement.

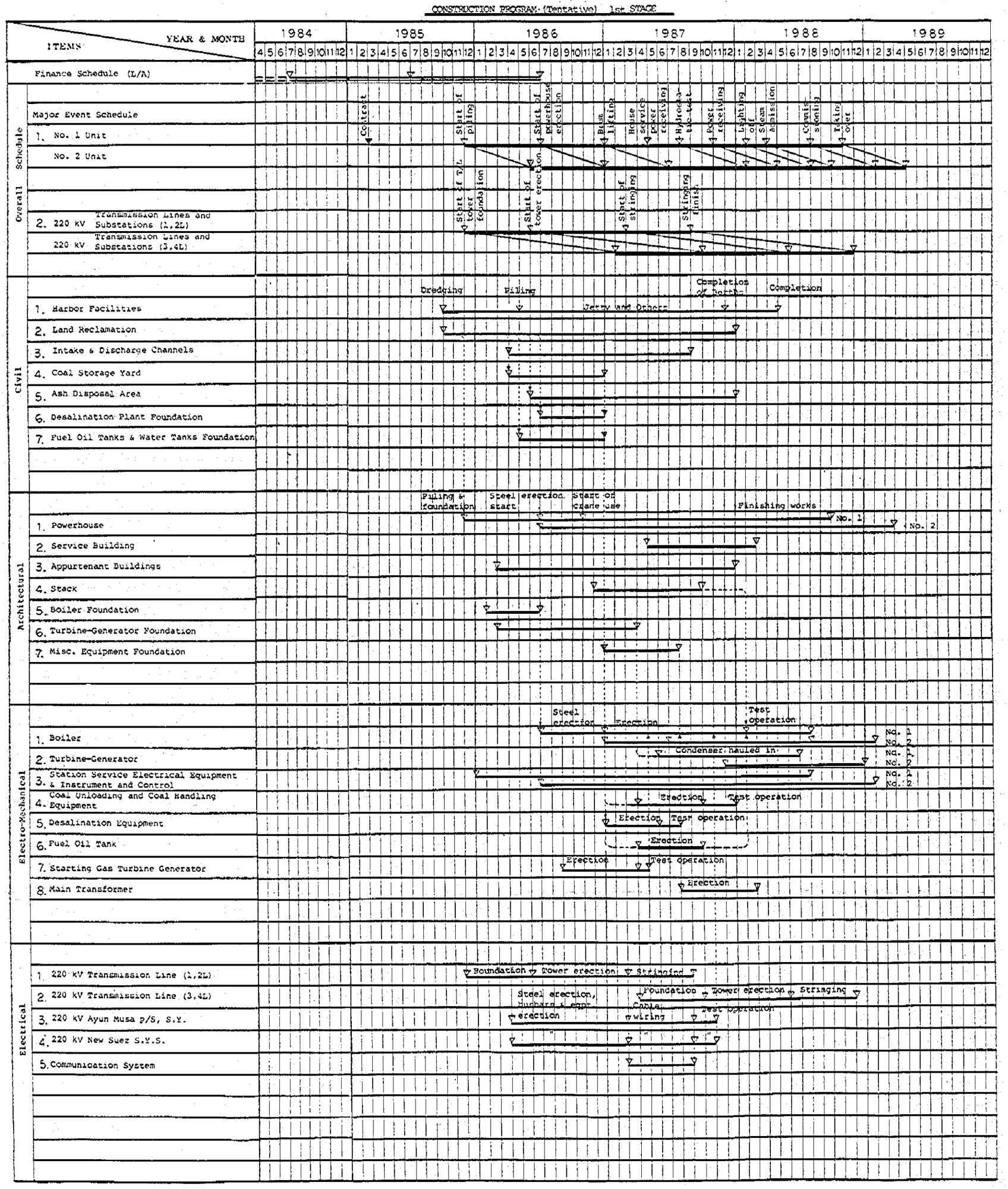
5) The total Project period is 57 months after contract signing for consultant.

Table 8-1 Overall Construction Program (Tentative) 1st Stage

	ITEM \ YEAR & MONTH	1983						1984												1985						1986						1987						1988						1989					
		7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	2	4	6	8	10	12	2	4	6	8	10	12	2	4	6	8	10	12	2	4	6	8	10	12	2	4	6	8	10	12
	FINANCING AND OFFICIAL PROCEDURES	Summary I.P						I.P	Pledge					L/A				Appr.																															
	TENDERING/CONTRACTING AND RELATED PROGRAMME					F.R		Fact finding																								Appr.																	
													C/A for Consultant																																					
															T/Issue					C/A-1		C/A-2						C/A-3																					
								Tender Documents																																										
1ST PHASE	1. Harbour facility 2. Land reclamation of Power Plant																					Dredging				Piling																		Completion			Land reclamation		
	3. Detailed design of main equipments & materials of Power Plant for 300MW x 2 4. Boiler, T/G foundation for 300MW x 1.5 Building works for powerhouse of 1st unit																									Foundation & Bldg.						for 1st unit												Finishing works				
																		Detailed Design																													
	5. Detailed design, manufacturing, delivering & erection of New Suez Substation, civil/arch. works of outdoor foundation, control house, access road and other related works for substation																									Foundation & Erection																		Finishing works of civil				
	1. Detailed designing, manufacturing, delivering & installation of equipments & materials for 1st unit Power Plant with accessaries, coal unloading facilities, fuel handling facilities for 1st unit, water treatment, Screen/scraper & intake pump for 1st unit, desalination facility, main transformer & switching yard facilities for 1st unit, machine shop equipments/materials & tools, EP and other related facilities																					Manufacturing & delivering				Drum Lifting						Receiving			Comissioning Light Off			Take Over																		
																																Hydro Test			Steam Admission																		
																																Coal transportation Start						Finishing works																	
2ND PHASE	2. Civil works of intake/intake pit, circulating cooling water channel, discharge/outlet, foundations of fuel storage & transportation facilities, aux. equipments foundations, fresh water pond & tank, ash pond facility and other related civil works for 1st unit																																															
	3. Architectural works of service building, machine shop house, ware house, stack works incl. foundation, control house for aux. facilities for 1st unit, gate & fense and misc. works																															Service Bldg. Appurtenant Bldg. Finishing works																			
																																Stack Bldg for 2nd unit Finish works																			
	Architectural works of boiler turbine-generator foundations and powerhouse for 300 MW x 1 (2nd unit)																															Foundation for 2nd unit																			
	4. Detailed designing, manufacturing, delivering and installation of equipments and materials for 220 kV x 2cct transmission line incl. Suez crossing facilities civil works of steel tower foundations and related works																																Erection				Completion (220 kV x 2cct T/L)													
																																Foundation			Stringing																	
3RD PHASE	1. Detailed designing, manufacturing, delivering & installation of equipments & materials for 2nd Power Plant with accessories, fuel handling facilities for 2nd unit, screen/ scraper & intake pump for 2nd unit, main transformer & switching yard facilities for 2nd unit, EP and other related facilities																																			Drum Lifting Manufacturing & delivering			Receiving		Comissioning #2 Lighting off			Take Over														
	2. Civil works of foundations of fuel storage & transportation facilities for 2nd unit aux. equipments foundations, drainage system works, access roads/station roads, land clean-up works, wash pond facilities and other related civil works incl. plantation 3. Architectural works of ware house, worker's house, control houses of aux. equipments for 2nd unit and other miscelaneous works																																			Storage Yard			Hydro Test		Road			Steam Admission														
																																						misc. work													
	4. Detailed designing, manufacturing, delivering and installation of equipments & materials for 220 kV x 2cct transmission line incl. Suez canal crossing facilities																																								Erection												
																																								Stringing												
	Civil works for steel tower foundations and other related works																																								Completion												
																																								Foundation					220 kV x 2cct T/L							

Table 8-2 SINAI COAL-FIRED THERMAL POWER PROJECT

CONSTRUCTION PROGRAM (Tentative) 1st STAGE



8-2 PROCUREMENT PROGRAM FOR THE PROJECT

As for the supply and construction it is desirable for procurement method to adopt one-package contract system on turnkey basis from the viewpoint of the matter of the Project.

Since this Project that is a public utility in Egypt is required high reliability for power supply, all of the construction works including civil and architectural works have to be high quality. Therefore, the contractor is with high sufficient qualification.

As a rule, equipment and materials for the Project which are able to procure in Egypt are to be adopted. Boiler, turbine, generator, main transformer and others procured at the outside of the Egypt by contractor will be shipped after pass of factory test.

As a rule, prime contractor will employ the local contractor for civil and architectural works and erection works for equipment. However, as mentioned above, since high quality for the construction works is required, foreign contractor may assist partially in case of a shortage of the construction technique in the part of local contractor.

And special construction technique and guidance by foreign engineers, technicians and skilled labor may be required for adjustment of overall construction schedule.

8-3 ORGANIZATION FOR THE PROJECT

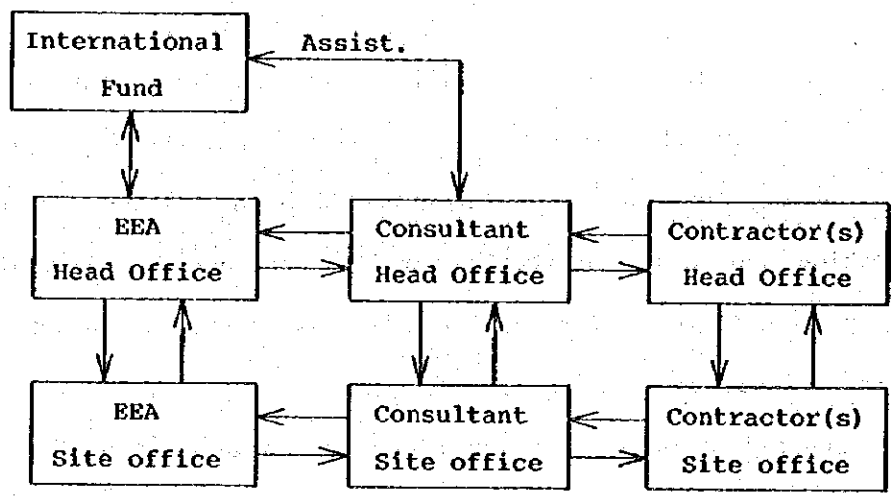
8-3-1 Organization

EEA will employ the consultant to assist the construction works for promotion of the Project because this Project is the first coal fired thermal power project in Egypt and its completion date has been already decided.

On the other hand, it is desirable for construction works to be procured in a lump-sum amount to be made clear of the organization of the Project and to be promoted smoothly.

Organization chart among EEA, consultant and contractor is as follows.

Fig. 8-1 Organization Chart



8-3-2 Duties

Major duties carried out by EEA and by consultant to complete this Project are as follows.

1) Duties Performed by EEA

a. Selection of consultant

b. Investigation and Study Items

Examination and final decision of general conditions, special conditions, technical specifications, drawings, etc., for the contract

Study of site conditions

c. Tendering and Contracting

Tendering and Bid Evaluation with the assistance of consultant and L/C open and procedures.

d. Decision of execution method of the Project

Personnel organization, construction plan, construction supervision method, test program, acceptance method, etc.

e. Preparatory works of construction

Land procurement, compensation, other necessary investigation

f. Inspection and coordination of construction

g. Testing and test operation, evaluation of the performance and acceptance of power plant

h. Testing and test operation, evaluation of the performance and acceptance of T/L and S/S

i. Others

2) Duties Performed by Consultant

As assistance works for EEA;

a. Check of feasibility report

b. Assistance in finance procurement and technical procedures based on the guideline of financing institution

c. Field survey and basic design for overall items

d. Preparation of bidding documents

e. Assistance in tendering and contracting

f. Check and review of approval drawings and data submitted by contractor

g. Preparation of detailed instruction drawings for civil and architectural works

h. Inspection and witness of factory test

i. Construction supervision

j. Preparation of test program

k. Assistance in tests

l. Witness of acceptance test and data analysis

m. Training of EEA's engineers for operation and maintenance

n. Compiling of operation/maintenance manuals

o. Preparation of progress reports and completion report